RISK FACTORS FOR COMPULSIVE EXERCISE

By

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CERTIFICATE OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this thesis, that the original work is my own except as specified in acknowledgments or in footnotes, and that neither the thesis nor the original work contained therein has been submitted to this or any other institution for a degree.

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Abstract

Background: The highly driven and often excessive exercise seen in eating disorder patients can be defined as a compulsive behaviour, and is often performed for weight control reasons, as well as for mood regulatory purposes. Compulsive exercisers often exercise in a rigid and rule-driven manner and predominantly report no enjoyment from the activity. Importantly, compulsive exercise has negative clinical implications, such as prolonging eating disorder treatment and representing a key factor in eating disorder relapse. However, despite these negative clinical implications and the large percentage of patients that may experience these harmful and detrimental behaviours, the body of literature examining the aetiology of compulsive exercise is relatively scarce and lacks a coherent theoretical underpinning. **Objectives:** This thesis aimed to provide the first known investigations into the possible correlates and risk factors for compulsive exercise in adolescent boys and girls. **Main Findings:** The key prospective predictors of compulsive exercise found in this thesis were self-perfectionism and obsessive-compulsiveness for boys. For girls, internal dysfunctional emotion regulation and a perceived media pressure to be thin were the key risk factors for compulsive exercise. **Implications:** The results from the thesis suggest that psychological factors are important in the development of compulsive exercise in boys, whereas in girls, a combination of dysfunctional emotion regulation and socio-cultural pressure to be thin could lead to the development of compulsive exercise cognitions and attitudes. Further research is needed to replicate and extend these results, although these thesis findings still provide useful empirical evidence to inform prevention and early intervention programmes for compulsive exercise in adolescents.

KEYWORDS: Compulsive Exercise; Eating Disorders; Adolescents; Personality; Socio-Cultural; Psychology; Longitudinal; Prospective

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Chapter 3; Study 1 has been accepted for publication as: Goodwin, H., Haycraft, E., Taranis, L., & Meyer, c. (in press). Psychometric evaluation of the Compulsive Exercise Test (CET) in an adolescent population: Links with eating psychopathology. *European Eating Disorders Review.*

Chapter 4; Study 2 has been submitted for publication as: Goodwin, H., Haycraft, E., Willis, A., & Meyer, C. (under consideration). Compulsive exercise: The role of personality, psychological morbidity, and disordered eating. *International Journal of Eating Disorders.*

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Chapter 5; Study 5 has been submitted for publication as: Goodwin, H., Haycraft, E., & Meyer, C. (under consideration). Friends and family: The relationship between physical activity support and compulsive exercise among adolescents. *Journal of Pediatric Psychology.*

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PART 1: Introduction and Methodology

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Chapter 1

Introduction

Risk Factors for Compulsive Exercise

1 Introduction

1.1 Thesis Overview

Eating disorders are highly debilitating mental disorders that are of high clinical significance, with anorexia nervosa reporting the highest mortality rate of all mental disorders (Millar et al., 2005). Previous risk factor research has focused on the development of either anorexia nervosa or bulimia nervosa. However, given that around fifty percent of clinical cases do not fit into either diagnosis, and/or change diagnosis throughout their lifetime, then many researchers have focused instead on specific behaviours or beliefs (Nicholls, 2007). A key behaviour of the eating disorders that crosses diagnoses is that of compulsive exercise (Beumont, Arthur, Russell, & Touyz, 1994; Davis, 1997). This excessive activity has been shown to be often the first symptom to appear (Davis, Kennedy, Ravelski, & Dionne, 1994), to negatively affect treatment (Solenberger, 2001), and also to be a key causal factor in the relapse of the disorder (Strober, Freeman, & Morrell, 1997). However, it has been shown that it is more than just excessive exercise behaviour that appears to be influential in the relationship with the eating disorders (Ackard, Brehm, & Steffen, 2002; Siegel & Hetta, 2001). When measured multi-dimensionally (to include cognitive and affective components), this excessive exercise has been shown to be more closely intertwined with eating disorder psychopathology than when it is just measured behaviourally (Siegel & Hetta, 2001; Steffen & Brehm, 1999).

It has been demonstrated that the development of eating disorders occurs most often during adolescence (e.g., Sands, 2000; Striegel-Moore & Bulik, 2007). Additionally, a greater prognosis is evidenced with earlier detection and treatment (Rome et al., 2003). Therefore, any risk factor research within the eating disorders field aimed at informing prevention work would be advised to target adolescent samples. However, despite the apparent influence of compulsive exercise in the development of eating disorder symptoms, to date no studies have investigated the potential psychological (e.g., personality) and socio-cultural factors that may constitute risk factors for the development of such compulsivity towards exercise among adolescents.

This thesis, therefore, will report research into possible risk factors for compulsive exercise attitudes among adolescents. The novel findings from this thesis result in the creation of a proposed aetiological model of compulsive exercise to be applied to adolescents, which is the first such model to guide potential prevention and early intervention work. This chapter will begin with an overview of the eating disorders followed by an overview of the current literature on compulsive exercise. This overview will include a systematic review of the literature that has investigated compulsive exercise in clinical eating disorder samples. The review will then be extended to a wider body of literature (e.g., the exercise psychology literature) to include further possible correlates and risk factors for compulsive exercise. This first chapter will conclude with a presentation of the proposed aetiological model of compulsive exercise, which will be subsequently tested in a series of studies reported throughout this thesis. These studies will begin with an examination of the cross-sectional correlates of compulsive exercise; namely psychological (e.g., personality, psychological morbidity), socio-cultural (e.g., pressure to be thin, physical activity support) and behavioural correlates (e.g., sport participation). These studies will then be replicated using longitudinal designs with the aim of identifying temporal risk factors for compulsive exercise.

1.2 Eating Disorders

1.2.1 Diagnosis

The eating disorders are severe mental health disorders, which have discouraging outcomes that can include high rates of mortality (Millar et al., 2005). There are several clinically-diagnosed eating disorders, as defined by the American Psychiatric Association's (APA) Diagnostic and Statistical Manual of Mental Disorders (4^{th} ed.) (DSM-IV; APA, 1994). The two primary diagnoses are Anorexia Nervosa (AN) and Bulimia Nervosa (BN), plus there is a residual diagnostic category to include individuals who meet most but not all of the criteria to fulfil clinical diagnosis of either of the two primary eating disorders. The diagnostic criteria for AN, as defined by the DSM-IV (APA, 1994), can be seen in

Table 1.1, whilst the DSM-IV (APA, 1994) diagnostic criteria for BN are presented in Table 1.2. The residual term, known as Eating Disorder Not Otherwise Specified (EDNOS) does not have specific criteria, but simply includes individuals who meet several but not all of the criteria of the first two diagnoses for an eating disorder, but still have sufficient symptoms that warrant a clinical diagnosis.

Table 1.1 Diagnostic criteria for anorexia nervosa

Diagnostic and Statistical Manual of Mental Disorders (all components required)
A. Refusal to maintain body weight at or above a minimally normal weight for age and height (e.g., weight loss leading to body weight less than 85% normal weight for age). B. Intense fear of gaining weight or becoming fat, even though underweight. C. Disturbance in perception of body weight or shape, undue influence of body weight or shape on self-evaluation, or denial of seriousness of current low body weight. D. In post-menarcheal women, amenorrhea (at least three consecutive menstrual cycles). *Specify type:* During the current episode of anorexia nervosa -*Restricting type:* No regular binge eating or purging. -*Binge eating or purging type:* Regular binge eating or purging *Differential diagnosis:* general medical conditions, superior mesenteric artery syndrome, major depressive disorder, schizophrenia, social phobia, obsessive-compulsive disorder, body dysmorphic disorder, and bulimia nervosa.

Table 1.2 Diagnostic criteria for bulimia nervosa

Diagnostic and Statistical Manual of Mental Disorders (all components required)
A. Recurrent episodes of binge eating characterised by (a) eating in a discrete period of time (2 hours) an excessive amount of food for time period and circumstances and (b) lack of control over eating during the episode. B. Recurrent inappropriate compensatory behaviour to prevent weight gain (e.g., vomiting, laxatives, fasting, or excessive exercise). C. The binge eating and inappropriate compensatory behaviours both occur, on average, at least twice a week for 3 months. D. Self-evaluation is unduly influenced by body shape and weight. E. The disturbance does not occur exclusively during episodes of anorexia nervosa. *Specify type:* -*Purging type:* Current episode includes regular self-induced vomiting, laxatives, diuretics, or enemas. -*Non-purging type:* Current episode includes fasting or excessive exercise but no regular self-induced vomiting, laxatives diuretics, or enemas. *Differential diagnosis:* Anorexia nervosa, binge-eating or purging type, Kleine-Levin syndrome, major depressive disorder with atypical features, borderline personality disorder.

As can be seen in Tables 1.1 and 1.2, there is overlap between the criteria for AN and BN, and therefore Reijonen, Pratt, Patel, and Greydanus (2003) summarised the APA criteria for an eating disorder as:

> *"(a) severe disturbances in eating behaviour, (b) disturbance in the perception of body shape, (c) fear about not controlling weight, and (d) using compensatory (self-induced vomiting, excessive exercise, fasting, or*

the misuse of laxatives, diuretics, enemas, thyroid hormones, or insulin medications) behaviours to lose weight or prevent weight gain." (p. 210)

These criteria are extremely useful in order to provide individuals with a clinical diagnosis and thus allow for the provision of standardised, proven treatments. However, the criteria are subject to criticism both specifically and more generally, i.e. in terms of the specific criterion and the categorical approach to diagnosis respectively. For example, the specific criteria have been reviewed and altered in preparation for the publication of the Fifth Edition of the DSM in 2012 (DSM-V). The key changes for AN include a greater focus on the behaviours, the removal of the word "refusal" for criterion A, as well as a complete removal of criterion D (requiring amenorrhea). The rationale for these changes was that it has been reported that some AN patients do not have enough insight to intentionally remain at a low weight, and likewise, some AN patients do try to engage in treatment and therefore do not demonstrate 'refusal' (Becker, Eddy, & Perloe, 2009). Additionally, some patients do not report a 'fear' of weight gain, but do remain at a low weight, and so once more, DSM-V will focus on the behaviours to maintain a low-weight. Further, criterion D requiring amenorrhea has been removed, based on the work of Attia and Roberto (2009), who reported no significant differences between AN patients with amenorrhea and AN patients without amenorrhea. This change also allows for the diagnosis of AN in pre-menarchal girls, to women taking oral contraceptives, to post-menopausal women, and to men. In BN, DSM-V has proposed that the binge eating and compensatory behaviours now only need to occur once a week for the previous three months, as opposed to the current twice a week required in criterion C. This change is important as it has been demonstrated that the clinical presentation of BN patients who engage in these behaviours once a week are not significantly different to BN patients who engage in these behaviours at least twice a week (Wilson & Sysko, 2009). Additionally, a literature review of BN patients suggested that the sub-type of non-purging BN was more closely aligned to Binge Eating Disorder (BED), and therefore, it should be removed (van Hoeken, Veling, Sinke, Mitchell, & Hoek, 2009).

The classification of eating disorders has also come under more general criticism (Garfinkel, 2002), beyond requiring changes to specific criteria. For example, the dynamic nature of eating disorders makes the practice of categorising individuals very difficult. Indeed, there is much debate as to whether the DSM-IV's (APA, 1994) discrete categorical approach is the most advantageous approach, or whether the eating disorders should be defined in a more continuous dimensional approach (Williamson, Gleaves, & Stewart, 2005). For example, the critics of the categorical approach point to the fact that the point at which a person's symptoms become 'clinical' in nature is unclear, as there are many individuals who suffer from varying degrees of eating disturbances but who have not reached diagnostic criteria levels (Jacobi, Hayward, de Zwaan, Kraemer, & Agras, 2004). These subclinical populations still represent a large number of sufferers, who clearly have symptoms that impact upon their quality of life (Touchette et al., 2010). This clinical threshold can have limited to no impact on expected psychosocial impairment, as it has been shown that psychosocial impairment is linearly associated with eating disorder symptoms (Wade, Bergin, Martin, Gillespie, & Fairburn, 2006). In other words, the difference between clinical and non-clinical eating disorders is arguably not a qualitative difference but simply a quantitative difference in terms of symptom presentation (Stice, Ziemba, Margolis, & Flick, 1996).

More recently, there has been a greater attention in research and practice on a transdiagnostic approach to the eating disorders (Fairburn, Cooper, & Shafran, 2003). This approach focuses on general eating disorder features that can occur across all diagnoses, and does not necessarily categorise the individual's symptoms into a specific diagnosed disorder. Focusing on underlying features that are inherent across the eating disorders as a whole is preferable to focusing on discrete diagnostic categories, due to many individuals changing eating disorder diagnosis during the course of their illness (Eckert, Halmi, Marchi, Grove, & Crosby, 1995; Tozzi et al., 2005). This dynamic nature of the eating disorders was further highlighted by a prospective study of eating disorder patients, which found that the majority of cases actually changed diagnosis over the course of a 30-month long investigation (Milos, Spindler, Schnyder, & Fairburn, 2005).

The transdiagnostic theory suggests that there is a core underlying dysfunctional scheme for self-evaluation that is at the heart of all forms of eating disorder pathologies (Fairburn et al., 2003). Specifically, individuals with eating disorders view their self-worth almost entirely based on their eating, weight and shape, and as such the other features of the eating disorders can be seen to stem from this core psychopathology, e.g. extreme weight control behaviours such as vomiting, or excessive exercising (Fairburn et al., 2003). Fairburn and colleagues suggest that this core psychopathology is supported by secondary negative self-evaluation, as individuals with eating disorders have unduly high levels of self-criticism, which is directed towards the area of their life of greatest importance, namely eating, weight and shape. Therefore, these two core psychopathologies synergistically help to develop and maintain the eating disorder.

In addition, the transdiagnostic theory of the eating disorders also suggests other key features, which are important characteristics of eating disorder psychopathology. Specifically, core low-self esteem is also fundamental in many eating disorder patients, where they have a pervasive negative view of themselves (Fairburn et al., 2003). Additionally, clinical levels of perfectionism, interpersonal difficulties and mood intolerance, as well as potentially self-perpetuating low weight and/or bingeing or compensatory behaviours are all features of the eating disorders, which can apply across all current eating disorder diagnostic categories (Fairburn et al., 2003).

1.2.2 Prevalence and incidence

Prevalence figures for the eating disorders have often varied considerably due to measurement difficulties (Hoek & van Hoeken, 2003), as well as due to lack of treatment-seeking behaviour of sufferers (Hudson, Hiripi, Pope, & Kessler, 2007). Furthermore, the eating disorders have also lacked large-scale epidemiological data and quality of life information from recognised bodies such as the US Centers for Disease Control and The World Health Organisation (Striegel-Moore & Bulik, 2007). Nonetheless, prevalence figures have been given in several large-scale studies. For example, the average point prevalence in young women was given as 0.3% for AN in American and European studies (Hoek & van Hoeken, 2003; Favoro, Ferrara, & Santonastaso, 2004). Further, Hudson and colleagues (2007) surveyed 9282 adults, and gave lifetime prevalence estimates of DSM-IV AN as 0.9% for women and 0.3% for men. For BN, lifetime prevalence was given as 1.5% for women and 0.5% for men (Hudson et al., 2007). More recently, a large-scale European-based survey gave lifetime prevalence figures for women as 0.93% for AN and 0.88% for BN (Preti et al., 2009). The same study did not find any cases of AN among men, whilst male lifetime prevalence for BN was given as 0.12% (Preti et al., 2009). Preti and colleagues (2009) noted that their figures only included an adult sample and as such, their figures should be seen along the lower bound estimate of frequencies. This is because specifically among adolescents, eating disorders are reported in greater numbers, with the suggestion that around 10% of surveyed samples may exhibit symptoms of either AN or BN (Stice, Killen, Hayward, & Taylor, 1998).

The incidence rates of the eating disorders were assessed in a large-scale survey in the United Kingdom, examining all new cases of AN and BN between the years 1994-2000 (Currin, Schmidt, Treasure, & Jick, 2005). The results from this study reported primary care incidence rates in 2000 as being 4.7 per 100,000 for AN and 6.6 per 100,000 for BN. Currin and colleagues (2005) noted that incidence rates of AN were relatively stable over the time period that they investigated, whereas BN incidence declined slightly. Incidence of bulimia in adolescents (10-19 years old) was reported as 35.8 per 100,000 in 2000 (Currin et al., 2005). Another study also examined incidence rates by reviewing the literature (Hoek & van Hoeken, 2003). This review gave incidence figures of 8 cases per 100,000 people in the population per year for AN and 12 cases per 100,000 people in the population per year for BN (Hoek & van Hoeken, 2003).

Prevalence figures appear to be slightly larger in younger age groups, with adolescence being the peak period of onset (Striegel-Moore & Bulik, 2007). Younger adolescents are more likely to display symptoms of AN, and older adolescents to display symptoms of BN (Reijonen et al., 2003). However, there have been issues with prevalence figures specific to adolescent populations. For example, there is criticism of the current classification system for eating disorders, namely the DSM-IV (APA, 1994), in so much as it is not truly applicable to adolescents (Kreipe et al., 1995). As a result, Reijonen and colleagues (2003) suggested a lower threshold for eating disorder diagnosis when assessing adolescents, as well as the suggestion that clinicians should consider for diagnosis any adolescents who: “(a) engage in potentially unhealthy weight control practices; (b) demonstrate obsessive thinking about food, weight, shape, or exercise; and (c) do not attain or maintain a healthy weight, height, body composition, or stage of sexual maturation for their gender and age." (p. 218).

Gender differences also exist in the prevalence of eating disorders. In adolescence, girls are four times more likely than boys to develop an eating disorder, and among adults this figure increases to women being ten times more likely to develop an eating disorder than their male counterparts (Reijonen et al., 2003). However, in terms of behaviour, it has been found that men report more compensatory behaviours, such as binge eating and the use of excessive exercise to control body weight, than women (Anderson & Bulik, 2004).

In terms of ethnicity and culture, eating disorders have been predominantly reported in Caucasian females (Striegel-Moore & Smolak, 1996). However, some studies have found greater eating disorder prevalence among women from other ethnic groups than among Caucasian females (e.g., Crago, Shisslak, & Estes, 1996; Le Grange, Telch, & Tibbs, 1998). These conflicting findings led to a review paper suggesting that there is a more complex picture than simply saying that being Caucasian represents a greater risk factor for developing an eating disorder (Jacobi et al., 2004).

1.2.3 Aetiological models of eating disorders

Research into the aetiology of the eating disorders has been widespread and varied, with different models being proposed, ranging from genetic causes to environmental causes (see Striegel-Moore & Bulik, 2007), to models that include a combination of several different psychological and environmental factors (e.g., Fairburn et al., 2003). Although these models have utilised adolescent and adult samples, the age of onset in the eating disorders occurs most often during adolescence and young adulthood, ranging from the age of 10-20 years old (Preti et al., 2009). Therefore, specifically, research into the aetiology of the eating disorders among adolescents has been regarded as an important area of study (Pratt, Phillips, Greydanus, Patel, 2003). In their review of adolescent eating disorders, Reijonen and colleagues (2003) noted that the aetiological course of eating disorders has not yet been fully identified. However, they added that the causes are often multi-factorial and that they consist of genetic, psychological, and socio-cultural factors. The behavioural symptoms of dieting and exercise can also be self-perpetuating and lead to full clinically-diagnosed eating disorders (Reijonen et al., 2003). These categorical factors will now be briefly summarised. As mentioned, although aetiological models would often focus on adolescence, models are often generic and talk about the onset of eating disorders at any age group (e.g., Fairburn et al., 2003). Therefore, the following summaries are not specific to adolescent samples.

Studies investigating the genetic cause of eating disorders have increased in frequency in recent years, and it is suggested that clinical features of AN and BN have their basis in underlying heritable personality and biological factors (Strober & Bulik, 2002). Certainly, several studies have found genetic factors to be influential in the development of eating disorders (e.g., Bulik, Sullivan & Kendler, 1998; Wade, Bergin, Tiggemann, Bulik, & Fairburn, 2006; Wade, Neale, Lake, & Martin, 1999). Another study interviewed over 300 probands with AN or BN, as well as a control group who had no lifetime psychiatric disorders (Strober, Freeman, Lampert, Diamond, & Kaye, 2000). Their results, among other findings, demonstrated that relatives of those with AN were 11.4 times more likely than relatives of the control group to have AN, whereas for BN it was 3.7 times as high in the relatives of the BN probands compared to the relatives of the control group. Interestingly, these potential genetic familial transmissions were only found in female relatives. Despite the limitations that the authors raised (i.e., that environmental modelling cannot be ruled out), their large-scale study does infer a potential genetic basis for AN as well as BN (Strober et al., 2000).

The psychological and personality factors associated with the eating disorders are quite widespread (e.g., Bulik, Sullivan, Fear, & Joyce, 1997; Lilenfield et al., 1998; Wonderlich & Mitchell, 1997). The factors proposed in the literature are often specific to either diagnostic category and/or eating disordered behaviours. For example, low self esteem has been reported as a risk factor for BN (Fairburn, Welch, Doll, Davies, & O'Connor, 1997), although it has not been replicated for the development of AN (Fairburn, Cooper, Doll, & Welch, 1999). Binge eating and other compensatory behaviours have been longitudinally predicted by greater body dissatisfaction as well as greater negative affect (Stice & Agras, 1998), whilst for AN, the risk for developing it is greater if the individual has obsessive-compulsive disorder (OCD; Bulik et al., 1997). Certainly, the association of obsessive-compulsiveness and perfectionism with the eating disorders has been studied extensively (e.g., Halmi et al., 2005; Sallet et al., 2010; Wu, 2008), with results generally implicating these two personality traits in the development of the eating disorders (Anderluh, Tchanturia, Rabe-Hesketh, & Treasure, 2003; Halmi et al., 2000).

The socio-cultural factors implicated in the aetiology of the eating disorders can vary from cultural norms to family dysfunction (e.g., Kluck, 2008). Ultimately, the severity of eating disordered symptoms can be attributable to the environment in which the sufferer lives (Wade, Bergin, Martin, Gillespie, & Fairburn, 2006). Wade, Bergin, Martin and colleagues (2006) specifically highlighted the parent-child relationship up to the age of 16 years old as being a key environmental factor. Anecdotally, parents have often blamed themselves for the development of their child's eating disorder (Lacey & Price, 2004). Family processes have been proposed to be both general risk factors for mental disorders (Laliberte, Boland, & Leichner, 1999), as well as being a specific risk factor for disordered eating (Kluck, 2008). Kluck (2008) further examined a mediation model and suggested that the dysfunctional family's effect on disordered eating operates fully through the family's food-related experiences (e.g., modelling, dieting, teasing, and criticism).

However, environmental factors extend beyond the family into societal and peer group influences. For example, weight and shape comments from peers, and not just the family, have been shown to be related to increased lifetime eating disorder behaviours (Wade, Bergin, Martin et al., 2006). Similarly, modern Western culture has emphasised the desirability of a thin ideal for women, which can be problematic (e.g., Lindeman, 1999), particularly when an individual internalises these messages to be thin (Knauss, Paxton, & Alsaker, 2007). The internalisation of the thin ideal, as well as greater perceived pressure to be thin has been shown to longitudinally predict the onset of binge eating and compensatory behaviours among female adolescents (Stice & Agras, 1998).

Ultimately, these distinct risk factor categories never occur in isolation, and will invariably interact with each other to form multi-factorial risk factor models that are not specific to any eating disorder diagnosis. Therefore, the transdiagnostic theory of the eating disorders was created (Fairburn et al., 2003). This theory was proposed to explain the maintenance of the eating disorders, but it can also explain the aetiology of them as well (Fairburn et al., 2003). This model points to the importance of negative self-evaluation and overly critical self-perfectionism, together with dysfunctional mood regulation, all interacting with interpersonal life events. This combination of factors is a more accurate representation of the development of many mental disorders, and indeed the transdiagnostic model could be applied to other psychopathologies as well (Fairburn et al., 2003).

However, the transdiagnostic theory of eating disorders as a single cause of the eating disorders has been questioned, as there is insufficient evidence to suggest that AN and BN represent a single disorder (Birmingham, Touyz, & Harbottle, 2009). Indeed, Birmingham and colleagues suggested that the literature on genetics, epidemiology and pharmacological treatment do not support the transdiagnostic theory of the eating disorders. Instead, it is suggested that other forms of comparisons and categorisations are studied, such as comparisons between males and females, or between different ages of eating disorder onset, to help elucidate the causal pathways of the eating disorders.

1.2.4 Conclusions

The eating disorders are serious clinical disorders that have detrimental physical and psychological effects on the sufferer (Pomeroy & Mitchell, 2002). The diagnostic criteria for the eating disorders, however, have been criticised and there are many individuals who do not reach clinical levels of the disorders but still exhibit problematic attitudes and behaviours that affect their quality of life (Touchette et al., 2010). The causes of the eating disorders are still unknown and the multi-factorial aetiological models demonstrate the complex nature of the eating disorders. Further, the risk factors that have been proposed in the literature for AN, for example, may not translate across to be risk factors for other eating disordered groups, such as BN sufferers (Birmingham et al., 2009; Lacey & Price, 2004). Instead, future research may be better advised to investigate the risk factors for specific eating disorder features and behaviours (Nicholls, 2005), rather than the general eating disorder diagnostic categories. One key feature of the eating disorders that is currently under-researched is that of compulsive exercise. This is defined in the subsequent sections of this chapter, followed by an exploration of the potential correlates and risk factors for this particular symptom of eating disorders.

For the purposes of this thesis, there will be a focus on the psychological and environmental (socio-cultural) correlates and risk factors for compulsive exercise, which have been more widely reported than the physiological risk factors for compulsive exercise (e.g., Meyer, Taranis, Goodwin, & Haycraft, in press). In addition, the physiological causes of the eating disorders in general often have their basis in genetic research, which has not been applied to compulsive exercise, and is beyond the scope of the methodology chosen in this thesis.

1.3 A Drive to Exercise: Compulsive Exercise

1.3.1 Definitions

There have been many terms used to describe a host of similar behaviours and cognitions around exercise, where a person seemingly feels compelled to exercise, and often pushes themselves to physical injury and exhaustion. Terms such as ‘exercise addiction’ (Terry, Szabo, & Griffiths, 2004), ‘exercise dependence’ (Ogden, Veale, & Summers, 1997), ‘obligatory exercise’ (Thompson & Pasman, 1991), ‘compulsive exercise’ (Yates, 1991), and ‘excessive exercise’ (Davis, Brewer, & Ratusny, 1993) are the most common terms in the literature. However, the literature is largely atheoretical, and so it is unclear as to whether each term is describing a different construct, or whether they are simply different names for the same phenomenon.

This driven exercise is often described behaviourally and, given the large volume of exercise that is often performed, it is usually termed ‘excessive exercise’ (e.g., Davis et al., 1993). However, the main criticism over the use of ‘excessive exercise’ is that several studies point to the importance of exercise-related cognitions and not the volume of behaviour per se in defining this apparent phenomenon. Indeed, exercise volume has been seen to be independent of ‘obligatory exerciser’s’ cognitive profile (Ackard et al., 2002), whilst exercise cognitions rather than behaviour have been more closely associated with eating disorder psychopathology (Seigel & Hetta, 2001). In other words, it is the exercise motivation and exercise-related attitudes that demonstrate the individual’s level of compulsive exercising, and not simply the behavioural volume that they perform.

Therefore, when describing and defining this compulsive exercise behaviour, it would appear to be wise to include an emotional and cognitive aspect to it as well (Steffen & Brehm, 1999).

A more comprehensive definition than behavioural volume is highlighted by the attempts to provide diagnostic criteria for this excessive and highly driven exercise. Veale (1987), using the concept of exercise dependence, proposed two distinct disorders called ‘primary exercise dependence’ and ‘secondary exercise dependence’. The diagnosis of primary exercise dependence consisted of the following criteria:

A) Preoccupation with exercise which has become stereotyped and routine.
B) Significant withdrawal symptoms in the absence of exercise (e.g., mood swings, irritability, insomnia).
C) The preoccupation causes clinically significant distress or impairment in their physical, social, occupational, or other important areas of functioning.
D) The preoccupation with exercise is not better accounted for by another mental disorder (e.g., as a means of losing weight or controlling calorie intake as in an eating disorder).

(Veale, 1987, p. 736)

The key feature of this definition of compulsive exercise is that it is a pathology in its own right. This conceptualisation was based on the DSM’s diagnostic criteria for substance dependence, which was expanded upon by Hausenblas and Symons Downs (2002a) in their development of the Exercise Dependence Scale. Importantly, Veale (1987) emphasised that primary exercise dependence could only occur in the absence of a clinical eating disorder. If an eating disorder was present and the above criteria were still satisfied, then Veale (1987) labelled that condition ‘secondary exercise dependence’. This second diagnostic term represented the same construct as its primary counterpart, except secondary exercise dependence co-occured in the presence of a clinically diagnosed eating disorder.

The validity of these diagnostic criteria has been questioned (Bamber, Cockerill, & Carroll, 2000; Bamber, Cockerill, Rodgers, & Carroll, 2003). In a qualitative study of female exercisers, narratives revealed that all the women who met the criteria for exercise dependence were also all diagnosed with eating disorders and were therefore considered to be exhibiting secondary exercise dependence (Bamber et al., 2003). The authors concluded that exercise dependence is not a pathology in its own right, but instead is an element of an eating disorder. This result supported previous work, which provided the argument that there is no such thing as primary exercise dependence, as the concept of exercise dependence always co-occurs with some degree of eating disorder pathology (Bamber, Cockerill, & Carroll, 2000).

Veale (1987) and Hausenblas and Symons Downs (2002a) provided a definition of this driven exercise in an addictions and dependency framework. However, contrary to this, it has been argued that the excessive drive for exercise seen in the context of the eating disorders is better described from an obsessive-compulsive conceptualisation, as a compulsive behaviour (Adkins & Keel, 2005; Beumont et al., 1994; Davis, 1997) that encompasses elements of guilt when the exercise is not performed (Mond, Hay, Rodgers, & Owen, 2006), than from an addictions model. This distinction between an addiction and a compulsion is a key debate in the compulsive exercise literature, with regards to its definition (e.g., Davis, 2000). This debate is summarised in the following section.

1.3.1.1 Compulsion or addiction?

The two most prominent theoretical models of compulsive exercise in trying to define the construct have been those based on a compulsive-anxiety model (e.g., Yates, 1991) and those that have tried to define compulsive exercise within an addictions model, through its diagnosis as exercise dependence (Veale, 1987). This can be rather conflicting, as clinically, compulsions and addictions are grounded in separate classifications (APA, 1994). However, there is considerable overlap in the two constructs. For example, Leuenberger (2006) defined exercise dependence, a seemingly addictive conceptualisation as being “characterised by a *compulsion* to exercise excessively” (p. 1). Further, Griffith (1996) provided criteria for an addiction to a behaviour, which included salience (activity takes on increasing importance), mood modification, tolerance, withdrawal, conflict (interpersonal and intrapsychic), and relapse. Despite these criteria describing an addiction, they also could apply to the compulsive behaviour of exercising in eating disorder patients, whose compulsive exercise behaviour is often withdrawn and ever-increasing, with an inability to give it up (e.g., Beumont et al., 1994).

However, a key distinction between addictions (often viewed as impulsive behaviours) and compulsions is whether the behaviour is performed for self-gratification or whether it is performed for fear of negative consequences, respectively (Hollander, 1998). For example, addiction and dependence infers an ego syntonic state for the individual, where the individual continues to exercise in order to get further gratification resulting from their behaviour. This is similar to those addicted to drugs or alcohol (Leuenberger, 2006). However, it is commonplace for the compulsive exerciser to experience no enjoyment from the activity and instead they often feel compelled to engage in their behaviour, separate from their self concept, and in fact their behaviour is ego dystonic. In other words, they engage in further exercise in order to avoid anything negative happening (Hollander, 1998; Taranis, Touyz, & Meyer, in press). This is more similar to an obsessive-compulsive anxiety-based drive to perform a routine behaviour (Beumont et al., 1994).

The term ‘exercise addiction’ and/or ‘exercise dependence’ would also suggest a physiological dependence upon a substance, or some neuro-chemical change that occurs, whereby the individual achieves the “runner’s high” (Leuenberger, 2006). However, research into this area is largely based on self report measures and the physiological basis for there being an addiction is in fact rather slim and unequivocal (Davis, 2000; Leuenberger, 2006), even though it is a popular hypothesis amongst clinicians (Cox & Orford, 2004). Instead, further evidence that the excessive exercise behaviour associated with the eating disorders is a compulsive behaviour is found in research that demonstrates the close link between obsessive-compulsiveness, exercise and eating disorders (Davis, Katzman, & Kirsh, 1999; Thome & Espelage, 2007). Based on empirical research, as well as anecdotal reports of patient behaviour, it would seem appropriate to use the term compulsive exercise, particularly in the context of the eating disorders (Adkins & Keel, 2005). Therefore, throughout this thesis, the problematic exercise associated with the eating disorders will be conceptualised as being compulsive. This compulsive exercise is further defined in the following section.

1.3.1.2 Compulsive exercise definition: A symptom of the eating disorders

The proposition that compulsive exercise is connected primarily with the eating disorders is currently not widely recognised by eating disorder diagnostic criteria, with only limited reference to excessive exercise (APA, 1994). This brief description of excessive exercise does not fully describe or capture the complex nature of compulsive exercise. Therefore, recent work has been conducted to coherently describe the exercise element of the eating disorders (e.g., Meyer et al., in press; Taranis et al., in press; Taranis & Meyer, 2010). This work has used the term compulsive exercise, and emphasised its affective and cognitive elements and not simply the excessive exercise behaviour, as has been measured in many previous investigations (e.g., Brewerton, Stellefson, Hibbs, Hodges, & Cochrane, 1995; Davis & Kaptein, 2006; Penas-Lledo, Leal, & Waller, 2002). This qualitatively defined compulsive exercise incorporates the following dimensions, and it is this conceptualisation that will be used for this thesis.

Firstly, compulsive exercise encompasses avoidance and rule-driven behaviour. This is a key part of compulsive exercise that refers to an individual continuing to exercise due to negative reinforcement. In other words, the person is compelled to exercise because of the negative emotional consequences that may occur if they do not exercise, such as guilt, anxiety and depression (Beumont et al., 1994; Mond et al., 2006). This key element of compulsive exercise has been closely associated with an array of eating disorder cognitions and behaviours (Taranis & Meyer, 2010), and has been supported by recent evidence that found excessive exercising in eating disorder patients to be primarily performed to control negative affect (Bratland-Sanda et al., 2010a; 2010b). Avoidant and rule-driven behaviour around exercising has also been shown in non-clinical samples, where exercising to control negative affect was associated with eating disordered behaviours in university students (De Young & Anderson, 2010a). The avoidance and rule-driven behaviour also considers that an individual will feel that they have let themselves down in some way if they miss their exercise, and therefore will make up for any sessions that they may have missed.

The second key element is exercising for weight control reasons, incorporating compensatory exercise, such as debting (Beumont et al., 1994). This is the traditional view of the exercise element to the eating disorders (Fairburn &

Beglin, 1994), where an individual feels compelled to exercise in order to control their weight, and/or where they will feel compelled to exercise in order to burn off any of the calories that they have gained from recent food consumption. This is a key focus of the current definition of compulsive exercise. Indeed, weight control exercise has been positively and significantly associated with a wide range of eating disorder cognitions and behaviours (Taranis & Meyer, 2010). However, unlike previous investigations (e.g., Davis & Kaptein, 2006), this current definition describes more features of compulsive exercise than simply exercising for weight and shape reasons.

One additional function of compulsive exercise is the mood regulatory reasons for exercising. This has been widely seen for normal exercise behaviour in the general population (Salmon, 2001), but is also included here as an element of compulsive exercise. Certainly it has been suggested that eating disorder patients exercise to improve their mood (Penas-Lledo et al., 2002) and it is because of this desire to feel better after exercising that the individual continues to exercise. However, it must be noted that this exercising for feeling better is more akin to the exercise dependence conceptualisation (Hausenblas & Symons Downs, 2002a) than the compulsive exercise seen in eating disorder patients to avoid negative feelings (Bratland-Sanda et al., 2010a; 2010b). Indeed, it has more recently been found that this element of compulsive exercise is not related to eating disorder cognitions or behaviours (Taranis & Meyer, 2010), which led Taranis and Meyer to contest the mood improvement element of compulsive exercise. However, it could be that this element of compulsive exercise is a remnant of the reasons for exercising that existed for the individual when they first took up exercise behaviour. Certainly, exercise to increase positive affect is associated with non-clinical samples (see Yeung, 1996), whereas exercise to reduce negative affect is the key function of exercise in eating disorder samples (e.g., Bratland-Sanda et al., 2010a). Nonetheless, exercise may still be rewarding for patients (Bewell-Weiss & Carter, 2010), and compulsive exercise has also been found in non-clinical samples as well (Taranis & Meyer, 2010). Therefore, until further work to demonstrate otherwise, mood improvement is still regarded as a qualitatively important dimension of compulsive exercise in the eating disorders.

Another element of compulsive exercise in the current definition is a lack of exercise enjoyment. This is reported in many patients, where they experience no enjoyment from their excessive exercising, and instead view it as a chore (Taranis et al., in press). This is akin to the compulsive behaviours seen in obsessive-compulsive disorder sufferers, who feel compelled to perform their compulsion despite deriving no personal enjoyment from it (Beumont et al., 1994). The inclusion of this is supported by the close relationships seen between physical activity, obsessive-compulsiveness, and the eating disorders (e.g., Davis, Katzman, Kaptein, Kirsh, & Brewer, 1997). Finally, this close link with obsessive-compulsiveness is also found in the final element of the compulsive exercise definition; namely exercise rigidity. This describes the feature of a compulsive exerciser's exercise behaviour being performed in a rigid, strict, and routine-like fashion, which is the typical exercise behaviour of eating disorder patients (Beumont et al., 1994).

1.4 Compulsive Exercise in the Context of Eating Disorders

1.4.1 Overview

The conceptualisation of compulsive exercise, as defined by Taranis and colleagues (in press) incorporates the literature on problematic exercise in the eating disorders (Meyer et al., in press). Recently, it has been empirically demonstrated that this compulsive exercise is associated with eating disorder cognitions as well as behaviours (Taranis & Meyer, 2010). Prior to this new theory of compulsive exercise being devised, the excessive exercise behaviours seen in eating disorder patients had been subject to a variety of measurements and definitions. Regardless of measurement issues, compulsive exercise is undisputedly a widely reported symptom in patients receiving treatment for eating disorders (Dalle Grave, Calugi, & Marchesini, 2008).

The prevalence of compulsive exercise is unclear. It has been documented as being around 34% in AN patients (Bewell-Weiss & Carter, 2010) and approximately 20-25% in BN patients (Shroff et al., 2006). However, another study reported the prevalence of compulsive exercise as high as around 70% of all eating disorder patients (Davis et al., 1997). Further, lifetime prevalence of compulsive exercise has been reported at 84% of sampled eating disorder patients (Davis et al., 1994). These disparate figures are likely a result of methodological inconsistencies (Shroff et al., 2006). Nonetheless, it is relatively undisputed as to the negative impact that compulsive exercise has on the eating disorders (Meyer et al., in press). For example, compulsive exercise has been shown to negatively influence the course, treatment and outcome of the eating disorders (Strober et al., 1997), as it has been associated with a greater duration of hospital treatment, as well as being the key factor in increasing the likelihood of relapse after treatment (Carter, Blackmore, Sutander-Pinnock, & Woodside, 2004; Solenberger, 2001; Strober et al., 1997). Furthermore, it has been implicated in the development of the eating disorders, with some researchers demonstrating that early childhood participation in physical activity is associated with greater compulsive exercising, and suggesting that this can place those individuals at a greater risk of subsequently developing an eating disorder (Davis, 1999).

Despite these negative clinical implications and the large percentage of patients that may experience these harmful and detrimental behaviours, the body of literature examining prevalence, aetiology, and/or maintenance of compulsive exercise is relatively scarce. It certainly lacks a coherent theoretical underpinning, and therefore this thesis will attempt to go some way to rectifying the current atheoretical literature in the aetiology of compulsive exercise.

The lack of theory and definition of this widely prevalent symptom is highlighted by the relative lack of presence in the diagnosis of the eating disorders (APA, 1994), as well as the absence of its inclusion in the proposed changes to the eating disorders diagnostic criteria in the DSM-V (APA, 2010). Currently, the closest description to compulsive exercise is in the DSM-IV, which includes “excessive exercise” as a feature of “bulimia nervosa non-purging sub-type”, and states that if exercise is going to be described as “excessive” it must “significantly interfere with important activities, occur at inappropriate times, or in inappropriate settings, or continue despite injury or other medical complications” (p.546). This limited reference to excessive exercise only accounts for the behavioural aspect of compulsive exercise. Additionally, despite this reference to BN, empirical research has demonstrated that compulsive exercise is more prevalent in AN patients, particularly the restricting sub-type of AN (Bewell-Weiss & Carter, 2010; Dalle-Grave et al., 2008).

The close link between exercise and eating disorders is also shown in community samples. For example, Lipsey, Barton, Hulley, and Hill (2006) found that in a sample of female exercisers, commitment to exercise was associated with eating disorder psychopathology. Further, the profiles of eating disordered individuals and obligatory exercisers are reportedly very similar (Matheson & Crawford-Wright, 2000). Specifically, using the current definition of compulsive exercise, eating disorder psychopathology has also been directly linked with eating disorder cognitions and behaviours in a non-clinical sample (Taranis & Meyer, 2010). However, it is still unknown what directly causes this compulsive exercise and what can be viewed as potential risk factors for this symptom of the eating disorders.

Ultimately, the aetiology of compulsive exercise in the eating disorders is unknown. There is a complex relationship between clinical eating disorders and compulsive exercise, which may have an impact on the development of compulsive exercise. Exercise has, in some instances, been shown to cause and maintain eating disorders (Davis et al., 1994). Conversely, disordered eating symptoms have been shown to increase the risk for compulsive exercise behaviours (Zmijewski & Howard, 2003), while a reciprocal relationship has also been proposed, where compulsive exercise and disordered eating behaviours act synergistically in a vicious maintaining cycle (Cockerill & Riddington, 1996; Epling & Pierce, 1996). Additionally, it is unknown whether there are specific risk factors for compulsive exercise or whether there is an underlying personality trait, or shared environment that leads to general eating disorder pathology, including compulsive exercise (Eisler & Le Grange, 1990). These equivocal findings need to be further explored. Therefore, the following systematic review was conducted to draw together the current knowledge on compulsive exercise in the eating disorders, and to identify any correlates and risk factors that could be implicated in the aetiology of compulsive exercise.

1.4.2 A systematic review of correlates and risk factors for compulsive exercise in clinical eating disorder samples

The following systematic review forms part of a published article, cited as: *Meyer, C., Taranis, L., Goodwin, H., & Haycraft, E. (in press). Compulsive* *exercise and eating disorders. European Eating Disorders Review.* As a result, elements of the introduction of the systematic review are similar to the introduction of this thesis, as they could not be changed once the paper was accepted for publication. Additionally, it must be noted that although this systematic review investigates the correlates and risk factors of *compulsive exercise*, given the largely disparate methodology on exercise in the eating disorders (see Meyer et al., in press), the reviewed studies invariably utilised different operational definitions of the problematic exercise seen in eating disorder patients. For the purposes of the review, the varying definitions were all regarded as a measurement of compulsive exercise.

BACKGROUND

Exercising among eating disordered individuals has traditionally been seen as a method of weight control (Davis et al., 1994). However, it has also been shown to be used for a wider variety of reasons, such as mood regulation, as well as being described as being performed due to a compulsion to exercise (Taranis et al., in press). The prevalence of this compulsive exercise among the eating disorders varies, although it has been reported as being present in 46%-55% of patients (Dalle Grave et al., 2008; Shroff et al., 2006). This variability in prevalence figures is arguably due to the different methods for its assessment (Solenberger, 2001). However, even accounting for measurement variation, the equivocal figures in the literature highlight the lack of knowledge over this key element of the eating disorders.

This compulsive exercise has been associated with longer treatment time for eating disorder pathology (Solenberger, 2001), greater chance of relapse for an eating disorder (Strober et al., 1997), and also with greater psychopathology associated with the eating disorder (Shroff et al., 2006). Despite this negative effect on a sufferer's treatment for eating disorders, the body of literature around compulsive exercise is relatively scarce. It is further complicated by the use of a variety of definitions and measures used to assess it.

Recently, the multidimensional model of compulsive exercise (Taranis et al., in press) has been developed, which describes compulsive exercise as the sum of a number of interlinked facets. These facets are: Avoidance and Rule-Driven Behaviour, Weight Control Exercise, Mood Improvement, Lack of Exercise

Enjoyment, and Exercise Rigidity. The model also highlights a number of complex maintaining factors for this behaviour, including perfectionism, mood regulation, and eating disorder psychopathology itself.

However, although these maintaining factors have been proposed to sustain this compulsive exercise, it is unknown why some individuals have an exercise element to their eating disorder in the first place, and why others do not. Given the detrimental effect of compulsive exercise on eating disorder treatment, it would be useful to identify the associated correlates and predictors of compulsive exercise. This would identify key factors that may be causing this compulsive exercise, and/or interacting with the eating disorder and exercise in such a way as to hinder treatment outcome.

The majority of papers examining correlates of ‘problematic exercising’ have focused on non-clinical populations, i.e. samples who do not have a clinically-diagnosed eating disorder (Davis, 1997). This was highlighted by a key systematic review paper by Hausenblas and Symons Downs (2002b), examining exercise dependence. They had an inclusion criterion of primary exercise dependence only. In other words, they reviewed papers that had non-clinical (i.e., non-eating disorder) samples. However, the results of Hausenblas and Symons Downs’ review (2002b) may not translate to clinical eating disorder samples, as it has been suggested that exercise dependence in the absence of an eating disorder does not display the same level of psychological morbidity as compulsive exercise in the context of an eating disorder (Mond et al., 2006).

Therefore, this current systematic review is concerned with problematic exercising within the eating disorders, and so is essentially reviewing ‘secondary exercise dependence’ (Veale, 1987). Nonetheless, given the varying degrees of eating disorder pathology, there will likely be some articles reviewed which will have been included in the Hausenblas and Symons Downs (2002b) review paper as well.

Aim:

The aim of this review is to identify the key factors that are related to and longitudinally predict compulsive exercise among individuals with a clinical eating disorder.

METHODS

Inclusion / Exclusion Criteria

Table 1.3 lists the inclusion and exclusion criteria that were used to conduct the systematic review.

Table 1.3 Inclusion and exclusion criteria used for systematic review

Inclusion Criteria

- Empirical work, written in English, using qualitative or quantitative designs.
- Studies which investigated psychological and/or situational factors associated with compulsive exercise behaviour.
- All or part of the sample must have been recruited from a clinical eating disorder population; or were recruited from a different population but were clinically diagnosed with an eating disorder (AN, BN, or EDNOS only).

Exlusion Criteria

- Samples which used non-clinical samples only, Binge Eating Disorder samples, obesity samples, or samples where the eating disorder was defined simply by body image disturbance or weight control behaviours.
- Individual case study designs.
- Outcome study designs

Given the variety of terms used to describe compulsive exercise, wider terminology was included in the literature review. Specifically, any study that investigated exercise (and/or physical activity) behaviour or any qualitative dimension of exercise (e.g., commitment to exercise, obligatory exercise, exercise addiction, exercise dependence) was included. A further difficulty and complication of reviewing the literature on exercise and eating disorders is the presence of semi-starvation-induced hyperactivity, commonly seen in the acute phase of AN (Hebebrand et al., 2003). This increased activity appears to be a result of physiological changes associated with starvation, rather than of any underlying etiological problem. Davis (1997) suggested that while this physiological adaptation may be important in the maintenance of compulsive exercise, it is more likely that psychosocial factors are of greater importance in the aetiology of the disorder. Therefore, given that this review intends to focus on the precipitating factors of compulsive exercise, studies focusing on this resultant physiological hyperactivity after starvation will be excluded. Indeed, only psychological and situational correlates and predictors will be included in the review.

Importantly, several studies investigate predictors of extreme weight control behaviours and/or eating disordered behaviours, of which excessive exercising is sometimes mentioned. However, these studies are often simply an investigation of exercising for weight management reasons and are not measuring compulsive exercise. Therefore, these studies were also excluded.

Search Method

Evidence was gathered via several sources up to June 2009. First, electronic databases were used. These were Web of Science, PubMed, and PsycInfo, which is similar to the databases used in a previous systematic review (Gilbert, unpublished; Roberts, Tchanturia, Stahl, Southgate, & Treasure, 2007). The search terms used in the electronic database searches can be seen in Table 1.4:

Table 1.4 Search terms used for electronic database searches

Compulsive Exercise	Exercise Addiction	Habitual Exercise	Obsessive Exercise
Obligatory Exercise	Exercise Dependence	Physical Activity AND Eating Disorder	Disordered Exercise
Excessive Exercise	Exercise Commitment	Purge AND Eating Disorder	Anorexia Athletica
Eating Disorder Exercise	Exercise Abuse	Hyperactivity AND Eating Disorder	Activity Anorexia

Note: Combinations of terms were also used to identify any further articles.

Second, eating disorder journals were examined; namely, The International Journal of Eating Disorders, European Eating Disorders Review, Eating Behaviors, and Eating Disorders. Third, reference lists of relevant review papers as well as reference lists of key articles were also checked to ensure that any further articles missed by the database and journal searches were also identified and included for this review.

RESULTS

Due to the large number of search terms employed, over 500 possible articles were produced from the databases. However, the majority of these articles were not relevant to the systematic review (n = > 300), i.e. they did not fulfil the second inclusion criterion in Table 1.3, and therefore were not included in the review. Likewise, a notable number of the remaining articles (n = >100) did not use a sample with a clinical eating disorder (see Table 1.3, third inclusion criterion), and so these were also excluded from the review. Finally, after taking account of duplications, and using the additional exclusion and inclusion criteria stipulated in Table 1.3, a final sample of 38 articles were retained for closer inspection.

Following on from the procedure outlined in Gilbert (unpublished), these 38 articles were graded according to relevance, from ‘0’ representing irrelevance, through to ‘4’, which represented high relevance. A total of 22 articles were graded as either 3 or 4 and were subsequently retained for this review. A summary of these selected studies can be seen in Table 1.5. The remaining articles, which all had rankings of below 3, were excluded.

Table 1.5 Descriptions of studies reviewed in systematic review

Authors & year	***Study type & level of evidence***	***Sample***	***Purpose (relevant to review)***	***Measures used***	***Results relevant to review****
Bamber, Cockerill, & Carroll (2000)	Cross-sectional; self report	194 adult female exercisers from clinical and non-clinical sources; lowest n per group = 14	Compare Primary exercise dependent (EX) vs Secondary exercise dependent (CE) vs Eating disorder only (ED) vs Control (C) on levels of psychological morbidity, personality profiles, and exercise beliefs	Exercise Dependence Questionnaire (EDQ); Eating Disorder Examination Questionnaire (EDEQ); General Health Questionnaire (GHQ); Rosenberg Self Esteem Scale (RSE); Menstrual dysfunction; Eysenck Personality Questionnaire-Revised (EPQ-R); Body Shape Questionnaire (BSQ); Exercise Beliefs Questionnaire (EBQ); Physical Activity	Compulsive exercisers (CE) in general reported greater psychological morbidity and different personality profile than EX and C group; CE = sig greater than ED on EDQ total, exercise for weight control (EDQ), interference with social/ family/work (EDQ), stereotyped behaviour (EDQ), severe depression, EBQ total, social desirability (EBQ), mental and emotional functioning (EBQ), physical activity CE = sig. less than ED on venturesomeness (EPQ-R)
Bamber, Cockerill, Rodgers, & Carroll (2000)	Qualitative; Semi-structured interviews	16 adult female exercisers screened for ED and exercise dependence; 4 in each group	Compare Primary exercise dependent (EX) vs Secondary exercise dependent (CE) vs Eating disorder only (ED) vs Control (C) to explore the concept of exercise dependence	Eating Disorder Examination (EDE); Exercise Dependence Interview (EXDI)	CE described greater psychological distress than eating disorders alone and/or than the primary exercise dependents; Exercise dependence is always in the context of an eating disorder *(cont)*

Blaydon, Linder, & Kerr (2004)	Cross-sectional; Self report	393 (227 M; 166 F) highly active amateur participants; of which: 79 = clinical ED; Adult and adolescent	Compare Primary exercise dependent (EX) vs Secondary exercise dependent (CE) vs Eating disorder only (ED) vs Control (C) on metamotivational characteristics	EDQ; Eating Attitudes Test (EAT); Motivational Style for Sport and Exercise (MSP-SE); Personal information on gender, main sport participation, hours of exercise and competitive level	CE is associated with telic, arousal avoidance and pessimistic dominance;
Brewerton, Stellefson, Hibbs, Hodges, & Cochrane (1995)	Cross-sectional; Self report	110 female eating disorder patients Age not given	Comparison of eating disorder patients with and without compulsive exercising on ED and psychological variables	Diagnostic Survey for Eating Disorders (DSED); demographic and clinical characteristics, including time spent exercising	CE scored sig higher than non-CE on body dissatisfaction, distress due to weight gain; CE's less likely to use other bulimic behaviours (e.g., vomit, laxatives, binge); Among CE's time spent exercising was correlated with anxiety and irritability; CE more prevalent in AN than in BN; Among ANs dieting occurred sig. earlier in CE's than non-CE's
Dalle Grave, Calugi, & Marchesini (2008).	Cross-sectional; Self report	165 adult female eating disorder patients	Examine the prevalence and associated features of compulsive exercise and examine its effect on treatment outcome	Demographic and clinical variables; EDE; Temperament and Character Inventory (TCI); Beck Depression Inventory (BDI); Eating Disorder Inventory-Perfectionism subscale (EDI-P)	Highest CE prevalence in Restricting-AN; CE predicted by EDE restraint; Compared to non-CE, CE had sig higher: EDE global score, restraint, shape concern, weight concern; Compared to non-CE, CE had sig lower: novelty seeking (TCI) and lower self-induced vomiting behaviour *(cont)*

Davis & Claridge (1998)	Cross-sectional; Self report	83 adult female eating disorder patients	Examine the influence of addictiveness and obsessive-compulsive personality on predicting weight preoccupation and excessive exercising	EPQ-R addictiveness subscale (EPQ-R-A); De novo scale to assess obsessive compulsive personality; EDI-drive for thinness subscale (EDI-DT); volume of exercise questions to establish both historical exercising status and current exercising status	Addictiveness and obsessive-compulsiveness both predicted historical and current excessive exercising
Davis & Kaptein (2006)	Prospective self report	50 female eating disorder patients with restricting-AN only Predominantly adult sample	Examine whether psychopathological differences between CE and non-CE are antecedent factors or whether they occur as a result of CE and severe ED behaviour	Exercise questions regarding current and lifetime exercise volumes; Maudsley Obsessive-Compulsive Inventory (MOCI); De novo scale to assess obsessive-compulsive personality; BMI	Current CE reported greater OC personality traits and greater OC symptoms than current non-CE; Lifetime CE reported greater OC personality traits and OC symptoms than lifetime non-CE; BMI did not differ between CE and non-CE; the OC differences between CE and non-CE persisted even with re-feeding
Davis, Kaptein, Kaplan, Olmsted, & Woodside (1998)	Quasi-experiment al Self report and structured interview	53 adult female eating disorder patients with AN	Examine the link between obsessionality and AN and the role of excessive exercise	Exercise questions regarding current exercise habits; MOCI; De novo scale to assess obsessive-compulsive personality; Multidimensional Perfectionism Scale (MPS) ; Commitment to Exercise Scale (CES); EDI-DT, EDI-bulimia (EDI-B), EDI-body dissatisfaction (EDI-BD); Body Esteem Scale (BES); Janis-Field Feelings of Inadequacy Scale (JFFIS); BMI	CE sig greater than non-CE on: OC symptomatology, OC personality, and self-orientated perfectionism; there were no other differences between the groups were found, including BMI *(cont)*

Davis et al. (1997)	Cross-sectional Structured interviews	Sample 1: 127 adult female eating disorder patients; Sample 2: 40 adolescent female AN patients	Examine the prevalence and associated features of excessive exercise both premorbidly and comorbidly in relation to eating disorder pathology	Interview covered the following topics: exercise status, chronology of dieting and sport/exercise, childhood activity status, sport/exercise participation at target ages, attitudes to exercising; BMI	Sample 1: Greater CE among AN than among BN during acute phase of ED; CE perform greater exercise during 12 months prior to ED than the non-exercising counterparts; Among AN, exercise preceded dieting; the reverse was true among BN; CE reported sig greater childhood activity (more active than average girl) than non-CE; Sample 2: similar results were found as reported in Sample 1 although sample was too small to establish full findings
Davis, Katzman, & Kirsh (1999)	Cross-sectional; Structured interviews	84 female adolescent AN patients	Examine a model of compulsive exercise, personality, cognitions, and behaviour	Questions on exercise status; CES; EPQ-R-A; De novo scale to assess obsessive-compulsive personality; question on childhood activity status	Addictiveness and OC personality predicted CE, but not exercise behaviour directly; Childhood activity predicted current exercise behaviour but not CE directly
Davis et al. (1995)	Cross-sectional; Self report & structured interviews	Sample 1: 46 adult female AN patients; Sample 2: 88 adult female community exercisers; Sample 3: 40 high-level exercising adult females	Examine relationship between obsessive compulsiveness, high-level exercising and AN	Symptom Checklist-90-obsessive compulsive subscale (SCL-90-OC); EDI-DT; CES; leisure time physical activity participation question	Among the patient group, obligatory exercise was sig associated with weight preoccupation (EDI-DT); among the same group, physical activity was positively correlated with OC and EDI-DT *(cont)*

Davis & Woodside (2002)	Cross-sectional; Self report & structured interview	186 adult female eating disorder patients	Examine link between anhedonia and high-level exercising	Physical Anhedonia Scale Revised (PAS-R); SCL-90 depression subscale (SCL-90-D); BMI; questions on exercise/sport participation	Among BN and EDNOS, CE scored sig greater on anhedonia than non-CE; this finding was not found among AN
Davis, Woodside, Olmsted, & Kaptein (1999)	Cross sectional; Self report & structured interview	92 adult female eating disorder patients (AN-R and BN only)	Compare high-level exercisers and non-high level exercisers on obsessionality and other associated psychopathology	MOCI; De novo scale to assess obsessive-compulsive personality; O'Brien Multiphasic Narcissism Inventory (OMNI); Neurotic Perfectionism Scale (NPS); JFFIS; BES; SCL-90; BMI; questions on exercise/sport status	CE AN scored sig. higher OC symptoms than other three groups (i.e. AN non-CE; and BN CE and non-CE); CE across all patient groups scored sig higher on OC personality than all non-CE; For both AN CE and BN CE, they scored sig higher than AN non-CE and BN non-CE respectively on: body dissatisfaction, narcissism, neurotic perfectionism, global psychopathology; and had lower self esteem; no difference between CE and non-CE across groups was found for BMI
Holtkamp, Hebebrand, & Herpertz-Dahlmann (2004)	Cross-sectional; Structured interview & self report	30 adolescent female AN patients	Examine link between caloric restriction, psychopathology, and physical activity in AN	Structured Interview of Anorexia and Bulimia Nervosa (SIAB); SCL-90-R	Physical activity was positively correlated with food restriction and anxiety, where strong excessive physical activity was associated with greater food restriction and more anxiety; BMI was not associated with physical activity
Klein et al. (2004)	Cross sectional; Self report	21 adult female eating disorder patients	To measure exercise dependence in AN	Substance Dependence Severity Scale – Revised; Beck Anxiety Inventory (BAI); BDI; Yale-Brown-Cornell Eating Disorder Scale; CES	CE was positively associated with anxiety; no association was found between CE and BMI *(cont)*

Klein, Mayer, Schebendach, & Walsh (2007)	Quasi experimental; Self report & structured interview & objective measurements	36 adult female AN patients	Examine relationship between objectively assessed exercise in AN and various physical and psychological markers	BDI; BAI; EDI; CES; questions on exercise history; objective assessment of physical activity; cortisol measurement	CE was positively associated with locomotor activity ; CE scored sig higher than non-CE on CES; No difference between CE and non-CE was found for BMI, BDI, BAI, or EDI
Kron, Katz, Gorzynski, & Weiner (1978)	Cross-sectional; Interview & self report	33 female AN patients; Adolescent and adult	Examine characteristics of abnormal physical activity among eating disorder patients	Medical charts	Greater activity prior to ED was linked with CE
Mond & Calogero (2009)	Cross-sectional; Self report	286 females: n = 102 eating disorder patients; n = 184 healthy women; predominantly adult sample	Examine the nature of excessive exercise among eating disordered individuals	CES; Reasons for Exercise Inventory (REI); EDE-Q exercise questions	CE was most closely associated with AN-purging subtype of eating disorder
Penas-Lledo, Leal, & Waller (2002)	Retro-spective case series; Self report	124 female eating disorder outpatients; Adolescent and adult	Examine excessive exercise and psychopathology and eating disorder diagnoses	EAT; Bulimic Investigatory Test, Edinburgh (BITE); SCL-90-R; BMI; ED diagnosis	CE reported sig. greater than non-CE on: BMI and eating psychopathology; and on anxiety and depression; AN CE scored higher than non CE AN on: bulimic and general eating psychopathology symptoms; and on anxiety and somatisation (SCL-90-R) *(cont)*

Shroff et al. (2006)	Cross-sectional; Structured interview & self report	1857 female eating disorder patients and affected relatives	Examine features of excessive exercise across sub types of eating disorders	SIAB; Structured Clinical Interview for DSM-IV Axis I Disorders (SCID); TCI; Frost Multidimensional Perfectionism Scale (MPS); State-Trait Anxiety Inventory (STAI); Yale-Brown Obsessive-Compulsive Scale (Y-BOCS); YBC-EDS	CE was sig greatest among Restricting-AN and sig least among Purging-BN; CE scored sig lower lifetime and current BMI than non-CE; CE scored sig higher than non-CE on: anxiety, persistence, and perfectionism; CE scored sig lower than non-CE on: novelty seeking; CE was associated with greater OC and with greater ED severity, as described by worst ritual, worst preoccupation, and worst motivation to change (YBC-EDS)
Solenberger (2001)	Retro-spective case series; Structured interview & self report	199 female eating disorder patients; Adolescent and adult	Examine exercise behaviour among ED patients and compare high and low level exercisers	EAT; EDI; questions regarding exercise behaviour and type	CE scored sig higher than non-CE on: total EAT score, and weight preoccupation
Vansteelandt, Rijmen, Pieters, Probst, & Vanderlinden (2007)	Daily process design; Objective assessment & self report	32 female eating disorder patients; Adult & adolescent	Examine link between drive for thinness, affect regulation, and physical activity in eating disorders, using ecological momentary assessment	De novo ecological momentary assessment questionnaire assessing urge to be active, physical activity behaviour, drive for thinness, and affect; BMI; BDI; SCL-90 Dutch version; Positive and Negative Affect Schedule (PANAS)	Mean urge to be active (CE) is sig associated with lower BMI and greater chronic negative affect; Greater exercise behaviour was sig. associated with lower BMI and higher drive for thinness

Note: *In this column, all findings are reported here as compulsive exercise (CE) rather than as each study's individual terminology

Description of the studies

The characteristics of the different samples were largely similar across the studies. Participants were predominantly recruited at eating disorder clinics and the majority of the studies used young adult female samples. This is reflective of the demographics typical of eating disorder clinics. The only exception to the use of a female-only sample was that of Blaydon et al. (2004), who also recruited highly active male exercisers.

The vast majority of the studies adopted cross-sectional designs. One paper used a prospective design (Davis & Kaptein, 2006) and two were quasi-experimental (Davis et al., 1998; Klein et al., 2007). Several studies involved a retrospective case series design (Kron et al., 1978; Penas-Lledo et al., 2002; Solenberger, 2001), whilst one study adopted a daily process design (Vansteelandt et al., 2007).

The majority of studies utilised one of two methods for gathering data. Self report measures were used either on their own, or as part of an overall assessment. Structured interviews were the other key method used to identify key features and qualitative experiences. Objective measures of height and weight were taken in several studies, whilst physical activity was assessed using objective measures in only one study (Klein et al., 2007).

Correlates of Compulsive Exercise

The studies reviewed demonstrated several factors that are correlated with compulsive exercise. The most frequently reported factors were greater eating disorder psychopathology, obsessive-compulsiveness, anxiety, psychological morbidity, perfectionism, depression, body dissatisfaction, and addictiveness; as well as lower BMI. Several other correlates were also identified in individual studies. These findings are presented below in the order of most frequently reported to least frequently reported finding.

Eating Disorder Psychopathology

The most frequently reported association with compulsive exercise was that of greater eating disorder psychopathology. Brewerton and colleagues (1995) reported that compulsive exercisers scored significantly higher on body dissatisfaction and distress at weight gain than the non-compulsive exercisers.

Dalle Grave et al. (2008) found that compulsive exercisers scored significantly higher on the Eating Disorder Examination (EDE; Fairburn & Cooper, 1993) restraint, shape concern, and weight concern subscales and on the global EDE score. To strengthen the association between compulsive exercise and eating psychopathology, a logistic regression in the same study found that EDE restraint was the only significant unique predictor of compulsive exercise.

This correlation with restrained eating is in line with another study, which found that greater food restriction was significantly correlated with a greater level of physical activity (defined quantitatively and qualitatively) (Holtkamp et al., 2004). This association was also replicated in a regression model in the same study, where food restriction significantly contributed to the variance in physical activity (Holtkamp et al., 2004).

The compulsive exercise association with food restriction would suggest differences between AN and BN. Indeed, in a retrospective analysis of inpatient hospital charts, there was a trend for greater compulsive exercise among AN than among BN or EDNOS patients (Solenberger, 2001). Importantly, in the same study, across the whole eating disorder sample, compulsive exercisers showed significantly greater total EAT (EAT; Garner & Garfinkel, 1979) scores as well as reporting more weight preoccupation than the non-compulsive exercisers.

The EAT was also used in the study by Penas-Lledo et al. (2002), who found that compulsive exercisers scored significantly greater than non-exercisers on total score of the EAT. Further, Penas-Lledo et al. looked at compulsive exercising within specific eating disorder diagnoses and their results demonstrated that compulsive exercising AN patients scored significantly greater than their non-exercising counterparts on bulimic and general eating symptoms, as measured by the EAT. Contrastingly, there was no association between the eating attitudes and exercising among BN patients.

Finally, the link between compulsive exercise and greater eating disorder psychopathology was further demonstrated by Shroff et al. (2006). The Shroff et al. (2006) study was the largest study in the review, with a sample of 1857 female eating disorder patients, and they reported that across the whole sample, compulsive exercise was significantly associated with greater severity of eating disorder symptoms. Specifically, they found that compulsive exercise was present in 39% of their participants, and that compulsive exercise was significantly more prevalent among the purging only type AN than any other eating disorder diagnosis.

Obsessive-Compulsiveness

There was a strong association found between compulsive exercise and obsessive-compulsiveness; both obsessive compulsive personality as well as obsessive compulsive symptoms. Davis and Claridge (1998) found that among their sample of female inpatients, obsessive-compulsive personality significantly predicted compulsive exercising, both currently and historically. Likewise compulsive exercisers reported significantly more obsessive-compulsive personality traits than non-compulsive exercisers within a sample of restricting-AN patients only (Davis & Kaptein, 2006). This finding was true also for both current and lifetime compulsive exercisers. Interestingly, this study also demonstrated that this relationship held regardless of nutritional status.

Compulsive exercisers also demonstrated significantly greater obsessive-compulsive personality traits than non-compulsive exercisers in a study of female eating disorder inpatients and outpatients (Davis et al., 1998). This finding was replicated in a later study with a similar sample (Davis, Woodside et al., 1999). The same conclusions were also supported among female adolescent patients with AN (Davis, Katzman et al., 1999). Using a structural equation modelling procedure, this study found that obsessive-compulsive personality predicted compulsive exercise attitudes.

Several studies also assessed the relationship between compulsive exercise and obsessive-compulsive symptoms. The overall results suggested similar findings to those studies who reported an association between compulsive exercise and obsessive-compulsive personality (e.g., Davis et al., 1998; Davis, Woodside et al., 1999). The study of Davis and Kaptein (2006) found that compulsive exercisers reported significantly greater obsessive-compulsive symptoms than the non-compulsive exercisers. Interestingly, the study also found that these obsessive-compulsive symptoms decreased between admission and discharge for both groups.

The same cross-sectional finding was replicated in the Davis et al. (1998) study. These results were later extended by Davis, Katzman, and colleagues (1999), who found that it was compulsive exercising AN patients that reported significantly higher obsessive-compulsive symptoms than both BN exercisers and non-exercisers, as well as AN non-exercisers. Finally, greater obsessive-compulsiveness was associated with compulsive exercise in an extensive study of female eating disorder patients (Shroff et al., 2006).

Anxiety

The link between exercise and anxiety is not new, as a wide array of literature has previously found exercise to be used for its anxiolytic properties (e.g., Salmon, 2001). This association was also found across the studies reviewed here, with five studies identifying a significant association between compulsive exercise and greater levels of anxiety (e.g., Holtkamp et al., 2004; Shroff et al., 2006). Further, Holtkamp et al. (2004) reported that anxiety significantly predicted physical activity level (compulsive exercise) in a regression model. Klein et al. (2004) also found an association between anxiety and level of compulsive exercise among their small sample of adult female eating disorder patients.

This association between compulsive exercise and anxiety was further strengthened by Penas-Lledo and colleagues (2002), who demonstrated that compulsive exercisers reported significantly greater anxiety than non-compulsive exercisers. Specifically, an effect of eating disorder diagnosis was also found for this relationship. The study found that anxiety was related to compulsive exercise among AN patients only, and not among BN patients. Interestingly, Brewerton et al. (1995) in their sample of both AN and BN patients did not find a significant difference between compulsive exercisers and non-compulsive exercisers on levels of anxiety. However, contrary to this, they did report that anxiety was significantly and positively correlated with exercise volume among the compulsive exercisers only, suggesting that anxiety was still related to compulsive exercise.

Psychological Morbidity

In addition to anxiety, compulsive exercise was also found to be correlated with more general psychological morbidity. Davis, Woodside et al. (1999) reported that on a global psychopathology score, compulsive exercisers scored significantly higher than their non-exercising counterparts. This association between compulsive exercise and psychological morbidity was also found when using different methodological designs. For example, when using an ecological momentary assessment design, Vansteelandt and colleagues (2007) showed that compulsive exercise, as defined as an urge to be physically active, was associated with chronic negative affect. Alternatively, in their qualitative study of compulsive exercisers, Bamber, Cockerill, Rodgers, and Carroll (2000) found that it was the combination of eating disorder pathology and compulsive exercising that appeared to be related to greater psychological distress, as opposed to eating disorder pathology or exercising alone.

Perfectionism

The recent multidimensional model of compulsive exercise purports that perfectionism is a maintaining factor for compulsive exercise (Meyer et al., in press; Taranis et al., in press). The studies reviewed here support the notion that perfectionism is associated with compulsive exercise. Shroff et al. (2006) noted that the compulsive exercisers in their large sample reported significantly greater perfectionism scores than non-compulsive exercisers. The same study also found that persistence, an often used indicator of perfectionism, was also reported in greater amounts among the compulsive exercisers than the non-compulsive exercisers.

More specifically, other studies have found that different aspects of perfectionism have been associated with compulsive exercise. Davis and colleagues (1998) found that it was self-orientated perfectionism that was significantly greater among the compulsive exercisers than among their non-exercising counterparts. A later study reported that compulsive exercisers scored significantly higher on neurotic perfectionism than the non-compulsive exercisers (Davis, Woodside et al., 1999). This type of perfectionism is characterised by setting high standards and being driven by an anxious fear of failure, which would be in line with the anxiety associations alluded to in the previous section of this review.

Depression

The use of compulsive exercise as a mood regulation strategy has been previously found among healthy participants (Salmon, 2001). This review of eating disorder patients also showed an association between mood and exercise, namely between depression and compulsive exercise. Bamber, Cockerill, and Carroll

(2000) found that one of the few distinguishable features between compulsive exercising and non-compulsive exercising eating disorder individuals was that of severe depression, with the former reporting a significantly higher score. Further support for this association with depression was identified by Penas-Lledo et al. (2002). In this study of eating disorder patients, they also found that the compulsive exercisers reported significantly greater depression than the non-compulsive exercisers.

Body Dissatisfaction

Two studies specifically reported body dissatisfaction as a feature associated with compulsive exercise. Brewerton and colleagues (1995) found that compulsive exercisers differed from non-compulsive exercisers on body dissatisfaction, with the former reporting significantly greater scores. This finding was replicated by Davis, Woodside et al. (1999), who found that compulsive exercisers had greater body disparagement (lower body esteem) than non-compulsive exercisers.

Addictiveness

Compulsive exercise associations with individual personality differences were also found among addictiveness scores. Both Davis and Claridge (1998) and Davis, Katzman et al. (1999) found that addictiveness predicted the extent to which patients reported compulsive exercise. This association with addictiveness appeared to be linked with greater compulsive exercise both currently and historically (Davis & Claridge, 1998).

Other Identified Correlates of Compulsive Exercise

A number of other correlates of compulsive exercise were also identified in this review. However, these factors were only measured in individual studies, and therefore require further replication. For example, compulsive exercisers demonstrated lower values than non-compulsive exercisers on levels of self esteem only in the study by Davis, Woodside et al. (1999).

Another finding reported in an individual study was in the study by Davis and Woodside (2002), which found an interesting relationship with anhedonia (lack of ability to experience pleasure). They reported that BN and weight-restored AN (i.e., EDNOS) exercisers had significantly greater anhedonia than their non-exercising counterparts. However, this difference was not found among the AN patients, who appeared to be highly anhedonic regardless of level of exercising.

Another correlate of compulsive exercise found in an individual study was that of narcissism, which was identified in the study by Davis, Woodside and colleagues (1999). Their study of female eating disorder patients showed that the compulsive exercisers scored significantly greater than the non-compulsive exercisers on a measure of narcissism. This personality variable difference was extended in the study by Bamber, Cockerill & Carroll (2000), who reported that compulsive exercisers only differed from individuals with eating disorders on a measure of venturesomeness. This finding was similar to that of Shroff and colleagues (2006) who found that compulsive exercisers scored significantly lower on novelty seeking than their non-compulsive counterparts.

Using a different theoretical approach, Blaydon and colleagues (2004) investigated the metamotivational characteristics of both highly active individuals and individuals with an eating disorder. They found that in either group, those individuals with compulsive exercise reported telic, arousal avoidance and pessimistic dominance. These characteristics are in line with the associations found in the other studies reviewed here. For example, a tendency to avoid problems is not unlike those with obsessive-compulsiveness, which was found to be associated with compulsive exercise in several studies (e.g., Davis et al., 1998; Davis & Kaptein, 2006). Additionally, the pessimistic dominance here is in line with the previous associations found between compulsive exercise and depression (e.g., Bamber, Cockerill, & Carroll, 2000; Penas-Lledo et al., 2002).

Risk Factors for Compulsive Exercise

The predominantly cross-sectional design of the studies precluded the ability to identify true risk factors for compulsive exercise. Only childhood exercise involvement and/or exercise prior to the onset of an eating disorder could be regarded as risk factors, given their temporal precedence by definition. Only three studies investigated these factors. First, Kron et al. (1978) investigated medical notes among eating disorder patients and found that greater activity prior to the eating disorder was linked with current compulsive exercise.

Second, Davis and colleagues (1997) compared compulsive exercising and non-compulsive exercising eating disorder patients. They found that compulsive exercisers reported significantly greater exercise in the 12 months prior to the acute phase of their eating disorder (i.e., prior to admission), than their non compulsive exercising counterparts. Specifically, this greater activity prior to the eating disorder was seen among the AN patients in the Davis et al. (1997) study, where the AN patients reported that their increased levels of exercising preceded their dieting. This finding extended to childhood activity, in the same study. For example, compulsive exercisers reported being significantly more active than the average girl during childhood, which was not reported by the non-compulsive exercisers.

Finally, a slightly different finding relating to childhood activity and current compulsive exercise was reported by Davis, Katzman et al. (1999). They found that childhood activity predicted current exercise behaviour but not compulsive exercise directly. However, ultimately, it would still appear that exercise prior to an eating disorder is associated with subsequent increased compulsive exercise.

DISCUSSION

The most frequently reported correlates of compulsive exercise in this review were greater eating disorder psychopathology, obsessive-compulsiveness (including personality and symptoms), psychological morbidity (including anxiety and depression), perfectionism, body dissatisfaction and addictiveness. Several other correlates were also identified in individual studies.

The association between eating psychopathology and compulsive exercising appeared to be stronger among AN than with BN patients. This could be due to the closer link between restrained eating and compulsive exercise (Holtkamp et al., 2004). This restraint and greater exercise link may be a product of the semi-starvation-induced hyperactivity seen in the acute phase of AN (Exner et al., 2000). However, the fact that many of the studies in this review did not find a difference in BMI between the compulsive and non-compulsive exercisers, would suggest that there is more to the association between compulsive exercise and eating disorder psychopathology, prior to the acute phase; i.e. it is not a result of the starvation. This is further supported by the finding that compulsive exercisers also reported significantly greater exercising prior to the onset of their eating disorder than was reported by the non-compulsive exercisers (e.g., Davis et al., 1997).

The subsequent associations identified were invariably correlates rather than risk factors. Given that the samples were eating disorder patients, then many of these associations could simply be describing maintenance factors rather than true risk factors that have an impact on the prior development of compulsive exercise. Perfectionism and anxiety, for example, link in to the multidimensional model of compulsive exercise (Meyer et al., in press) and its suggested maintenance factors of high standards, self criticism, and negative affect.

This review demonstrates that the existing literature is largely scarce in variety, with the majority of studies employing cross-sectional designs. Nonetheless, the associations found among these studies do help to build a preliminary model of risk factors for compulsive exercise. Interestingly, no environmental factors were identified as either correlates or risk factors of compulsive exercise in this review. This may be due to the limited number of studies that actually assessed socio-cultural and/or environmental factors. In fact, it would be worthwhile for future investigations to examine the association between compulsive exercise and specific types of environments, to identify whether certain situations are additional risk factors for its development. Moreover, it would be useful to find out how the individual correlates, found in this review, interact with specific environments to produce greater compulsive exercising attitudes and behaviour.

The results suggest that individuals with a predisposing personality type would be at greater risk of developing compulsive exercise than those without these specific personality traits. These predisposing factors of obsessive-compulsiveness, perfectionism, and addictiveness do not always lead to compulsive exercise (there are relatively few people with these characteristics who actually develop compulsive exercise). Instead, these personality traits could be interacting with the individual’s environment (and/or culture), which could then lead to compulsive exercise.

It is unknown which types of environment may be regarded as a greater risk factor for compulsive exercise. In the case of eating disorder pathology, invalidating childhood environments have been shown to be associated with the eating disorders (Haslam, Mountford, Meyer, & Waller, 2008). Hypothetically, in the case of exercise, a child who has an underlying tendency towards perfectionism, and suffers from an anxious drive to achieve, may be likely to engage in greater childhood activity if his/her family judged self-worth by sporting achievement and/or competence. This greater activity, and its underlying motivation, could lead to the subsequent compulsive exercise if the unhealthy environmental and cultural factors are not attenuated.

The results also demonstrate the potential causes of compulsive exercise through additional routes, namely through eating disorder psychopathology and psychological morbidity. It is still unclear whether compulsive exercise occurs prior to an eating disorder or whether it is caused by the disordered eating. The studies reviewed here did suggest that excessive exercising did occur before the onset of the eating disorder (Davis et al., 1997; Kron et al., 1978), which concurs with other research that found that among a sample of eating disorder patients, 60% of them reported that their exercising concerns began prior to any dieting (Davis et al., 1994). However, maintenance models also point to the deleterious effect of eating disorder psychology on exercising, through the effects of starvation (Hebebrand et al., 2003). Therefore, it could be that an individual could still develop compulsive exercise as a result of an eating disorder.

The causative effect of an eating disorder on compulsive exercise may also be due to the underlying motivation of compulsive exercise as a mood regulator. The additional psychological morbidity associations found within this review could be a result of the compulsive exercise and eating disorder psychopathology in combination. However, the psychological morbidity may also have been present prior to the eating disorder. In other words, the person may have been particularly prone to anxiety and depression, and they may have turned to exercise to manage their negative affect. This reliance on exercise could become problematic if it is their sole coping strategy, as exercise will simply provide a short term alleviation from the negative state, and the true cause of the anxiety (e.g., body dissatisfaction) will persist.

Many of these suggested links are simply hypotheses, which need to be specifically targeted by researchers. More studies are needed that utilise a longitudinal and experimental design to reliably examine and identify the risk factors for compulsive exercise. This will help further the understanding of the chronological development of compulsive exercise and hopefully help increase the chances of prevention of both compulsive exercise and eating disorder pathology.

Finally, it must be noted that the findings here could in theory apply to both male and female patients. However, as the samples in the studies reviewed here demonstrated, the vast majority of research in this area is conducted using female-only samples. Studies looking at male patients are warranted to see whether gender differences exist in the development of compulsive exercise. Admittedly, it is probably harder to recruit sufficient numbers for male samples, given the paucity of male patients in eating disorder clinics. Nonetheless, the prevalence of eating disorders among males is a substantial minority (Striegel-Moore et al., 2009) and often it is reported that they do indeed have exercising elements to their pathology (Anderson & Bulik, 2004; Lewinsohn, Seeley, Moerk, & Striegel-Moore, 2002). Therefore, risk factor research into compulsive exercise should attempt to analyse both men and women.

Conclusion

The key findings from this systematic review suggest that compulsive exercise is a significant feature of the eating disorders that is associated with greater eating disorder psychopathology, greater psychological morbidity, and specific personality differences (e.g., obsessive-compulsiveness and perfectionism). The studies reviewed here demonstrate that compulsive exercise is more likely to be present among AN patients than among the other eating disorder diagnoses. It is repeatedly linked with obsessive-compulsive symptoms, obsessive-compulsive personality, perfectionism, and anxiety. Compulsive exercise is also predicted by greater childhood activity prior to the onset of an eating disorder. Ultimately, this review points to the need for further research into compulsive exercise in order to increase the understanding of its aetiology and to provide better prevention options.

1.4.2.1Summary

The systematic review, reported above, highlighted several key correlates and possible risk factors for compulsive exercise. The systematic review only focused on clinical eating disorder samples, where the compulsive exercise was definitely an element of the disorder. However, there may be potential risk factors that disappear once a clinical eating disorder has occurred and so it is important to also look at the possible risk factors and correlates of compulsive exercise in the general population as well. Further, as was also highlighted in the definitions section (see 1.3.1), there are many terms in the wider literature (i.e., beyond eating disorders) that could include elements of compulsive exercise, which may have been missed by the systematic review. These studies which have used different terminology for compulsive exercise have used a variety of samples, including exercisers, runners and university students (Hausenblas & Symons Downs, 2002a; Ogden et al., 1997; Pasman & Thompson, 1988). Therefore, it is necessary to review this more general literature to build upon the findings of the systematic review, which only included studies that had clinical eating disorder samples.

Various comorbidities have been linked to the eating disorders, such as depression, personality disorders, mood instability, and anxiety disorders (see Reijonen et al., 2003). Although there are gender differences in the prevalence of eating disorders (APA, 2000), it has been shown that the same gender differences do not exist in the types of psychosocial problems that are associated with eating disorders (Woodside et al., 2001). Therefore, the literature will be reviewed applying to both genders. Any gender specific findings will be highlighted in each section, where necessary.

Finally, in the absence of risk factor research for compulsive exercise this review will draw upon studies that have suggested possible risk factors for the eating disorders in general. These suggested risk factors will then be considered and hypothesised to apply to compulsive exercise where appropriate.

1.5 Possible Risk Factors for Compulsive Exercise: Review of the Wider Literature

The following sections will be categorised based on the suggested aetiological categories for the eating disorders, noted by Reijonen and colleagues (2003). A model that proposes the key risk factors for compulsive exercise will be developed for each of these categories (with the exception of physiological risk factors; see 1.5.1.1). After these separate models have been created, they will be amalgamated to form a complete risk factor model for compulsive exercise, which will form the basis of the research in this thesis. The links in this final model will be tested in the studies that are subsequently reported in this thesis.

1.5.1 Physiological risk factors

In the addiction literature, it has been proposed that exercise mimics the actions of opiate drugs (such as, morphine, codeine, and heroine) (Boecker et al., 2008). Exercise acts as a stimulant in that it causes physiological arousal in the brain, it alters short term mood, and facilitates a feeling of euphoria or, as it is known “runners high” (Boecker et al., 2008). This high that exercisers get is similar to the feelings experienced by people who take opiates and can be referred to as an addiction (Chapman & De Castro, 1990). Like other addictions the person can tolerate the exercise and then they must increase the frequency to get a similar high (Veale, 1987). Also, similar to substance dependence, exercise is continued despite injury or pain. However, as defined earlier, compulsive exercise in the eating disorders literature appears to be less of an addiction and more aligned to a compulsive behaviour that is performed because of feelings of guilt when it is not carried out (Adkins & Keel, 2005; Mond et al., 2006).

Certainly, for eating disordered individuals there are physiological underpinnings of compulsive exercise, which appear to be framed at the clinical end of the eating disorders spectrum. Holtkamp et al. (2004) proposed that anxiety and food restriction work synergistically to create a self-perpetuating cycle of dieting and exercise that is maintained. This self-perpetuating form of compulsive exercise has been termed activity-based anorexia (Epling & Pierce, 1988), or semi-starvation-induced hyperactivity (Exner et al., 2000). It has been found in several animal studies, and has been translated to AN sufferers (Hebebrand et al., 2003). The mechanisms are still debated, but it appears that lower levels of leptin, associated with prolonged caloric restriction, plays a role in contributing to this paradoxical hyperactivity (Exner et al., 2000). This suggestion of the role of hypoleptinemia is supported by the fact that the hyperactivity returns to normal levels once weight (and therefore leptin) is restored (Hebebrand et al., 2003).

This form of compulsive exercise is clearly apparent in the eating disorders, and is certainly a viable cause of compulsive exercise once an eating disorder has already developed. It is also an extremely viable reason as to why compulsive exercise is maintained during treatment in the eating disorders, even after psychological treatment has been attempted. However, this thesis is concerned with the aetiology of compulsive exercise, where it occurs at an earlier age, and among healthy adolescents, where a clinical eating disorder is not already present. Therefore, it would appear that biological factors are less important in the aetiology of compulsive exercise than psychological and environmental factors (e.g., obsessive-compulsiveness; Davis et al., 1997). Consequently, for the rest of this thesis, the focus will be on psychological and socio-cultural risk factors for compulsive exercise.

1.5.2 Psychological correlates and risk factors

The following section reviews the literature on possible psychological correlates and risk factors for compulsive exercise. The hypothesised psychological links with compulsive exercise have been summarised in Figure 1.1.

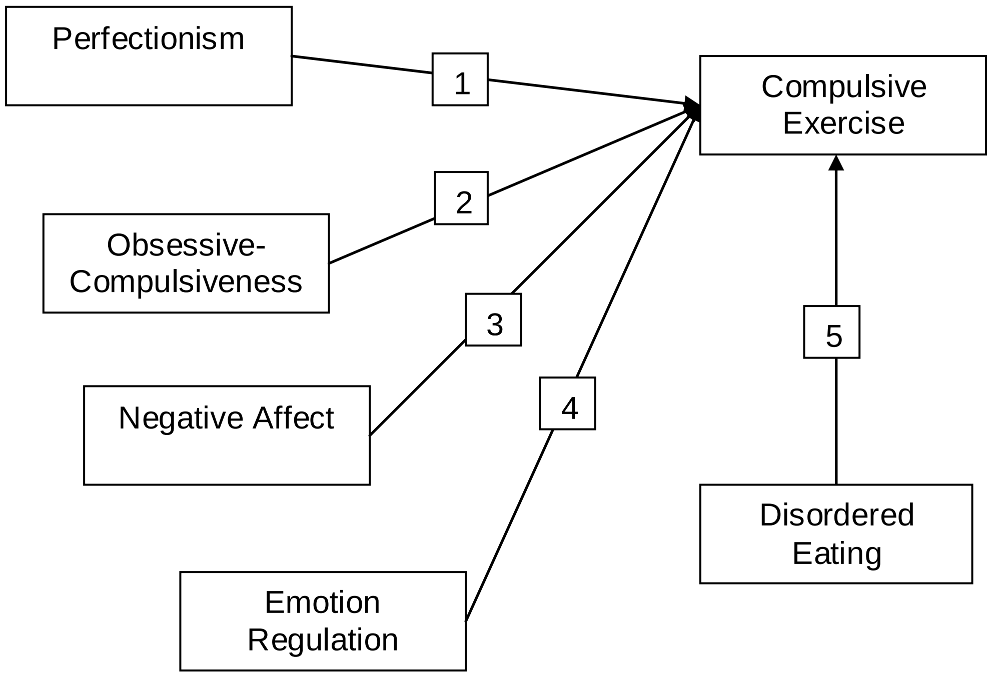


Figure 1.1 Hypothesised psychological correlates and risk factors for compulsive exercise

1.5.2.1Perfectionism

There has been a wealth of research investigating the link between perfectionism and eating disorders (for review, Franco-Paredes, Mancilla-Diaz, Vazquez-Arevalo, Lopez-Aguilar, & Alvarez-Rayon, 2005). Perfectionism has been reported as a risk factor for both AN (Tyrka, Waldron, Graber, & Brooks-Gunn, 2002) and BN (Fairburn et al., 1998), as well as being reported as an antecedent to obligatory exercise (Coen & Ogles, 1993) and exercise dependence (Hagan & Hausenblas, 2003).

However, the results are not entirely conclusive. For example, an investigation into eating disorder profiles of obligatory exercisers found that perfectionism did not differ between the obligatory and non-obligatory exercisers (Matheson & Crawford-Wright, 2000). However, this study used the Eating Disorder Inventory (Garner, Olmsted, & Polivy, 1983) Perfectionism subscale, which has often failed to discriminate between eating disorder patients and normal controls (Franco-Paredes et al., 2005). Therefore, it could be the case that the Eating Disorder Inventory Perfectionism subscale is not sensitive enough to assess the multidimensional nature of perfectionism in both an eating disorder (Franco-Paredes et al, 2005) and compulsive exercise context.

Indeed, the perfectionism construct is often regarded as multidimensional in nature (Frost, Martin, Lahart, & Rosenblate, 1990). Different types and dimensions of this construct have been identified, with the two types most often cited being self-orientated perfectionism and socially-prescribed perfectionism (Hewitt & Flett, 1989). When measured as a multidimensional construct, it has been shown that some components of perfectionism are more strongly linked to certain types of eating pathology than other components (Forbush, Heatherton, & Keel, 2007). Specifically for compulsive exercise, Hall, Kerr, Kozub, and Finnie (2007) recently studied motivational antecedents of obligatory exercise and found that perfectionism was certainly linked with obligatory exercise. For men, the pursuit of achievement goals and perfectionistic standards led to obligatory exercise, whereas in women it was more of a neurotic perfectionism that seemed to cause excessive exercise behaviour. In other words, among women, an avoidance of failure and its subsequent impact upon self-worth appears to be more prominent in their motivation to exercise excessively. Either way, for both men and women, perfectionism could be an important risk factor for compulsive exercise. Therefore, perfectionism has been included in the psychological risk factors model for compulsive exercise (see Figure 1.1, arrow 1).

1.5.2.2 Obsessive-compulsiveness

Obsessive-compulsiveness has been strongly linked with compulsive exercise in both clinical and non-clinical eating disorder samples. For example, Wyatt (1997) showed that obligatory exercise was related to obsessive-compulsiveness in a sample of health club exercisers. In a study of a clinical eating disorder sample, obsessive-compulsiveness was related to weight preoccupation and excessive exercise (Davis & Claridge, 1998). In studies that have used the term ‘exercise dependence’, obsessive-compulsiveness (Adams & Kirkby, 1998) and rigidity (Adams, Miller, & Kraus, 2003) have been proposed as common characteristics of exercise dependent individuals. A recent model proposed that obsessive-compulsiveness was one of two key variables in the development of obligatory exercise (Thome & Espelage, 2007). This model was based on a previous study, which found that obsessive-compulsiveness was strongly linked with the development and maintenance of eating disorders (Davis, 1999). This close link with eating disorders is often cited, so much so that some authors have suggested that both behaviours (eating disorders and compulsive exercise) are the result of an underlying obsessive-compulsive disorder (Davis & Kaptein, 2006; Eisler & le Grange, 1990).

Contrary to the majority of the prevailing literature, one study has actually found no relationship between compulsive exercise and obsessive-compulsiveness. Specifically, Iannos and Tiggemann (1997) found no link between obligatory exercise attitudes and obsessive-compulsiveness amongst a non-clinical sample of gym users. However, this may have been due to methodological weaknesses, namely that they used a non-validated measure of obligatory exercise. Secondly, they distinguished compulsive exercisers from non-compulsive exercisers based on exercise volume. This method of categorising compulsive exercise based on purely behavioural volume has been shown to be rather inaccurate (Ackard et al., 2002), and instead the multidimensional attitudinal measures that capture the emotional element of compulsive exercise appears to be more valid (de la Torre, 1995). Ultimately, obsessive-compulsiveness does appear to be a prominent personality variable that could influence the development of compulsive exercise, and as such it has been included in the psychological risk factor model for compulsive exercise (see Figure 1.1, arrow 2).

1.5.2.3Negative affect

The effects of a cessation of exercising amongst regular exercisers include negative mood states, such as, anxiety, depression, and guilt (Hausenblas & Symons Downs, 2002b). Importantly, though, two other studies have found negative affect, in its various forms, to be related to continued exercise and not simply as a resultant state after exercise deprivation. First, Coen and Ogles (1993) found that obligatory exercisers scored higher on anxiety than non-obligatory exercisers. Second, Ricciardelli and McCabe (2003a) found body change strategies to be related to negative affect in boys. These body change strategies included exercise, as well as disordered eating patterns.

A cognitive-behavioural approach to compulsive exercise (Loumidis & Roxborough, 1995) suggests that individuals will have underlying personality styles for rule development, but that dysfunctional rules will develop out of stressful life events. This short term fix of a negative mood may develop into long term compulsive behaviour if a tolerance is developed and if no other coping strategies are sought nor found (Adams et al., 2003). This would suggest that negative affect, including anxiety, is important in the development and maintenance of compulsive exercise.

Individuals classified at ‘high risk’ for developing eating disorder symptomatology also reported greater emotional problems than a ‘low risk’ group (Steinhausen, Gavez, & Metzke, 2005). Additionally, specifically looking at depression, Gardner, Stark, Friedman, & Jackson (2000) conducted a longitudinal study investigating the predictors of eating disorder scores of boys and girls between the ages of 6 through to 14 years. They found, among other variables, that depression was the strongest predictor of later eating disorder scores for both boys and girls.

This importance of depression in eating disorder pathology has not been widely replicated in relation to compulsive exercise. The few studies that have investigated it have found that compulsive exercise is indeed related to greater levels of depression (Penas-Lledo, et al., 2002; Yates, Leehey, & Shisslak, 1983). This association is not surprising, given the mood-altering effects of exercise (Yeung, 1996), and of the efficacious role exercise has played in treating depression (Daley, 2007). However, the specific research on compulsive exercisers has been limited and warrants further investigation to identify whether negative affect, specifically anxiety and depression, are risk factors for compulsive exercise. This negative affectivity has been included as a risk factor for compulsive exercise (see Figure 1.1, arrow 3), and will be tested empirically in this thesis.

1.5.2.4 Social physique anxiety

Women with eating disorder behavioural tendencies are more likely to be fearful of negative evaluation and have greater sensitivity to the impressions of others than women without eating disorder symptoms (Mack, Strong, Kowalski, & Crocker, 2007a). However, a meta-analytic review also found that among more general populations, appearance-related social comparisons were associated with greater body dissatisfaction (Myers & Crowther, 2009). This tendency to negatively evaluate other people's impression of oneself can lead to general social anxiety (Rapee & Heimberg, 1997), which has been implicated in the development of eating disorders (Halmi et al., 1991).

Specific to compulsive exercising, social comparisons have been shown to have a stronger impact on adolescent boys' exercising than on their eating (Ricciardelli, McCabe, & Banfield, 2000). These authors found that around 43% of boys reported that social comparisons were responsible for their exercise patterns to alter their body size or shape, whereas only 19% said that social comparisons had the same effect on their eating. This suggests that for boys at least, social comparisons are important in potential compulsive exercise behaviours. This would be particularly true of someone who experienced greater social physique anxiety.

Previous research has also found that social physique anxiety, a body specific form of social anxiety, is positively related to greater exercise frequency (Frederick & Morrison, 1996). Importantly, this social physique anxiety has also been linked with exercising for appearance-related reasons, as opposed to exercising for health and fitness (Brown, unpublished), which has been associated with greater eating disordered attitudes (Hubbard, Gray, & Parker, 1998). Therefore, social physique anxiety could represent a potential risk factor for both disordered eating symptoms (Thompson & Chad, 2002), as well as for compulsive exercise, particularly, weight control exercise (Taranis et al., in press). However, no study has specifically focused on the role of social physique anxiety in the development of compulsive exercise. Therefore, social physique anxiety will be tested in this thesis for its association with compulsive exercise. It has been included in the psychological risk factors model of compulsive exercise under the general term of negative affect (see Figure 1.1, arrow 3), although it will be tested specifically in subsequent studies in this thesis.

1.5.2.5Emotion regulation

Emotion regulation has been studied in the eating disorder literature, as well as the compulsive exercise literature. For example, maladaptive coping strategies to deal with stress and manage emotions have been linked to disordered eating (Troop, Holbrey, Trowler, & Treasure, 1994). Specifically, one key strategy found to discriminate between a non-clinical and an eating disorder group of women based on their coping styles was that of avoidance of negative affect (Corstorphine, Mountford, Tomlinson, Waller, & Meyer, 2007), with the eating disorder individuals reporting significantly greater avoidance of affect. The emotion regulation relationship with compulsive exercise has received less attention than its association with eating disorders, even though exercise has been linked to mood regulation for its anxiolytic properties (Salmon, 2001). A preliminary study has found that eating disorder related exercise is more compulsive with those who have a tendency to avoid negative affect (Meyer & Taranis, 2007). Thus, it would appear that those who have an inability to manage negative affect, and instead choose to avoid it, perhaps exercise compulsively as a means of avoidance. This would be in line with the attentional biases findings of Engel and colleagues (2006). In their experimental study of female students, these authors found that avoidance of body/shape words appeared to be related to the development of eating disorder attitudes. Furthermore, early studies found that exercise dependence can result from an avoidance of other stressful life problems (Morgan, 1979; Zaitz, 1989). Warner and Griffiths (2006) also found this to be true, with some compulsive exercising participants reporting stress relief as a key driving force behind exercising. However, although compulsive exercise is theorised to be related to the regulation of emotions, it is unknown whether specific emotion regulation styles represent risk factors for the development of compulsive exercise, and therefore, these will be tested empirically in this thesis (see Figure 1.1, arrow 4).

1.5.2.6Disordered eating attitudes and body dissatisfaction

Disordered eating attitudes, encompassing weight and shape concerns, are distinct from clinical eating disorder symptomatology as they are regarded as occurring premorbidly, and as such, have been presented as key risk factors for clinical eating disorders (e.g., body dissatisfaction; Stice & Shaw, 2002). Disordered eating and weight and shape concerns have also been closely linked with compulsive exercise. For example, Lipsey et al. (2006) found that a commitment to exercise was associated with eating disorder psychopathology, while Matheson and Crawford-Wright (2002) found compulsive exercisers and individuals with disordered eating to report similar psychological profiles. More recently, in a non-clinical sample, compulsive exercise has been significantly associated with disordered eating attitudes and behaviours (Taranis & Meyer, 2010).

In addition, a negative body image has also been seen to be predictive of later eating pathology (Attie & Brooks-Gunn, 1989; Stice, 1998) and of general weight restricting behaviours (Donovan, Spence, & Sheffield, 2006). Further, it has been proposed that body dissatisfaction is the most robust risk factor for maladaptive eating patterns (Stice, 2001). In a longitudinal study investigating stress, coping, and disordered eating, body dissatisfaction was the only variable that predicted disordered eating longitudinally (Ball & Lee, 2002). The literature appears unequivocal in its message that a negative body image is of great importance in the development of eating disturbances (e.g., Attie & Brooks-Gunn, 1989; McVey, Pepler, Davis, Flett, & Abdolell, 2002).

Specifically, in relation to a compulsive exercising, a commitment to exercise also has been found to be positively related to body dissatisfaction (Martin & Hausenblas, 1998). However, few studies have investigated the direct link between body dissatisfaction and compulsive exercise. It is conceivable that an individual who is dissatisfied with their weight and shape would partake in physical activity with a view to altering their appearance and reducing their dissatisfaction. For someone with an enduring negative body image, this dissatisfaction may not be removed and, as such, the exercise patterns may gradually increase until it becomes compulsive. Indeed, McCabe and Ricciardelli (2004a) found that among late maturing girls, exercise dependence was directly predicted by body dissatisfaction. Further to this finding, previous work has suggested that obligatory exercise in women stems from body dissatisfaction (Imm & Pruitt, 1992), even in the absence of an eating disorder.

This importance of disordered eating attitudes and body dissatisfaction as a risk factor for compulsive exercise needs to be tested empirically, and they have been included in the psychological risk factors model for compulsive exercise under the term disordered eating (see Figure 1.1, arrow 5).

1.5.3 Socio-cultural correlates and risk factors

The following section reviews the literature for possible socio-cultural correlates and risk factors for compulsive exercise. These hypothesised links have been summarised in Figure 1.2.

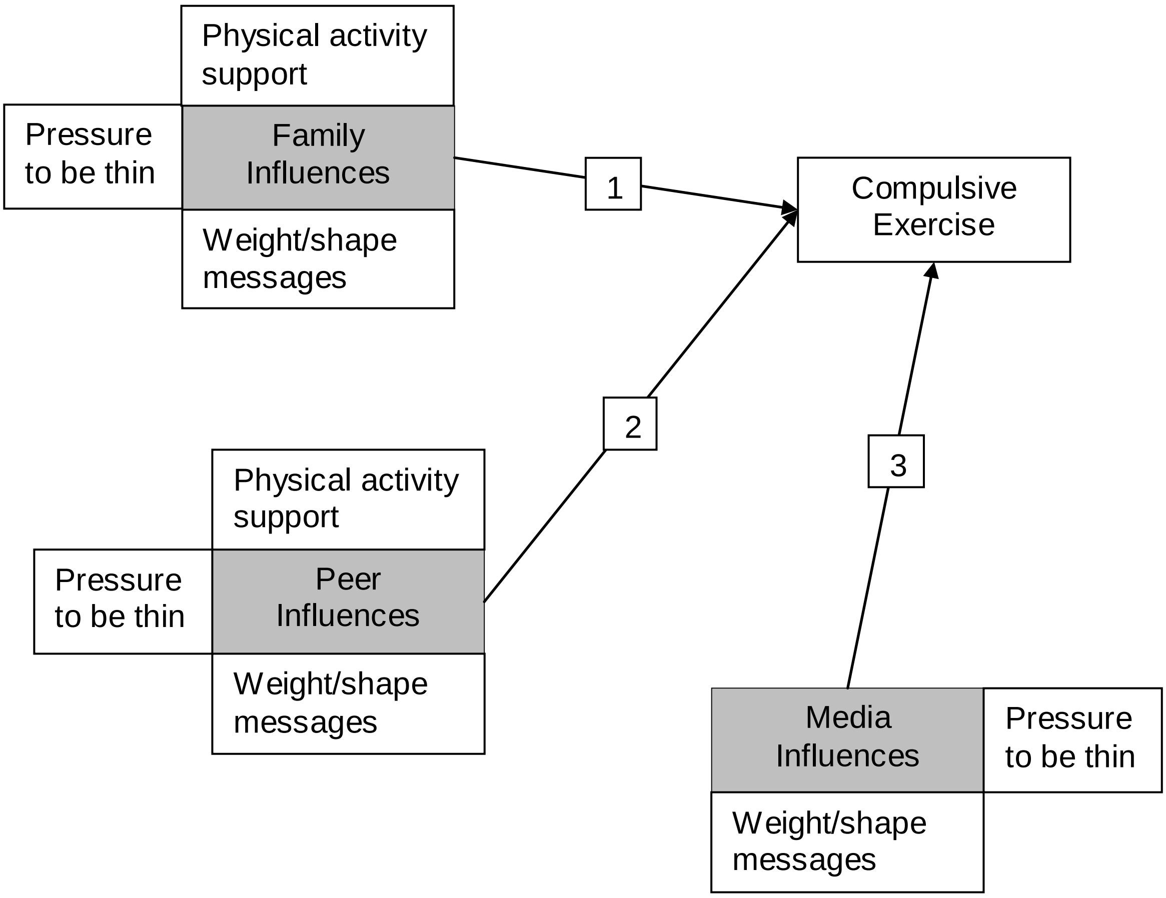


Figure 1.2 Hypothesised socio-cultural correlates and risk factors for compulsive exercise

1.5.3.1Family influences

Family influences have been reported as being risk factors for the subsequent development of eating disorders (Leon, Fulkerson, Perry, & Dube, 1994). For example, girls have been shown to engage in greater unhealthy weight control practices when their mother is dieting and is overly concerned with their weight and shape (Hill & Franklin, 1998). This transference of negative behaviour and concerns from parents to adolescent has also been reported in boys, where both boys' and girls' weight concerns were affected by their parents' comments (Smolak, Levine, & Schermer, 1999).

Many of these parental influences are examined in relation to eating disordered behaviours, weight control practices, or weight and shape concerns. In relation to compulsive exercise, though, little research has been conducted. A recent study that did investigate the socio-cultural correlates of compulsive exercise found that perceived pressure to lose weight and to build muscle were related to a compulsive need to exercise in boys and girls (White & Halliwell, 2010). However, it was not stipulated whether these pressures specifically came from the family or the media and society as a whole.

Currently, therefore, any specific potential link between compulsive exercise and parental influences comes from a combination of the eating disorder literature and the physical activity literature. For example, in the eating disorder literature, it has been found that adolescent girls exhibiting greater eating disturbances reported having mothers who were more critical of their weight and appearance than girls without disturbed eating behaviours (Pike & Rodin, 1991). Further, Attie and Brooks-Gunn (1989) found that the vulnerability to developing eating problems amongst adolescents was associated with a less cohesive and less supportive family. Specifically, early research also found that girls in environments that emphasised weight and appearance experienced greater pressures to be thin (Brooks-Gunn, Burrow, & Warren, 1988; Pike & Rodin, 1991). Given that during pubertal onset, adolescent girls increase their fat stores and that this increase in body fat is often associated with greater desires to be thinner (Dornbusch et al., 1984), a further social pressure from the child's family would likely increase the individual's efforts to control and reduce their weight and shape. This may manifest as disordered eating patterns or alternatively as compulsive exercise patterns.

Specifically, although general family influences could be important in the development of compulsive exercise, Laliberte et al. (1999) found that statistically, a family focus on appearance was a more powerful predictor of disturbed eating than other family processes. This relationship between family focus around weight and shape and compulsive exercise has not been previously examined. However, it would appear that the family's attitudes towards weight, shape and appearance could be an important contextual factor in the development of compulsive exercise as well as eating disorders.

In the general exercise literature, parents have been shown to influence their child's physical activity both directly and indirectly (e.g., Sallis, Prochaska, & Taylor, 2000; Welk, Wood, & Morss, 2003). Trost and colleagues (2003) pointed to the importance of parental beliefs and general support, rather than actual parental activity behaviour in determining the child's activity levels. This importance of parental exercise attitudes has often been overlooked in preference for a simple measure of their activity behaviour (Trost et al., 2003). However, children can model their parents and may be supported or discouraged to be active by parental attitudes related to exercise (Baranowski, 1997). Davison (2004) found that adolescents who were more active reported greater amounts of support, including general familial support and sibling support, and also parental logistic support around their exercise. This study investigated these relationships from a population inactivity perspective, with the view of identifying factors that may lead to inactivity. However, the same relationship could arguably affect individuals at risk of over-activity, i.e., high activity involvement of parents may lead to greater activity amongst their offspring. However, this parent-child interaction around exercise has never been investigated as a risk factor for compulsive exercise, even though parents have been seen to have a strong influence on their child's physical activity in the general exercise psychology literature (e.g., Davison, Cutting, & Birch, 2003; Trost et al., 2003). Consequently, the level of parental and sibling support in relation to physical activity will be examined in this thesis as a possible risk factor for compulsive exercise.

In summary, little is known about family influences on the development of compulsive exercise. More evidence exists on the importance of a functional, supportive family for the protection from eating disorders (e.g., Attie & Brooks-Gunn, 1989) than on compulsive exercise. Given the close relationship that exists between compulsive exercise and the eating disorders (Taranis & Meyer, 2010), and the influence of parents on a child's normal exercise levels (Davison, 2004), it could be suggested that there is a familial influence on the development of compulsive exercise. Indeed, Ricciardelli et al. (2000) reported that boys who received more exercise messages from fathers also engaged in more exercise to alter body shape and size. Therefore, family messages around weight and shape, as well as parental activity support may be risk factors for compulsive exercise (see Figure 1.2, arrow 1). These will be tested empirically in this thesis.

1.5.3.2Peer influences

The influence of peers on adolescent dieting and weight and shape attitudes has been previously established (e.g., Hutchinson & Rapee, 2007;

Lieberman, Gauvin, Bukowski, & White, 2001; Stice & Agras, 1998). However, compared to the family, the peer environment has received less attention in the literature (Hutchinson & Rapee, 2007). In relation to compulsive exercise, specifically, little to no research has been conducted. However, peers could represent a key socio-cultural risk factor for compulsive exercise, as Shroff and Thompson (2006a) suggested that friend and peer influence could be potential risk factors for body image, eating disturbance and self-esteem.

Likewise, adolescents have felt greater pressure to be thin from peers than from other sources of influence, such as family and the media (Stice, 1998). Stice (1998) also found that it was peer (and not media) influence that predicted bulimic behaviour in his sample of adolescent girls. Dieting behaviour has also been associated with peer discussions around dieting as well as with perceived peer dieting behaviours (Wertheim, Paxton, Schutz, & Muir, 1997). Consequently, the socio-cultural messages around weight and shape may also come from peers in addition to the family and these too could represent a risk factor for compulsive exercise (see Figure 1.2, arrow 2).

Additionally, similar to the potential family influences on exercise behaviour, the activity support that an adolescent receives from their peers may also affect their level of exercise (Davison, 2004). Therefore, the effect of a peer group that is active and supports the individual around their exercise behaviour will also be examined for its relationship with compulsive exercise attitudes (see Figure 1.2, arrow 2).

1.5.3.3Media influences

The media has been shown to influence adolescent weight concern and weight control practices (Field et al., 2001). Field and colleague's study (2001) found that among both boys and girls, adolescents' attempts to look like their same-sex 'idols' in the media predicted subsequent weight concerns and regular dieting behaviour. It is the Western culture of the "thin ideal" that the mass media encourages, which leads adolescent girls to also form unrealistic ideals about their body weight and shape (Field, Camargo, Taylor, Berkey, & Colditz, 1999). This 'internalisation' of the thin ideal can be a risk factor for the development of eating disorder pathology (Thompson & Stice, 2001; Shroff & Thompson, 2006b), although it has not been tested for its effect on the development of compulsive exercise. One study that did look at general socio-cultural influences on compulsive exercise did report a significant correlation between pressure to lose weight and build muscle with compulsive exercise in both boys and girls (White & Halliwell, 2010). Therefore, it is possible that the media messages around weight and shape, and the pressure that the individual feels to be thinner could lead the adolescent to engage in greater amounts of exercise and therefore it could conceivably be a risk factor for compulsive exercise (see Figure 1.2, arrow 3). These weight and shape messages and the pressure felt from the media to be thin will be tested in this thesis.

1.5.4 Behavioural correlates and risk factors

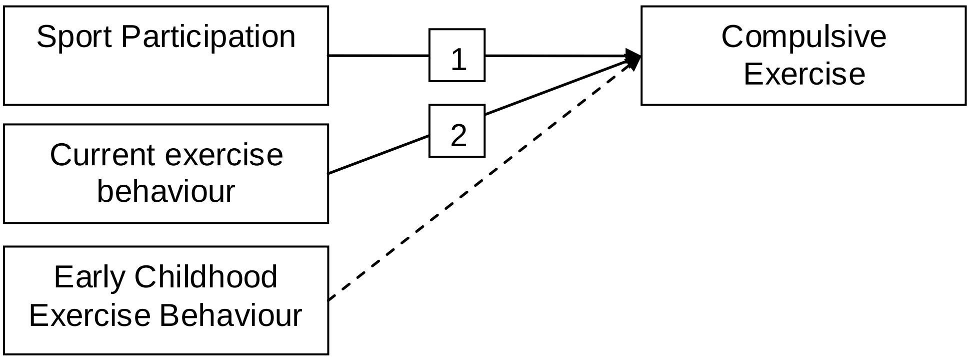


Figure 1.3 Hypothesised behavioural correlates and risk factors for compulsive exercise

Engagement in exercise and sport often precedes dieting and subsequent eating disorders (Davis et al., 1994, 1997; Davis, Blackmore, Katzman, & Fox, 2004). For example, a significantly higher number of women with eating disorders were found to be competitive athletes before developing an eating disorder (Davis & Strachan, 2001). This emphasis, or rather over-emphasis, on sport has sometimes been proposed as the motivation behind physical activity amongst many eating disorder individuals (Davis, Fox, Cowles, Hastings, & Shwass, 1990), and therefore, could act as a potential risk factor for the development of compulsive exercise. The cross-sectional association between compulsive exercise and sport participation needs to be explored, and therefore, will be tested in this thesis (see Figure 1.3, arrow 1). General exercise behaviour will also be tested to identify the association between compulsive exercise cognitions and exercise behaviour (see Figure 1.3, arrow 2)

An additional behavioural risk factor for compulsive exercise is that of childhood exercise behaviour (e.g., Davis et al., 1994). However, it is beyond the scope of this thesis to measure early childhood activity, and therefore it is only represented in Figure 1.3 with a dotted line, as it will not be tested in the current thesis. It could be possible to measure it retrospectively, but this could be subject to reporter bias and poor memory recall (Striegel-Moore & Bulik, 2007). Certainly, it has been advocated that risk factor research be conducted using prospective, as opposed to retrospective, designs (Jacobi et al., 2004). Therefore, childhood activity will not be measured in this thesis, although it was still included in this model (Figure 1.3) given its apparent importance in the development of compulsive exercise (see 1.4.2).

1.5.5 Conclusions

The systematic review, as well as the general literature review, has revealed several key factors that could be implicated in the development of compulsive exercise. These factors have been separated into psychological and socio-cultural factors, as well as reinforcing behavioural factors, and have previously been tested to varying levels in the literature. For example, the recent socio-cultural model of excessive exercise did propose that perceived pressure to lose weight and to build muscle were related to a compulsive need to exercise (White & Halliwell, 2010). This study was one of the first socio-cultural models of compulsive exercise and its findings are promising. Nonetheless, the study only used a cross-sectional design and also did not stipulate the source of the hypothesised pressures (e.g., whether it was from the family, peers, or the media). Therefore, the socio-cultural model of compulsive exercise needs to be expanded and tested longitudinally. Likewise, the psychological factors of perfectionism and obsessive-compulsiveness have been widely associated with compulsive exercise but these too need to be examined for their risk factor status related to compulsive exercise. The following model, therefore, incorporating psychological, socio-cultural, and behavioural factors, has been created with the aim of subsequently testing these associated links with the new multidimensional conceptualisation of compulsive exercise being used in this thesis (Taranis et al., in press).

1.6 A Proposed Risk Factor Model for Compulsive Exercise

Early detection of eating disorders and compulsive exercise is important to improve the outcome of the illness (Hsu, 1996; Rome et al., 2003). The existing literature on problematic exercising in the eating disorders has been plagued by a plethora of methodological and definitional approaches (Shroff et al., 2006). More recently, this symptom of the eating disorders has been defined in an affective and cognitive conceptualisation, incorporating several key features that make up overall compulsive exercise (Taranis et al., in press). It is suggested that all features are important in the compulsive exercise definition, although the key elements in relation to the eating disorders appear to be avoidance and rule-driven behaviour and weight control exercise (Taranis & Meyer, 2010). This supported previous work, which found that the experience of intense guilt when missing exercise and exercising solely or primarily for weight control were the two key exercise factors that distinguished between women with an eating disorder and a healthy comparison group (Mond & Calogero, 2009). However, the aetiology of this compulsive exercise has not been established. Therefore, based on the systematic review of compulsive exercise in eating disordered populations (see 1.4.2), together with the more general review of the wider literature incorporating non-clinical findings (see Figures 1.1 – 1.3), a risk factor model of compulsive exercise has been created, which can be seen in Figure 1.4.

The model has several hypothesised links (numbered) and these are the links that will be tested in the thesis (see 1.7.1). Additional links between the factors and with compulsive exercise could also have been added to the model to demonstrate that the risk factors themselves will likely interact with each other, which in turn could relate to risk status for compulsive exercise. However, the interaction effects are beyond the scope of this thesis, and therefore will not be reported on here. Noticeably, childhood exercise behaviour has been included due to its risk factor status given in the systematic review (see 1.4.2), but this behavioural factor will not be tested in this thesis, due to it being beyond the methodological scope of the thesis.

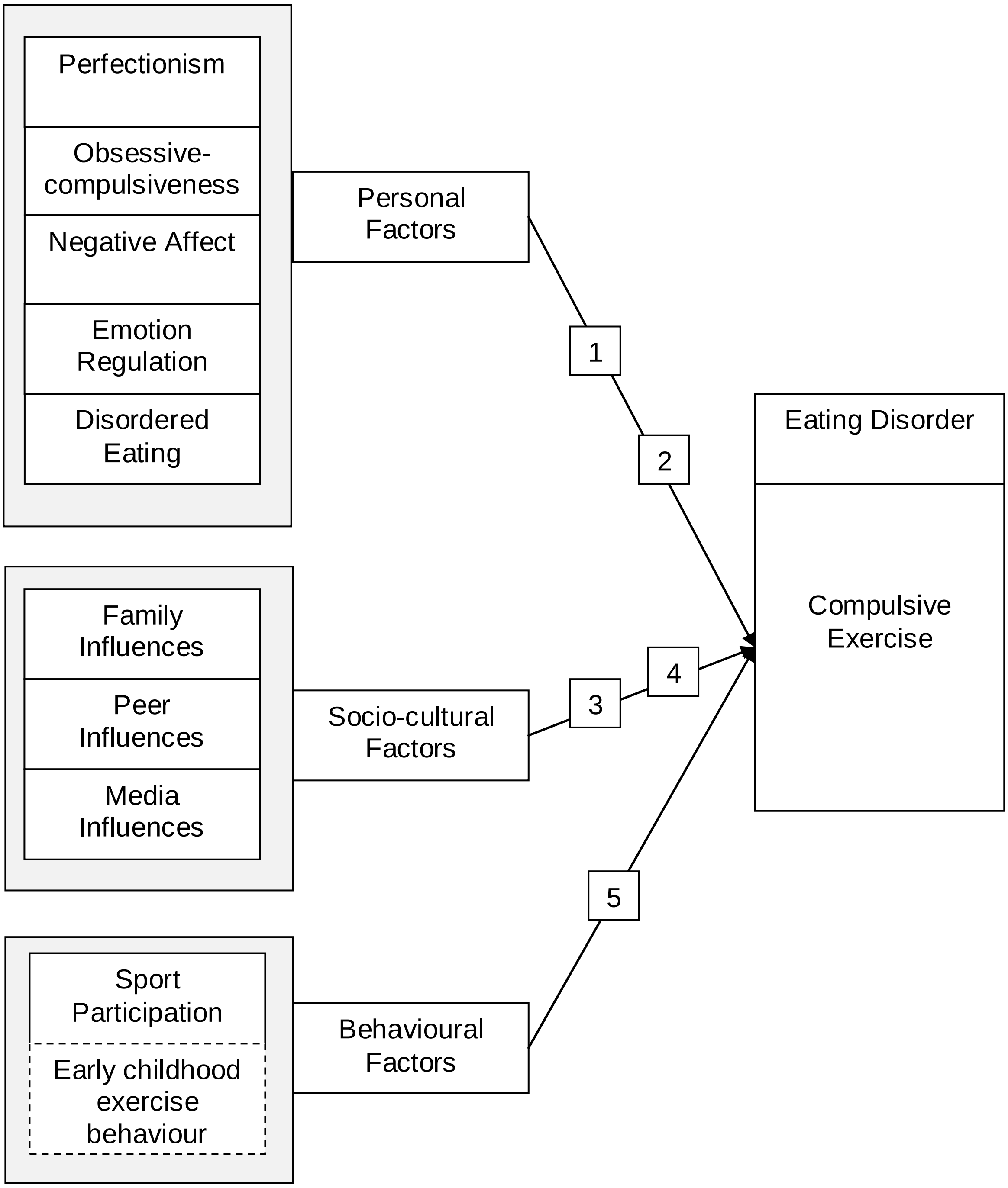


Figure 1.4 Hypothesised risk factor model for compulsive exercise in adolescents

1.6.1 Rationale for the model

The model uses the conceptualisation of problematic exercise in the eating disorders as a compulsive behaviour (Taranis et al., in press), rather than as an addictive behaviour (e.g., Veale, 1987). Taranis and colleagues (in press) have not tested the aetiology of this compulsive exercise. It is important to study the aetiology in addition to the maintenance of compulsive exercise as it has been demonstrated that risk factors for eating disorder symptoms may be different to the factors involved in the maintenance of these same symptoms (Stice & Agras, 1998). Therefore, it is important to create a separate and distinct model of the risk factors for compulsive exercise.

The risk factors proposed in the model have been included based on two criteria: 1) they have been identified as a consistent correlate with compulsive exercise in clinical eating disorder samples, as demonstrated by the systematic review conducted in this thesis (see 1.4.2); and/or, 2) they have been found to be related to either compulsive exercise (or other terms for compulsive exercise) in non-clinical samples, as highlighted by the general review of possible risk factors in this thesis (see 1.5). The model, therefore, highlights the key factors hypothesised to be important in the development of compulsive exercise. Physiological risk factors have not been included as it is suggested that they have more of an impact on the maintenance of compulsive exercise than on the aetiology, through the distinctly different phenomenon known as semi-starvation-induced hyperactivity, which occurs during the acute phases of a clinical eating disorder at low weight (Hebebrand et al., 2003).

Importantly, the potential outcomes listed in the model are twofold, namely compulsive exercise and general eating disorder psychopathology. The reason for both outcomes being highlighted in the model is that it is useful to have a risk factor model that identifies risk factors that are either specific to the outcome of interest (i.e., compulsive exercise), or are general risk factors for other clinical groups, such as eating disordered groups (Jacobi et al., 2004). Therefore, although the focus of this thesis is to identify risk factors for compulsive exercise, where an identified risk factor is found, its risk status for more general eating disorder psychopathology will also be highlighted. This will ensure the specificity of identified risk factors for compulsive exercise.

It must be noted here that Jacobi and colleagues (2004) also emphasised the need for outcomes to be defined in terms of whether full clinical disorder symptoms or early disordered symptoms are of interest, given that the risk factors for each outcome may differ. Therefore, given that no full clinical and categorical diagnosis has been established for compulsive exercise, together with the large number of individuals with subclinical clinical disorders (including eating disorders), the outcomes of interest in this research are non-clinical symptoms of compulsive exercise. It is assumed that compulsive exercise lies on a continuum, ranging from exercising for enjoyment and with complete control in exercise behaviour, to extreme compulsive, rigid behaviour, with no enjoyment of the activity. Identifying risk factors that may move someone along this continuum to the more compulsive end is a key aim of this research.

1.7 Broad Aims of the Thesis

The thesis aims to empirically examine the links postulated in the risk factor model of compulsive exercise, as seen in Figure 1.4. Given that the key age of onset for eating disorders is around adolescence (Reijonen et al., 2003), and that this age group represents the likely age for the development of eating disorder pathology (Striegel-Moore & Bulik, 2007), this thesis aims to examine the accuracy of this model among samples of early and middle adolescent boys and girls. The first part of the thesis will look to identify preliminary correlates that are cross-sectionally related to compulsive exercise. These studies will then be replicated using prospective designs to provide the first steps at identifying the risk factors (also known as variable markers; Jacobi et al., 2004) for compulsive exercise. A final prospective risk factor model, based on the studies' findings in this thesis, will be created for boys and girls separately. It is hoped that this model will help inform prevention and early intervention work into compulsive exercise among adolescent populations.

1.7.1 Broad aims of the studies in the thesis

The studies in the thesis will attempt to examine the links highlighted in Figure 1.4. Therefore, the following aims for the studies are to:

1. Identify the psychological correlates of compulsive exercise in adolescent boys and girls (Studies 2 and 3)
2. Identify the socio-cultural correlates of compulsive exercise in adolescent boys and girls (Studies 4 and 5)
3. Identify the association between sport participation, exercise behaviour and compulsive exercise attitudes (Study 6)
4. Identify the psychological risk factors (prospective) for compulsive exercise in adolescent boys and girls (Studies 7 and 8)
5. Identify the socio-cultural risk factors (prospective) for compulsive exercise in adolescent boys and girls (Study 9)

Chapter 2

Methodology

2 Methodology

2.1 Risk Factor Research

2.1.1 Risk factor research in psychology

Risk factor research has increased in recent times in the field of psychology (Jacobi et al., 2004). However, often there are inconsistent and imprecise usages of the term 'risk factor' (Kraemer, Stice, Kazdin, Offord, & Kupfer, 2001). A framework from which risk factor research should be conducted has been proposed, (Jacobi et al., 2004; Kazdin, Kraemer, Kessler, Kupfer, & Offord, 1997; Kraemer et al., 1997) in which a risk factor is described as a measurable characteristic, "which precedes the outcome of interest and which can be shown to divide the population into two groups: a high- and low-risk group" (Jacobi et al., 2004, p. 20). It is noted that many risk factor studies confuse terminology as there are specific definitions of similar, but distinct terms involved in risk factor research (Jacobi et al., 2004; see Table 2.1).

This approach to identifying true causal risk factors involves several stages of research, with variables able to change their status as more work is conducted and scientific knowledge about a factor is advanced (Jacobi et al., 2004). The first recommended stage is the conducting of cross-sectional studies, which will identify correlates (Chapters 4-6), before subsequent longitudinal studies can then identify specific risk factors (Kazdin, 1998; Chapters 7, 8). In order to examine for true risk factor status, it is recommended that prospective longitudinal designs are employed (Kazdin et al., 1997), as opposed to retrospective designs, which are plagued by such weaknesses as inaccurate participant recall (Jacobi et al., 2004). This longitudinal stage of the risk factor research process should begin with exploratory longitudinal designs as conducted in this thesis, followed by confirmatory longitudinal studies, which perhaps compare the course of high risk groups with that of low risk groups (Jacobi et al., 2004). The final stage suggested by this approach would then be to adopt randomized control trials to establish true causal risk factors (Kraemer et al., 1997).

Table 2.1 Risk factor typology and identification methods

Term	Definition	Study Design
Non-correlate	No significant association between factor and outcome (onset)	Cross-sectional and longitudinal studies
Correlate	Statistically significant association between factor and outcome	Cross-sectional studies: epidemiological studies, case-control studies, family or family history studies
Risk factor	Significant statistical and clinical association between factor and outcome; precedence	Longitudinal studies
Fixed marker	Risk factor that cannot be changed or change spontaneously	Cross-sectional studies using data from medical records or birth registers, longitudinal studies (including twin and genetic studies)
Variable risk factor	Risk factor that can be changed or can change spontaneously	Longitudinal studies
Variable marker	Variable risk factor, manipulation does not change the risk of outcome	Randomized clinical trial (preventive or therapeutic intervention study)
Causal risk factor	Variable risk factor, manipulation changes the risk of outcome	Randomized control trial (preventive or therapeutic intervention study)

Note: taken from Jacobi et al. (2004, p. 20)

This approach to risk factor research is important as it provides a step by step process from identification of initial correlates of the outcome of interest, to temporal risk factors, and then finally to causal factors, which would then provide a robust starting point for the creation of theoretically-driven prevention and early intervention programmes (Kraemer et al., 1997).

2.1.2 Risk factor research in eating disorders

To date, no risk factor research has been done specifically in relation to compulsive exercise and so methodological review of eating disorder studies will be relied upon. This risk factor research framework (i.e., Kazdin et al., 1997; Kraemer et al., 1997) has been applied to the eating disorders by a review of the eating disorders literature (Jacobi et al., 2004) and it has identified the key correlates and risk factors of eating disorders, and the potency and specificity of these risk factors. The potency of the risk factor is the magnitude of its association with the outcome variable, while the specificity of the risk factor is concerned with the degree to which the risk factor predicts just the outcome of interest or whether it predicts multiple outcomes (Kazdin et al., 1997).

Striegel-Moore and Bulik (2007) suggested that identifying risk factors in the eating disorders is important for several reasons. They noted that an understanding of the risk factors helps to: identify why an individual develops the disordered symptoms; improve the classification of eating disorders so that the nosology becomes more aligned to the aetiology of the disorder; improve treatment, given that the causes will be better known; identify high risk groups for targeted prevention and early intervention efforts. These reasons are true of any risk factor research into the eating disorders and as such provide good rationale for the current research into the risk factors for compulsive exercise.

A criticism of existing eating disorders risk factor studies is that often they are not driven by the testing of a theoretical model (Jacobi et al., 2004). It is also suggested that eating disorder risk factor research should not be limited to just abnormal eating patterns, but that future research should also target the use of extreme exercising, and how that has an effect on the development of eating disorders (Pratt et al., 2003). Therefore, the current research, testing the proposed risk factor model for compulsive exercise, provides an advance on the extant body of eating disorders research.

2.1.2.1 Risk factor research in eating disorders: adolescence

Research into the aetiology and risk factors for eating disorders among an adolescent population is an important area of study (Pratt et al., 2003). As mentioned, the key period of time in the development of eating disorders appears to be around adolescence (Striegel-Moore & Bulik, 2007). Given that the cost of eating disorder treatment is high (Pratt et al., 2003), prevention would be more advisable, and certainly more cost effective, than subsequent clinical treatment. Early intervention is also deemed appropriate in the early adolescent age group, as it is likely that their eating disorder symptoms are not yet deeply entrenched, and as such, the individual would likely be more amenable to intervention efforts (Fisher, Schneider, Burns, Symons, & Mandel, 2001). Therefore, identifying key factors associated with the early development of disordered eating cognitions, as well as with compulsive exercise cognitions and behaviours, would be advantageous for professionals working in the prevention and/or early intervention of eating disorders.

It would also be advisable in risk factor research to target this adolescent age group, as it has been shown that mild body image concerns and dieting behaviour in early adolescence can lead to more clinical levels of eating disordered behaviour in mid- to late-adolescence (Shisslak, Crago, & Estes, 1995). However, currently, most of what is known about adolescents who develop eating disorders comes from a body of literature that has predominantly used samples from inpatient settings, who already had severe forms of eating disorders, and who often represented age groups upwards of 17 years old (Pratt et al., 2003). Research that has prospectively assessed younger adolescents on more general eating disorder symptom development concluded that early adolescence (and maybe even younger) is the period of time to target for eating disorder prevention work, as this is the time that the risks for the eating disorders are at their greatest (Leon, Fulkerson, Perry, Keel, & Klump, 1999). Therefore, it seems advisable to recruit an early adolescent age group for the purposes of the current thesis risk factor research into compulsive exercise.

2.1.3 Risk factor research methods in eating disorders

2.1.3.1Cross-sectional

The majority of studies that have tried to investigate potential risk factors have used cross-sectional designs (Jacobi et al., 2004). However, this design cannot infer true cause and effect and cannot even determine temporal precedence and is therefore not advised to determine true risk factors on their own. Nonetheless, true risk factor research requires many studies, incorporating different designs (Striegel-Moore & Bulik, 2007). Therefore, cross-sectional studies are useful for identifying initial potential factors that may be associated with the outcome of interest and, as such, they represent a good first step in the research process for identifying risk factors (Jacobi et al., 2004; Kazdin et al., 1997).

2.1.3.2Prospective

Prospective studies represent the next step in the process of identifying risk factors. They are able to establish the temporal precedence of the proposed risk factors and the outcome variable. However, a key problem of longitudinal research in the eating disorders is the identification of new cases of eating disorders during the time period of study, with often none or very few new cases being found (McKnight Investigators, 2003). This problem can be reduced by broadening the outcome definition to include partial syndrome eating disorder cases (e.g., Ghaderi & Scott, 2001), or by having a continuous outcome variable rather than a categorical outcome (see Williamson et al., 2005). However, Stice and Shaw (2002) noted that stronger effects are found in risk factor studies that have employed categorical outcomes than those that had a continuous composite score of symptoms.

Another method of risk factor research in the eating disorders is to focus on a specific symptom of the eating disorders and to identify risk factors for that specific symptom, such as binge eating (e.g., Johnson & Wardle, 2005). This method of focusing on specific behaviours rather than general eating disorder attitudes has the advantage of allowing for an increase in sample sizes in research studies (Striegel-Moore & Bulik, 2007), as well as being more focused on specific symptoms rather than assuming that risk factors cross over to all elements of a given diagnosis of an eating disorder (Striegel-Moore & Bulik, 2007).

2.1.3.3 Other methods

Ultimately, true risk factor research requires the manipulation of the proposed risk factor to establish whether there is any subsequent change in the outcome variable as a direct result (Kazdin et al., 1997). This type of manipulation would take place in experimental studies or clinical trials, where other factors can also be controlled. Indeed, experimental studies provide a “more rigorous test of aetiological hypotheses than longitudinal studies” (Striegel-Moore & Bulik, 2007, p. 188). However, the difficulty of experimental design in psychological research is that many of the potential risk factors are almost impossible to manipulate, certainly directly (Kazdin et al., 1997). Further, experimental designs can only identify and test a small number of specific risk factors individually at a time (Striegel-Moore & Bulik, 2007). However, the risk factors for many mental health behaviours and disorders, including eating disorders, are multi-factorial and therefore, it would require an extremely complex experimental design to manipulate just one of the potential risk factors, whilst also being able to control for the remaining factors. Instead, it would be more advantageous to adopt designs that can test for multi-factorial risk models (Striegel-Moore & Bulik, 2007). Therefore, to test for the risk factors for compulsive exercise, the current thesis adopted an approach to test for possible risk factors in regression models, where interaction between the risk factors was accounted for in the study design.

2.2 Current Thesis Research Methods

2.2.1 Sample selection

The use of community samples enables researchers to examine the risk factors associated with eating and exercise abnormalities (Steinhausen et al., 2005). The age of the sample is important in order to fully target early development of eating problems and compulsive exercise attitudes. Abnormal eating behaviour has been shown to reach a peak around middle and late adolescence (Steinhausen et al., 2005) and therefore, in order to capture any pre-existing factors that may lead to the subsequent development of eating and exercise problems related to the eating disorders, samples consisting of participants aged around early adolescence and longitudinal samples that include participants aged from early to middle adolescence, are required. Consequently, this age group was targeted for sample recruitment.

The age of the participants sampled in this thesis was between 12-16 years old. This age has been chosen as it is early adolescence, around puberty, that has been seen to be a key point in the development of weight preoccupation (Sands, 2000). Notably, 16 years old is technically middle-adolescence. However, the design of this thesis was predominantly a large-scale longitudinal design, and therefore, although the age range for the thesis sample is up to 16 years old, the majority of these individuals were aged 12-14 years old on initial recruitment into the thesis research, which constitutes early adolescence.

Importantly, the further rationale for examining this age group is that by late adolescence individual variation in bulimic symptoms may be largely non-existent (Stice, 1998), having stabilised by mid-adolescence (Leon, Fulkerson, Perry, & Early-Zaid, 1995), and therefore it will already be too late to identify risk factors. Admittedly, some studies have found eating disorder cognitions and behaviours, in the form of weight and shape dissatisfaction, even earlier than adolescence (e.g., Davison et al., 2002; Davison, Markey, & Birch, 2000). However, in order to measure individuals at that earlier age and then longitudinally into adolescence, retention of participants would be much more difficult. This is due to participants changing schools at the age of 11 years as part of the English educational system. Additionally, the change of schools would incorporate a key period of transition, which has been shown to be related to eating disorder psychopathology (Smolak & Levine, 1996).

2.2.2 Sample size

Prevalence data on eating disorders suggest that less than 5% of adolescents will suffer from eating disorders or even subclinical eating disorders at any one time (e.g., Steinhausen, Winkler, & Meier, 1997). Therefore, this has led to difficulties in following the natural outcome and course of the illnesses, as identifying new cases in naturalistic samples would require thousands of participants in order to generate sufficient power to produce useful findings (Field, 2005). To enable authors to generalise findings wider, and ensure that enough cases of eating disorder pathology are identified, larger samples are therefore required. To achieve this relatively large sample size, often the outcome used is changed to incorporate more subclinical levels of eating disorders (Ghaderi & Scott, 2001), or alternatively individual disordered eating behaviours in the community, such as abnormal eating patterns, are chosen for study rather than full eating disorder diagnosis (Steinhausen et al., 2005). A previous longitudinal investigation of just abnormal eating behaviours (as opposed to full eating disorder cognitions as well) among adolescents, for example, recruited a sample of 330 participants who took part in all three of the study's designated time points (Steinhausen et al., 2005).

Participants in the current research were adolescents attending secondary schools in selected locations across the United Kingdom, who were recruited using a convenience sampling method. Based on previous adolescent studies adopting a longitudinal design, participation rates have been as high as 70% (McCabe & Ricciardelli, 2004a). Therefore, approximately 10 schools were invited to participate to ensure a sufficiently large enough sample size across all time points. Given that all schools were chosen based on contacts with the research team, response and participation rates were higher than if randomly chosen. From the participating schools, across all studies collectively, approximately 2000 students participated. Furthermore, consent to participate was accessed via parental opt-out forms. This reduced the need to wait for parents to send back forms, and therefore maximised the likelihood of the adolescents' participation, which also helped contribute to the large number of participants that took part in this research.

For the longitudinal studies within this thesis, subsequent attrition rates were expected along similar lines to other studies, which have reported attrition rates of around 18%-29% (Johnson & Wardle, 2005; Stice & Agras, 1998). To minimise attrition rates, schools were contacted well in advance of follow-up assessments and educational workshops were offered to provide an incentive for the schools to take part. However, although the final sample sizes were still relatively large for the longitudinal studies (>300), the attrition rates were relatively large. The reasons for this were that recruitment was conducted through schools, which enabled greater participants at initial recruitment. However, at follow-up there were incidences where the point of contact had retired or was no longer at the school, and no replacement was made available. Therefore, in some instances that immediately led to a loss of up to 350 participants. This makes the calculation of true attrition rates impossible, as it is unclear which drop-outs were due to active removal of participation by the participant, and how many were due to the participant simply not being given the opportunity to take part at follow-up assessments due to the school not taking part in that particular phase of follow-up.

2.2.3 Study designs used in this thesis

2.2.3.1Cross-sectional

Risk factor research in the eating disorders requires multi method research approaches (Striegel-Moore & Bulik, 2007). No risk factor research has been done specifically in relation to compulsive exercise. Therefore, the first step of the research design was to conduct cross-sectional studies assessing variables that could be potential risk factors for compulsive exercise. However, in the context of eating disorders, it has been found that many adolescents will display only transient abnormal eating behaviours (Patton, Johnson-Sabine, Wood, Mann, & Wakeling, 1990). Therefore, cross-sectional relationships found at one point in time may not be replicated at a later date, even with the same sample. Therefore, drawing conclusions from solely cross-sectional data, particularly on risk factors, must be done with due caution. These cross-sectional studies were used to identify correlates of compulsive exercise only, representing the first stage of the risk factor research process.

2.2.3.2 Longitudinal

Following adolescent eating and exercise behaviour over time will allow for the development of eating disorders to be understood more fully, as well as allowing for psychosocial associates to be identified (Steinhausen et al., 2005). It is important to assess relationships both cross-sectionally as well as longitudinally, as relationships may have different temporal dynamics. For example, Ball and Lee (2002) investigated stress, coping, and disordered eating and they reported different associations between cross-sectional and longitudinal analyses.

Therefore, the second section of the empirical work of this thesis (Part 3; Chapters 7, 8) used prospective, longitudinal designs for several studies. Gardner et al. (2000) noted that the seminal work of Attie and Brooks-Gunn (1989) was one of the first prospective designs studying the development of eating disorders in a non-clinical adolescent sample. Even since that investigation, only a handful of further studies have adopted such a methodology (e.g., Aime, Craig, Pepler, Jiang, & Connolly, 2008; Donovan et al., 2006; Gardner et al., 2000; Killen et al., 1994; Stice, Presnell, & Spangler, 2002), and certainly the majority of risk factor research in the eating disorders is cross-sectional in design (Jacobi et al., 2004). Therefore, the inclusion of longitudinal designs in this thesis is necessary in the literature and will provide novel information. Certainly, this is the first known work to employ a longitudinal research design into the risk factors for compulsive exercise.

Longitudinal data collection has the key issue of participant retention to consider. There are several approaches to data collection that may affect the ability to retain participants. For example, Nigg (2001) utilised several different methods for collecting data on adolescent exercise behaviour. One method, which used class time to complete measures, received a 66% completion rate when only asking for a single representative to provide parental consent. Other schools allowed measures to be administered during the school day and yet required no parental consent, which pushed completion rates up to as high as 91.5%. However, when the same study asked for individual parental consent for every student, the completion and return rate was only 20.6%. In an attempt to maximise completion rate, it was felt that completion at school during class time was a necessity, but it was also accepted that for ethical research, parental consent from the offset was critical. Therefore, it was decided that all students would complete questionnaires only after parents were fully informed and had been given sufficient time (approximately one week) to opt-out of the research, rather than choose the opt-in consent approach and have to follow up large numbers of parents for consent forms, which would have been ineffective and time-consuming. Ethical clearance was gained for this opt-out parental consent procedure (see 2.2.6).

2.2.4 Self-Report measurement of variables

The primary criteria for the use of measures throughout the thesis were: a) the measure is concise (i.e., not too many items); b) the measure has been used/validated among an adolescent population; and c) the measure is psychometrically sound. All the measures used in the thesis had provided reliable psychometrics for an adolescent population, unless otherwise stated. The specific rationale for the measures used in this thesis is provided in this section.

2.2.4.1Exercise behaviour

Despite the focus on the affective and cognitive measurement of compulsive exercise in this thesis, it was still important to measure adolescents' actual exercise behaviours. Self-report measures have been criticised for their level of subjectivity and imprecision of actual exercise behaviour (e.g., Reilly et al., 2008). However, self-reports are particularly useful as a means of assessing exercise behaviour in large numbers of individuals as they require less response burden than objective measures of exercise (Sirard & Pate, 2001). Therefore, given the large numbers of participants required for this thesis, a self-report measure was deemed most appropriate.

Currently, there are several measures that provide self-report assessments of physical activity/exercise, and which have been validated in an adolescent sample. For example, the Previous Day Physical Activity Recall (PDPAR; Weston, Petosa, & Pate, 1997) has been used with adolescents, and asks for duration and intensity of activities performed during 30-minute blocks of time outside of school only. It has displayed good positive correlations with objective measures of physical activity, namely a pedometer ($r = 0.77$) and the Caltrac accelerometer ($r =$

0.88) (Weston et al., 1997). However, it is uncertain as to how many assessments need to be conducted when using a one-day response format (Sirard & pate, 2001), and so instead a longer time response has been used in other measures. The Physical Activity Questionnaire for Adolescents (PAQ-A; Kowalski, Crocker, & Kowalski, 1997), for example, uses a seven-day recall response format, assessing frequency of participation in activities, but not duration. It has been validated for use in this age-group, but it's validation against an objective measure of activity is poor (accelerometer: $r = 0.33$; Kowalski et al., 1997).

Both of these self-report measures of exercise behaviour still require participants to complete a lot of detail, and may be time-consuming for the adolescent participants, particularly when only a single school class session was available for the data collection. One self-report measure that is quick, simple, and requires minimal participant response burden is the Godin Leisure Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985). The LTEQ is only three items long and asks participants how many times per week they engage in exercise for at least 15 minutes at mild intensity, at moderate intensity, and/or at strenuous intensity. A total exercise score is then calculated, and is measured in Metabolic Equivalents (METS). The LTEQ has been previously used with an adolescent population (Cumming, Standage, Gillison, & Malina, 2006; Gillison, Standage, & Skevington, 2006), and has been shown to have good psychometric properties (Jacobs, Ainsworth, Hartman, & Leon, 1993). This measure of exercise behaviour was chosen for this thesis, due to it being widely cited, previously used in this age group, and because of its minimal response burden in relation to the volume of information it provides.

In addition to current exercise behaviour in general, sport participation has also been seen as important in the later development of eating disorder concerns (Davison et al., 2003). Therefore, the child's current sport participation was also assessed. However, sport participation is invariably reported in studies using de novo questions created for single use in a specific study (e.g., McCabe & Ricciardelli, 2004a). Therefore, to assess sport participation in the current thesis, several questions were used, including whether or not the participant currently participated in sports and in which sports they participated (McCabe & Ricciardelli, 2004a). The lack of a validated measure for these variables could weaken any positive findings, but as this behavioural information was not the main focus of the investigation, and that these sport participation questions have been used in McCabe and Ricciardelli's (2004a) investigation, then it was deemed sufficient for its current purpose of acting as a measure of sport participation.

2.2.4.2 Compulsive exercise

As is indicated in the first chapter of this thesis, there are a variety of ways to define compulsive exercise. Unfortunately, the lack of a precise definition has caused disparity in both the assessment and measurement of exercise-related behaviours, clinically and non-clinically. Quantitative approaches have defined individuals as 'excessive exercisers' based on the number of hours per week (or day) that the person is exercising (e.g., Penas-Lledo et al., 2002). However, this has its limitations and misses the qualitative dimension of compulsive exercise, which is arguably more important in relation to the eating disorders (Adkins & Keel, 2005; Mond et al., 2006). Therefore, other studies have investigated the qualitative side of compulsive exercising, looking into the cognitions, emotions and attitudes of such individuals towards exercise (Cox & Orford, 2004). Guilt resulting from missing any scheduled exercise session appears to be a crucial factor in the qualitative experience of exercise compulsion (Mond, Hay, Rodgers, Owen, & Beumont, 2004).

In the context of the eating disorders, compulsive exercise assessment is usually carried out at admission, if at all, and varies in its rigour between clinicians (Hechler, Beumont, Marks, & Touyz, 2005). The Eating Disorders Examination (Fairburn & Cooper, 1993) only contains a few questions related to physical activity, of which none are related to the cognitions and attitudinal side of exercise. The Behaviour Assessment Interview produced by the World Health Organisation Collaborating Centre for Mental Health and Substance Abuse only poses eight questions on exercise behaviour. Ultimately, as Hechler and colleagues (2005) duly noted, "no study thus far has addressed the question as to which assessment tools should be used in the clinical setting" (p. 126).

In the research setting, a variety of measures have been developed to assess compulsive exercise. The Commitment to Exercise Scale (CES; Davis et al., 1993) is an 8-item analogue scale specifically designed to assess the 'obligatory' aspects of exercising (e.g., feelings of guilt when an exercise session is missed, and adherence to a fixed and set routine) and the ‘pathological’ aspects of exercising (e.g., continuing to exercise in the face of illness or fatigue). It has good construct validity (Davis et al., 1995) and has been well cited. However, its minimal number of items perhaps lacks the full conceptualisation of compulsive exercise. The Obligatory Exercise Questionnaire (OEQ; Thompson & Pasman, 1991) is a 20-item unidimensional measure of compulsive exercise that focuses on attitudes, beliefs, and behaviours related to exercise. High internal consistency, test-retest reliability and good discriminant validity have been demonstrated in non-clinical samples (Pasman & Thompson, 1988). This measure has also been used in clinical samples (Calogero & Pedrotty, 2004), but has largely been criticised for its unidimensional nature (Steffen & Brehm, 1999).

In contrast to the OEQ’s unidimensionality, Ogden et al. (1997) developed the Exercise Dependence Questionnaire (EDQ), which assesses attitudes to exercise over the past month. It is a multidimensional measure, and includes aspects of compulsive exercise that are: interference with social/family/work life, positive reward, withdrawal symptoms, exercise for weight control, insight into problem, exercise for social reasons, exercise for health reasons, and stereotyped behaviour. A further measure of the term ‘exercise dependence’ was created by Hausenblas and Symons Downs (2002a), who developed the Exercise Dependence Scale-21 (EDS-21). This scale operationalises compulsive exercise based on the DSM-IV criteria for substance dependence. This measure appears promising, but has not been widely used.

Recently, given the evidence that compulsive exercise always co-exists with some degree of eating disorder pathology (Bamber et al., 2000; Bamber et al., 2003), a new measure was created, which was based on a cognitive-behavioural model of eating disorders. The Compulsive Exercise Test (CET; Taranis et al., in press) provides assessment on five core features of compulsive exercise, namely, avoidance and rule-driven behaviour, weight control exercise, mood improvement, lack of exercise enjoyment, and exercise rigidity. This new measure is grounded in theory and could provide a useful method of assessing compulsive exercise. Ultimately, given the framework with which compulsive exercise has been defined in the current research, the Compulsive Exercise Test (Taranis et al., in press) was the most appropriate measure of compulsive exercise, and therefore was chosen for use in this thesis. However, although it provides the most accurate theoretical definition of compulsive exercise, it has not been validated for use with adolescents. Therefore, the initial study in this thesis (Chapter 3) constitutes an assessment of the Compulsive Exercise Test's factor structure, reliability and validity in an adolescent population, before the CET will be reliably reported in the subsequent empirical studies.

2.2.4.3 Disordered eating attitudes and body dissatisfaction

There appear to be a wide variety of self-report instruments that measure eating disorder psychopathology and which are used for research purposes. The gold standard for the self-report approach is the Eating Disorders Examination Questionnaire (EDEQ; Fairburn & Beglin, 1994), which is based on the Eating Disorder Examination (EDE; Fairburn & Cooper, 1993). The EDEQ looks at eating disorder behaviours and attitudes retrospectively over the previous 28 days. It covers behaviours, cognitions and attitudes, with subscales of Restraint, Shape Concern, Weight Concern, and Eating Concern. It also has the advantage of providing definitions of different forms of over eating, such as differentiating between subjective and objective binge episodes, allowing for more exact specification of these behaviours (Rizvi, Peterson, Crow, & Agras, 2000). Ultimately, it has important clinical usage in that it can be used as a diagnostic tool, mapping onto the criteria set out in the DSM-IV for BN and binge eating disorder (BED). It has been validated for use in adolescents (Carter, Stewart, & Fairburn, 2001), and given its high standing in the eating disorders literature it was used as one of the measures of disordered eating attitudes in this thesis.

Two other widely cited self-report measures are the Eating Disorder Inventory-2 (EDI-2; Garner, 1991) and the Eating Attitudes Test (EAT; Garner & Garfinkel, 1979). The latter was updated with fewer items from 40 down to 26, and is sometimes known as the EAT-26 (Garner, Olmsted, Bohr, & Garfinkel, 1982). The EAT was once described as "the most popular and influential instrument to identify patterns associated with AN" (Raciti & Norcross, 1987, p. 579). It certainly has been found to be a reliable and valid measure of the symptoms of AN (Garner et al., 1982), but also has been widely described as a measure of BN (Seiver, 1994), despite being originally developed solely for AN and with no formal validation studies to support this additional suitability with BN (Mintz & O'Halloran, 2000). The EAT-26 and EAT-40 use cut-off scores to diagnose AN, although their use in non-clinical samples has been criticised because the EAT was developed using a clinical sample, and so tends to produce a high rate of false-positives and has poor predictive power (Choudry & Mumford, 1992; Whitehouse & Choudry, 1992). Nonetheless, reasons for this lack of appropriateness in non-clinical samples have been provided (such as DSM criteria having changed significantly since it was developed), and further work by Mintz and O'Halloran (2000) found that the EAT could satisfactorily be used as a screening tool for identifying non-clinical women who are likely suffering from an undifferentiated DSM-IV eating disorder. They also found that the EAT can be used as a continuous measure, without cut-offs, i.e. that as EAT score increases, so does the extent of the subject's abnormal or disturbed eating.

The Eating Disorder Inventory-2 (EDI-2; Garner, 1991) assesses the symptomatic and personality-related dimensions associated with AN and BN (Lowe, Gleaves, & Murphy-Eberenz, 1998), and has been widely tested for its reliability and validity, both of which have been satisfactorily demonstrated (e.g., Eberenz & Gleaves, 1994; Garner, 1991). It contains 8 subscales measuring common behavioural and cognitive characteristics associated with both AN and BN. These aspects of eating disorder symptoms are Drive for Thinness, Body Dissatisfaction, Bulimia, Perfectionism, Maturity Fears, Ineffectiveness (feelings of inadequacy, insecurity, and worthlessness, etc), Interpersonal Distrust, and Interoceptive Awareness (lack of confidence in recognition of emotional states and hunger and satiety). The key subscales used in a shortened form of the EDI-2 are the drive for thinness, bulimia, and body dissatisfaction subscales. These three subscales are often used as the key measures of disordered eating attitudes as they form a symptom index for the eating disorders (Elfhag & Linne, 2005). Therefore, despite the promising utility of the EAT, the ability to distinguish between anorexic and bulimic attitudes is preferable for this thesis, as compulsive exercise has been shown to be more closely aligned to AN than to BN (Bewell-Weiss & Carter, 2010; Dalle-Grave et al., 2008). Therefore, the EDI-2 was chosen for use in this thesis. Further, given the high response burden of the full version of the EDI-2, only the short form of the EDI-2 (only the subscales of Drive for Thinness, Bulimia, and Body Dissatisfaction) was used for general disordered eating attitudes in this thesis. This short form has been previously used in the literature (e.g., Adkins & Keel, 2005; Elfhag & Linne, 2005).

The inclusion of the Body Dissatisfaction scale of the EDI-2 meant that a succinct and previously cited measure of body dissatisfaction (e.g., Kostanski & Gullone, 1998) was also used for this thesis. It has been noted that the items on the Body Dissatisfaction scale may be too specific to women (e.g., dissatisfaction with large thighs; Spillane, Boerner, Anderson, & Smith, 2004). However, despite this, it has been found in a previous study that boys and girls did not differ on this measure (Wiseman, Peltzman, Halmi, & Sunday, 2004). In addition, Spillane and colleagues (2004) validated the EDI-2 for use with men, suggesting that it was a sufficiently appropriate measure for both men and women.

Several other methods of assessing body dissatisfaction have been used. For example, studies have used body image silhouettes (Cooley & Toray, 2001), where respondents are asked to report discrepancies between their current and ideal body shape; similarly, a figure rating scale (Konstanki & Gullone, 1998), where respondents are also asked to point out ideal and current body shape, has been used to identify body dissatisfaction. However, given that a key aim of the design was to minimise response burden, it was felt best to simply use the EDI-2 Body Dissatisfaction scale, as it already forms part of the EDI-2 short-form, which had been chosen to assess disordered eating attitudes. Therefore, this scale was used to measure body dissatisfaction in the relevant studies in this thesis.

2.2.4.4 Potential risk factors for compulsive exercise

2.2.4.4.1 Perfectionism

Perfectionism has been measured in a variety of different ways. In the eating disorders literature, the EDI-Perfectionism scale has been used. This assesses perfectionism in a unidimensional way, which has been contested (Sherry, Hewitt, Besser, McGee, & Flett, 2004). The equivocal findings in the eating disorder literature have also been attributed to the lack of rigour in its measurement of perfectionism (Franco-Paredes et al., 2005). Indeed, many researchers have advocated the use of perfectionism measures that adopt a multidimensional framework for the construct (e.g., Hewitt & Flett, 1989; Frost et al., 1990). There are two key measures that have described perfectionism as a multidimensional construct. Firstly, the Multidimensional Perfectionism Scale by Frost and colleagues (MPS-F; 1990) assesses perfectionism using 35 items that form the subscales of: concern over mistakes, personal standards, parental expectancies, parental criticism, doubts about action, and preference for order. This has been widely cited and has demonstrated links with eating disorder pathology (e.g., Bulik et al., 2003; Halmi et al., 2000). However, the suitability of the factor structure of the MPS-F has been questioned (Purdon, Antony, & Swinson, 1999; Stober, 1998), with suggestions that it is better suited as a three-factor solution, with a possible fourth factor as well.

The other Multidimensional Perfectionism Scale (MPS-H) in the literature was created by Hewitt and Flett (1989). This measure splits perfectionism into Self-Orientated Perfectionism, Socially-Prescribed Perfectionism and Other Perfectionism, and has shown good reliability and validity (Hewitt & Flett, 1991). It has been used in the eating disorders literature (e.g., Cockell et al., 2002; Downey & Chang, 2007; Serpell, Hirani, Willoughby, Neiderman, & Lask, 2006), although its authors created a child and adolescent version, entitled the Child and Adolescent Perfectionism Scale (CAPS; Flett & Hewitt, 1992), when sampling children and adolescents. This measure is 22-items in length and is based on the MPS-H but its wording is more appropriate for a younger age group. Given that the MPS-H conceptualisation of self- and social-perfectionism is widely acknowledged and has been used in studies with compulsive exercise, then an age-appropriate version of it (i.e., the CAPS) represents a reliable measure of perfectionism. Consequently, the CAPS was chosen for the studies that utilised a measure of perfectionism in this thesis.

2.2.4.4.2 Obsessive-compulsiveness

Obsessive-compulsiveness has been measured in different ways, often due to the level of pathology required to be measured in specific studies. One of the most widely used measures is the Maudsley Obsessive-Compulsive Inventory (MOCI; Hodgson & Rachman, 1977). The MOCI is 30 items long and assesses intrusive thoughts, slowness and doubting, frequent checking, and worries about cleanliness. However, although it has been used in studies looking at compulsive exercise (e.g., Davis, Woodside et al., 1999; Thome & Espelage, 2007), as well as showing good validity (Emmelkamp, Kraaijkamp, & van den Hout, 1999), the MOCI has been criticised for its wording, such as the use of double negatives and items worded as being fixed in the past (Thordarson et al., 2004). Additionally, the internal consistency of its slowness subscale has been questioned (Taylor, 1998).

To satisfy the shortcomings of the MOCI's wording, an updated revised version was created, known as the Vancouver Obsessive-Compulsive Inventory (VOCI; Thordarson et al., 2004). The VOCI is based on the MOCI but has been altered in order to assess a wider range of obsessions and compulsions, and to incorporate the updated knowledge on obsessive-compulsiveness since the original MOCI was developed, such as including cognitive items and not simply behavioural items (Thordarson et al., 2004). Thordarson and colleagues (2004) demonstrated the VOCI's reliability and validity as a measure of obsessive-compulsiveness, but its length of 55 items could be too many for a sample of adolescent participants. Therefore, a less wordy measure that has been used in the literature is the Obsessive-Compulsive Inventory-Revised (OCI-R; Foa et al., 2002). This measure is only 18 items and is based on the original OCI, which was theoretically driven. It has sound psychometric properties amongst non-clinical individuals. However, it has not been validated with adolescents.

Finally, a succinct and adolescent-friendly measure that appears to fulfil the role of assessing obsessive-compulsiveness in this age group most successfully comes from the Spence Children's Anxiety Scale (SCAS; Spence, 1998). This scale assesses various anxiety disorder symptoms, and it is the obsessive-compulsiveness scale (SCAS-OC) that is of interest to the current research. The SCAS-OC is only 6 items in length and has been validated for use with adolescents up to the age of 18 years old (Muris, Merckebach, Ollendick, King, & Bogie, 2002). Therefore, due to its suitability for use in the participants used in this thesis, as well as its brief nature, the SCAS-OC was used as a measure of obsessive-compulsiveness for the relevant studies in this thesis.

2.2.4.4.3 Anxiety and depression

Both anxiety and depression have been linked with compulsive exercise (Penas-Lledo et al., 2002; Shroff et al., 2006). Despite there being several measures of both anxiety (e.g., State-Trait Anxiety Inventory; Spielberger, 1985) and depression (Beck Depression Inventory; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), given the number of different predictors being used in the survey design of this thesis, measures that incorporated both anxiety and depression into a single measure were sought. However, it was deemed important that the two constructs represented distinct subscales, rather than measures of general negative affect (e.g., Positive and Negative Affect Schedule; Watson, Clark, & Tellegen, 1988), as both anxiety and depression are hypothesised to be unique risk factors for compulsive exercise.

Two scales in the literature which fulfilled the above criteria were the Depression, Anxiety, and Stress Scale-21 (DASS-21; Lovibond & lovibond, 1995) and the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). The DASS-21 is quick and easy to administer, containing just 21 items, and has been validated in a non-clinical sample (Henry & Crawford, 2005), as well as being used in eating disorders research (e.g., Ricciardelli & McCabe, 2001). However, this measure is less suitable for the current research as it has not been officially validated with adolescents. The DASS-21's authors do contend that it would be possible for the measure to be user-friendly enough for use with adolescents, although this still needs to be substantiated in a psychometric evaluation.

Alternatively, the HADS has been validated for use with adolescents (White, Leach, Sims, Atkinson, & Cottrell, 1999). The HADS has only 14 items and measures the two key variables of anxiety and depression. Despite its hospital name tag, it has been reliably used in general populations (Crawford, Henry, Crombie, & Taylor, 2001). This scale is a brief and succinct measure that encompasses the two key variables of anxiety and depression, and has been validated for use within the sampled age groups used in this thesis. Therefore, the HADS was used in the relevant studies in the current research reported in this thesis.

2.2.4.4.4 *Social physique anxiety*

Social physique anxiety has been regarded as a potential risk factor for compulsive exercise in this thesis, due to its link with other disordered eating behaviours found in previous research (Diehl, Johnson, Rogers, & Petrie, 1998). Social physique anxiety represents the body-specific element of anxiety around social comparisons. The Social Physique Anxiety Scale (SPAS; Hart, Leary, & Rejeski, 1989) has been linked to perfectionism and disturbed eating attitudes (Haase, Prapavessis, & Glynn Owens, 2002). It has good psychometrics and has been used with adolescents (Koca & Asci, 2006; Smith, 2004; Thompson & Chad, 2002).

Other measures of anxiety around social comparison that were considered included the Brief Fear of Negative Evaluation scale (BFNE; Leary, 1983), as well as the Leibowitz Social Anxiety Scale – Children and Adolescents Version (SAS-CA; Masia-Warner et al., 2003). However, these measures are more assessments of negative evaluation and social anxiety, which were not the variable of interest for this thesis. Ultimately, it is only social physique anxiety that has been previously used in studies that have incorporated elements of compulsive exercising, and therefore, the SPAS was chosen as most suitable for the current research.

2.2.4.4.5 *Emotion regulation*

The regulation of emotions in relation to the eating disorders has not been widely studied in adolescents (Garcia-Grau, Fuste, Miro, Saldana, & Bados, 2002; Garcia-Grau, Fuste, Miro, Saldana, & Bados, 2004). For example, a relatively new measure of emotion regulation ability in the eating disorders, The Distress Tolerance Scale (DTS; Corstorphine et al., 2007), has been related to both general eating disorder psychopathology (Anestis, Selby, Fink, & Joiner, 2007) and compulsive exercise, using the Compulsive Exercise Test (Meyer & Taranis, 2009). However, it has not been used with adolescents, and therefore, could not be chosen for the current research. Another measure that assesses emotion regulation is the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004), although this too has not been validated for use with adolescents either. Importantly, another problem with these measures is that they predominantly describe negative styles of emotion regulation. However, exercise behaviour has been previously reported as a positive method for managing emotions (see Biddle, Fox, & Boutcher, 2000), and it should not be assumed that compulsive exercise is only associated with problematic and/or dysfunctional emotion regulation styles.

Therefore, a measure that has been validated for use with adolescents and which incorporates both positive and negative emotion regulation was chosen for use in this thesis. This measure was the Regulation of Emotions Questionnaire (REQ; Phillips & Power, 2007). The REQ is a new measure of emotion regulation in adolescents. Importantly, it has been specifically designed for adolescents, which separates it from other emotion regulation measures. It measures four subscales of internal (intrapersonal) functional, internal dysfunctional, external (interpersonal) functional, and external dysfunctional emotion regulation and has been validated within a UK adolescent population (Phillips & Power, 2007).

2.2.4.4.6 Social-cultural factors

The socio-cultural environment has been proposed to be a risk factor for compulsive exercise (White & Halliwell, 2010). The existing literature in the eating disorders does have a variety of measures that focus on socio-cultural factors that may play a part in the development of eating disordered symptoms. However, one of the most widely reported socio-cultural factor is the pressure to live up to socio-cultural norms of the “Thin Ideal”, even among adolescents (Harrison, 2000). The most consistent way of assessing this has been through the Socio-Cultural Pressure to be Thin Scale (Stice & Bearman, 2001). This measure examines the level of pressure that the participant feels from socio-cultural sources of family, friends and the media. It has been widely used in the eating disorders literature and has been linked with the development of various eating disordered symptoms (e.g., Presnell, Bearman, & Stice, 2004; Stice, Spangler, & Agras, 2001; Stice & Whitenton, 2002). It is a brief measure that incorporates pressure from family, peers and the media. Given the largely exploratory nature of this thesis, particularly of socio-cultural factors, it was felt that this measure was most appropriate for use in this thesis. Therefore, this was one of the measures chosen to assess socio-cultural risk factors for compulsive exercise in this thesis.

However, in relation to socio-cultural pressures, the current research presented in this thesis examined risk factors in both girls and boys. It has been suggested that although boys do desire to have a slim body, they also have a desire to become more muscular (McCabe, Ricciardelli, & Holt, 2005; Muris, Meesters, van de Blom, & Mayer, 2005). Indeed, it has been found that messages from parents to be more muscular have been related adolescent boys' muscle preoccupation (Meesters, Muris, Hoefnagels, & van Gemert, 2007). Socio-cultural pressure to increase muscles has been previously measured by the Perceived Socio-cultural Influences Scale on Body Image and Body Change Questionnaire (SCIQ; McCabe & Ricciardelli, 2001). This measure has been linked to body change strategies in a group of adolescent boys and girls (McCabe & Ricciardelli, 2003b). Unfortunately, the full measure was unobtainable for the current research. Nonetheless, a modified version of the SCIQ was used in another investigation of social and family correlates of eating problems in adolescents (Meesters, Muris, Hoefnagels, & van Gemert, 2007). This modified version was shorter than the SCIQ and therefore was deemed an appropriate and useful measure for potential socio-cultural risk factors for compulsive exercise. The modified SCIQ is described in more detail (including its internal consistency) in the relevant chapters in this thesis.

Another potential socio-cultural risk factor for compulsive exercise that was reviewed in the literature (see 1.5) was that of physical activity support. There are few validated measures available for use to assess this variable. One suitably placed measure is the Physical Activity Support Scale (PASS; Davison, 2004). The PASS assesses the level of support that an adolescent receives around their physical activity, and is separated into the subscales of: Family Support, Paternal Modelling, Paternal Logistic Support, Maternal Modelling, Maternal Logistic Support, Sibling Support, and Peer Support. It has been previously used among adolescent boys and girls, and has been shown to be related to adolescent exercise behaviour (Davison, 2004). Therefore, given the lack of other measures in the literature, the PASS was regarded as the most appropriate measure for physical activity support in this thesis.

One other measure that was considered was the Parent Support Scale, which used in a study by Prochaska, Rodgers, and Sallis (2002). The Parent Support Scale only has five items and asks the adolescent to answer questions about parental support in relation to: encouragement, praise, transportation of the adolescent to physical activity settings, physical activity participation with the adolescent, and watching the adolescent's participation in physical activity or sports. It is similar to the PASS but is not as extensive or thorough as the PASS. Additionally, it only assesses parental support, whereas the PASS also includes general familial support, sibling support, and peer support around physical activity. Therefore, it was deemed appropriate to use the PASS as a measure of physical activity support for the relevant study in this thesis.

2.2.5 Data analyses

The review of eating disorders risk factor research by Jacobi and colleagues (2004) demonstrated that risk factor studies had adopted a variety of statistical analyses. These strategies included multiple regression analyses (e.g., Attie-Brooks-Gunn, 1989), multivariate analysis of variance group comparisons between different groups (i.e., between at risk and non-at risk groups) (e.g., Ghaderi & Scott, 2001), or a mixture of several methods (Killen et al., 1996). The analysis chosen for the current research included multiple regression analysis for the cross-sectional studies. The subsequent longitudinal investigations adopted a mixture of multiple regression analyses and multivariate group comparisons. As described previously, both of these data analytic approaches have been used in risk factor research in the eating disorders (Jacobi et al., 2004).

It must also be noted here that the p values for the different studies in this thesis varied between studies. The rationale for this variation was that the sample size for several of the studies were extremely large, and therefore, they had an increased risk of Type I error if $p = .05$. Therefore, among the empirical studies, to ensure that significant findings were genuine findings of practical significance and not simply an arbitrary result of the strength of the test being performed, the following p value changes were made: where sample $N > 1250$, $p = .001$; where sample $N = 750\text{-}1250$, $p = .01$; where sample $N < 750$, $p = .05$.

2.2.6 Ethical considerations

All studies received institutional ethical review board approval prior to their commencement (see Appendix A). All schools firstly provided written consent for the research to take place in their school. Parental consent was also obtained, given the under-18 age group of the sample in this thesis. A passive consent procedure was chosen for this purpose, which is similar to that of a previous prospective study investigating a similar topic (Johnson & Wardle, 2005). This procedure involves providing information to both pupils and parents about the study aims and procedures. Parents were sent a letter with this information and were required to return an opt-out reply slip if they did not wish their child to participate. Given that all participating schools had consented to take part in the research, and that teachers act in loco parentis for their pupils during the school day, this opt out method of obtaining parental consent was deemed sufficient. Further to this passive parental consent, active consent on the part of the adolescent was also obtained.

Chapter 3

Measurement of Compulsive Exercise in Adolescents

Study 1

3 Measurement of Compulsive Exercise in Adolescents

The measures that have been developed to assess compulsive exercise (or any one of the other terms used to describe a similar phenomenon) have invariably been tested using an adult population. Risk factor research into compulsive exercise and the eating disorders needs to examine adolescent-based samples, given the early age of onset of eating disorders (Striegel-Moore & Bulik, 2007). Therefore, any measure that is used needs to be validated for use among this age group. However, it has been noted that there is not a suitable or appropriate measure of compulsive exercise for use with adolescents (Tata, Fox, & Cooper, 2001).

The Compulsive Exercise Test (CET; Taranis et al., in press) has been developed in the context of the eating disorders and represents the best measure of compulsive exercise in relation to eating disordered attitudes and behaviours. However, although the CET has reported good psychometrics within adult samples (e.g., Taranis et al., in press), it has not yet been validated among adolescent populations. Therefore, prior to its use in assessing compulsive exercise attitudes and cognitions among adolescents, the measure needs to be psychometrically evaluated within an adolescent age group.

The following chapter is based upon an article that has been accepted for publication in the European Eating Disorders Review, as "*Goodwin, H., Haycraft, E., Taranis, L., & Meyer, C. (in press). Psychometric evaluation of the Compulsive Exercise Test (CET) in an adolescent population: Links with eating psychopathology. European Eating Disorders Review"* and describes the psychometric evaluation of the CET among an adolescent sample.

Study 1: Psychometric evaluation of the Compulsive Exercise Test (CET) in an adolescent population: Links with eating psychopathology

Abstract

Objective: Compulsive exercise describes a rigid, driven urge to exercise that has been reported in different populations, including eating disordered patients. This compulsion can develop at an early age and yet the measurement of compulsive exercise in adolescents is limited by inappropriate assessment techniques. This study aimed to psychometrically evaluate the Compulsive Exercise Test (CET) in a sample of adolescents. **Methods:** The sample consisted of 1012 adolescents aged 12-14 years old, who completed the CET, the Commitment to Exercise Scale (CES), and selected subscales from the Eating Disorder Inventory – 2 (EDI-2). **Results:** Results confirmed the original five-factor solution of the CET. The CET's concurrent validity with the CES, as well as the convergent validity with the EDI-2, was established. The CET was not strongly related to exercise frequency. **Conclusion:** The CET appears to be valid and reliable for use with adolescents. Replication with an adolescent clinical sample is now required.

Psychometric evaluation of the Compulsive Exercise Test (CET) in an adolescent population: Links with eating psychopathology

Compulsive exercise typically describes a rigid and highly driven urge to exercise, with an inability to stop, and is often performed despite possible negative consequences (Taranis et al., in press). Such exercise can be detrimental to both physical and psychological health (Iannos & Tiggemann, 1997). It has been likened to a pathological behavioural addiction (Griffiths, 1997; Hausenblas & Symons Downs, 2002a; Veale, 1987), displaying similarities with obsessive-compulsiveness (Gulker, Laskis, & Kuba, 2001; Wyatt, 1997; Yates, 1991), and is often associated closely with clinical eating disorders (Davis et al., 1994; Matheson & Crawford-Wright, 2002). The association of compulsive exercise with eating, weight and shape concerns has also been found at a non-clinical level, among community exercisers (Lipsey et al., 2006), and also among athletic populations (Pierce, 1994).

Compulsive exercise is a serious problem that has been reported in between 40% (Shroff et al., 2006) and 80% (Davis, 1997) of eating disordered patients. It can negatively affect the sufferer's quality of life (Mond et al., 2006), as well as becoming a hindrance to their eating disorder treatment (Strober et al., 1997). One possible explanation for this hindrance is the suggested causal effect of exercise behaviour on the development of eating disorder pathology (Davis et al., 1990; Davis et al., 1994; Davis et al., 1997; Davis, et al., 2005), with premorbid activity levels being associated with comorbid compulsive exercising (Davis et al., 1997). Others have found that participation in aesthetic sports (e.g., gymnastics) can be associated with an increased focus on weight and shape among pre-adolescent girls (Davison, Earnest, & Birch, 2002).

Recent evidence suggests that compulsive exercise does not occur as a pathology in its own right, but instead co-exists in the context of eating disordered pathology (Bamber, Cockerill, & Carroll, 2000; Bamber et al., 2003). Therefore, an exercise-based measure assessing highly driven and injurious exercise could act as a screening tool for eating disorders (Yates, Edman, Crago, & Crowell, 2001). The use of an exercise-based measure to identify eating disorder risk could be particularly useful within exercise and sporting environments, as athletes' eating behaviours may often be attributed to their strict training environments, rather than any underlying eating pathology. This would be beneficial for prevention programmes as compulsive exercise is often one of the first symptoms of eating disorders to develop (Davis et al., 2005) and so could potentially increase the chances of identifying vulnerable individuals.

Importantly, the assessment of compulsive exercise is needed among the group most susceptible to eating disorders; namely adolescents (Striegel-Moore & Bulik, 2007). During pubertal onset, adolescent girls increase their fat stores and this increase in body fat is associated with greater desires to be thinner (Dornbusch et al., 1984), which in turn is associated with greater body dissatisfaction (Tremblay & Lariviere, 2009). A strong commitment to exercise has been found to be positively related to body dissatisfaction in this population (McCabe & Ricciardelli, 2004b), which in itself has been found to be a strong predictor of later maladaptive eating concerns and behaviours (Attie & Brooks-Gunn, 1989; Ball & Lee, 2002; Donovan et al., 2006; Stice, 1998, 2001). This period of adolescence, therefore, appears to be a crucial time in the development of exercise- and eating-related attitudes (Striegel-Moore & Bulik, 2007; Tremblay & Lariviere, 2009) but, to date, very few studies have investigated compulsive exercise within this age group.

Research which has been conducted among adolescents found that those who exercised hard and frequently did not seem to develop eating disorder pathology if they maintained a positive attitude towards exercise (Steffen & Brehm, 1999). The authors suggested that the link between excessive exercise behaviour and eating disorders could be determined to a greater extent by the individual's cognitions and attitudes towards exercise, than simply their exercise behaviour *per se*. Indeed, the equivocal prevalence figures of compulsive exercise in the eating disorders could be linked to whether studies assessed compulsive exercise in behavioural or attitudinal terms (Solenberger, 2001).

Previous attempts to quantify and describe this cognitive and affective element to excessive exercise behaviour have resulted in a plethora of terms (Allegre, Souville, Therme, & Griffiths, 2006), such as *exercise addiction* (Terry et al., 2004), *exercise dependence* (Ogden et al., 1997), *obligatory exercise* (Thompson & Pasman, 1991), *compulsive exercise* (Yates, 1991), and *excessive exercise* (Davis et al., 1993). The various measures of compulsive exercise already in use have been developed using a wide range of participants including runners (e.g., Obligatory Exercise Questionnaire; Thompson & Pasman, 1991), university students (e.g., Compulsive Exercise Test; Taranis et al., in press), individuals with eating disorders (e.g., Commitment to Exercise Scale; Davis et al., 1993), and community samples (e.g., Exercise Dependence Questionnaire; Ogden et al., 1997). Notably, few studies have actually assessed the measures' use within adolescent populations. Given that compulsive exercise has been closely linked with eating disorders (Davis et al., 1994; Lipsey et al., 2006; Matheson & Crawford-Wright, 2002), and that the majority of eating disorder concerns develop in adolescence (Beumont, 2002; Sands, 2000; Stice et al., 2002), the concept of compulsive exercise needs to be studied within an adolescent population.

The traditional view of exercising within the context of eating disorders is that individuals engage in exercise simply to manage their weight (Fairburn et al., 2003; Shroff et al., 2006). However, this assumption does not apply to all individuals (Thome & Espelage, 2007) and, as such, it is important that a measure of compulsive exercise accounts for a more multidimensional approach (Taranis et al., in press). In view of this need for a comprehensive exercise assessment, the Compulsive Exercise Test (CET; Taranis et al., in press) was recently created. The CET provides assessment on five core features of compulsive exercise, namely, avoidance and rule-driven behaviour, weight control exercise, mood improvement, lack of exercise enjoyment, and exercise rigidity. This new measure is based on a cognitive-behavioural conceptualisation and has been shown to provide a useful method of assessing compulsive exercise (Taranis et al., in press). However, it has not yet been used with adolescents.

In summary, compulsive exercise is an important factor in the development and management of eating disorders (Hechler et al., 2005), and among clients of sport and health professionals (Draeger, Yates, & Crowell, 2005). The evaluation of a measure that accurately assesses this concept is required. Specifically, given that the first onset of eating disorders often occurs during childhood and adolescence (Stice et al., 2002), a measure that has been tested for its use with this age group would appear useful. The CET has been developed and validated against other measures of compulsive exercise, as well as measures of eating psychopathology (Taranis et al., in press). However, to date, it has only been tested with non-eating disordered young adult exercisers (Taranis et al., in press), and so this study provides the first psychometric evaluation of the CET within an adolescent population.

The aims of the study are threefold. First, to confirm the factor structure of the Compulsive Exercise Test (CET) in a community adolescent sample; second, to assess the concurrent and convergent validity of the CET within the same adolescent population; and finally, to report the relationship between compulsive exercise and actual exercise behaviour.

METHODS

Participants

One thousand seven hundred and twenty-five participants were recruited from secondary schools across the United Kingdom. Nine secondary schools were contacted and all agreed to participate in a wider study about eating and exercise-related attitudes. Due to incomplete data and non-responders, there was a final response rate of 59%. Therefore, a sample of 1012 adolescents, aged 12-14 years old, completed questionnaires and were included in the analyses. The sample had a mean age of 13.02 years (SD = .72), and gender was evenly spread (male n = 458, 45.3%; female n = 554, 54.7%). The participants were predominantly British (96.4% of the sample) and classified their ethnicity as “White British” (94.7%). Only “Other white background” and “Asian or Asian British – Pakistani” scored above 1% of the sample (1.3% and 1.2% respectively). The sample of schools represented areas of average to low levels of economic deprivation, according to the Office for National Statistics’ figures on deprivation (Office for National Statistics, 2008).

Measures and Procedure

Following Institutional Review Board ethical approval and informed consent, questionnaire packs, including consent forms and parent letters, were sent to the participating schools. Each school’s point of contact (member of staff on senior management team) distributed letters to the parents/caregivers and, approximately one week later, administered the questionnaire packs during a regular timetabled class period to pupils within the age range required for the study. The administering teacher was given instructions to help ensure that packs were completed correctly and consistently. The participants completed a background information sheet collecting demographic information (including nationality, ethnicity, age, and gender). After this, they each completed the following questionnaires in the order presented below:

Leisure Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985). The LTEQ measures participants' current activity levels. It is a 3-item questionnaire recording how many times per week a participant engages in exercise for at least 15 minutes at mild (e.g., easy walking), at moderate (e.g., cycling), and/or at strenuous (e.g., running, vigorous workout) intensity. Exercise frequencies of strenuous, moderate, and mild exercise are then multiplied by nine, five, and three respectively to obtain the Metabolic Equivalents (METS). A total exercise MET score is then calculated by adding the three intensity MET values together. The LTEQ has been previously used with adolescent populations (e.g., Gillison et al., 2006), showing good psychometric properties within this age group (Sallis, Buono, Roby, Micale, & Nelson, 1993). In line with previous work employing the LTEQ (e.g., Gillison et al., 2006), only total exercise frequency (MET) was used in this study.

Commitment to Exercise Scale (CES; Davis et al., 1993). The CES is an 8-item scale that measures the 'obligatory' element of exercising (e.g., feelings of guilt when an exercise session is missed, and adherence to a fixed and set routine) and the 'pathological' element of exercising (e.g., continuing to exercise despite illness or fatigue). The CES was administered to act as a validated measure of compulsive exercise attitudes. In the original development of the measure (Davis et al., 1993), participants were instructed to mark their position on a horizontal line, indicating the extent to which the behaviour being described applied to them. More recent studies have adopted a Likert scale ranging from 0 to 10 to enable easier data entry and accuracy of answering (e.g., Mond et al., 2006). The same Likert scale approach (0 'never' to 10 'always') was used in this study. A total score was obtained by summing all items, and then was divided by the number of items, to obtain an average per item value. The higher the average item score, the greater the commitment to exercise. The CES has been previously used among adolescents (Davis, Katzman et al., 1999), has been shown to be related to dietary restraint (McLaren, Gauvin, & White, 2001), and has demonstrated good reliability in an adult population (Mond, Myers, Crosby, Hay, & Mitchell, 2008). In this current study, the CES reported a Cronbach's alpha value of .85, demonstrating good internal consistency.

Compulsive Exercise Test (CET; Taranis et al., in press). The CET is a 24-item self-report measure designed to assess the core features of compulsive exercise. It has five subscales: Avoidance and Rule-Driven Behaviour (e.g., "I feel extremely guilty if I miss an exercise session"); Weight Control Exercise (e.g., "I exercise to burn calories and lose weight"); Mood Improvement (e.g., "I feel less anxious after I exercise"); Lack of Exercise Enjoyment (e.g., "I find exercise a chore"); and Exercise Rigidity (e.g., "I follow a set routine for my exercise"). Responses are scored on a 6-point Likert scale, anchored with '0 – never true' and '5 – always true'. A total CET score can be calculated by summing the mean item score for each of the five subscales. Higher total scores represent greater compulsive exercise. The CET has been used with a community sample of young adult exercisers, displaying good psychometric properties (Taranis et al., in press).

Eating Disorder Inventory - 2 (EDI-2; Garner, 1991). The Drive for Thinness, Bulimia, and Body Dissatisfaction subscales of the EDI-2 were administered in order to assess eating and shape-related attitudes. It is scored on a 6-point Likert scale, with higher scores representing more disturbed eating and shape-related attitudes. The EDI-2 (and its previous versions) is extremely well cited (e.g., Anton, Perri, & Riley, 2000; Gilbert & Meyer, 2004; Hart & Kenny, 1997; Lowe et al., 1998) and measures the symptomatic dimensions associated with AN and BN. It has been widely tested for its reliability and validity; both of which have been satisfactorily demonstrated (Eberenz & Gleaves, 1994; Garner, 1991). It has also been used in its various forms among adolescents (e.g., Grylli, Hafferl-Gattermayer, Wagner, Schober, & Karwautz, 2005; Striegel-Moore et al., 2000; Williams, 1987). The Cronbach's alpha values found in the present study were .84 (Drive for Thinness), .74 (Bulimia), and .90 (Body Dissatisfaction), which are in line with previous studies that have used the EDI-2 within adolescent samples (Adams, Katz, Beauchamp, Cohen, & Zavis, 1993; Buchholz et al., 2007).

RESULTS

Preliminary Analyses

Initial analyses and screening were conducted to establish the factorability of the data. Missing data on items were replaced by the means for the individual, and not the sample, in order to avoid a reduction in the sample variance (Hill & Lewicki, 2005). The sample of 1012 participants provided an excellent size for factor analysis (>1000; Comrey & Lee, 1992), easily satisfying Nunnally's (1978) suggestion of ten cases per item. A preliminary principal components analysis (PCA) was conducted separately for males and females. Results confirmed that there were no gender differences in the number of factors retained, or in the underlying factor structure. Therefore all subsequent analyses were conducted using the entire sample.

Exploratory Principal Components Analysis (PCA)

An exploratory PCA was conducted on the 24-items of the CET using the whole sample, to identify the number of factors. A PCA was chosen as there are insufficient structural validity studies of the measure to warrant a confirmatory analysis (Byrne, 2006). The use of PCA, as opposed to factor analysis, also allowed for greater comparability with the original CET development paper (Taranis et al., in press). Inspection of the item correlation matrix demonstrated that there were sufficient inter-item correlations, with all 24 items correlated (> .3) with at least one other item (Tabachnick & Fidell, 2007). Kaiser's (1970, 1974) measure of sampling adequacy (the Kaiser-Meyer-Olkin MSA) indicated that the inter-correlation matrix was appropriate for factors analysis (MSA = 0.92), being well above the minimally recommended level (MSA = 0.60; Tabacknick & Fidell, 2007).

The retention of factors was determined by a number of criteria. Firstly, the Kaiser (1961) criterion (Eigenvalues greater than one) suggested a five factor solution. However, the scree test (Cattell, 1966) suggested that a four factor solution may be more appropriate. Additionally, Horn's parallel analysis (Horn, 1965) was conducted and this too suggested a four factor solution. Ambiguity of results between criteria requires inspection of communality values (Field, 2005), as well as the interpretability of each of the proposed solutions in respect to underlying theory (Simmons, Worrell, & Berry, 2008). Communalities produced by the PCA indicated that with the four factor solution, too many items had a communality value of less than .5 and, importantly, the average communality was less than .6 (.57), which is deemed insufficient (Field, 2005). Conversely, the five factor solution produced a communality average of .61, suggesting that this solution should be chosen. Additionally, all five factors contained at least three items that loaded greater than .3, which satisfied the criterion of Pallant (2007).

Lastly, on inspection of the items, and the interpretability of each factor in relation to the underlying theory of compulsive exercise, the five factor solution appeared to be more conceptually cohesive.

Therefore, a five-factor solution was chosen for subsequent oblique (direct oblimin) rotation. An oblique extraction method was chosen to allow for correlation between the factors. It was expected that factors would correlate to some degree as they assess facets of the same underlying compulsive exercise construct (Taranis et al., in press). Inspection of the component correlation matrix confirmed that the retained components were indeed correlated.

During examination of the individual items, a cut-off of >.50 as used by Taranis et al., (in press) was adopted to identify significant factor coefficients. Of the 24 items, there were two items with loadings of <.50 (items 11 and 15). However, given that the sample size in this study is much larger than that of the original paper's sample, the cut-off could be set too high, and there is the risk of eliminating important items based on arbitrary cut-off values. Certainly, in large samples, it is recommended that cut-off values be lowered (Tabachnick & Fidell, 2007). Tabachnick and Fidell (2007) also add that when homogeneity of responses are expected, as in the current study, then lower cut-offs are also warranted. Items 11 and 15 were therefore retained. One item (item 15), cross-loaded onto more than one factor (defined as loading simultaneously onto two or more factors with a difference between loadings of less than .10). However, cross-loadings were not unusual given that some conceptual overlap between facets of the scale was expected. Therefore, item 15 was retained (Table 3.1). The Pattern matrix of all items can be seen in Table 3.1.

Table 3.1 Factor loadings of the five factor solution of the CET (N = 1012)

Item	Factor (salient items, >.5, in bold) 1	2	3	4	5
Factor 1					
22 I feel like I've let myself down if I miss an exercise session	**.76**	.02	-.01	-.09	.20
16 If I cannot exercise I feel agitated	**.75**	-.04	.02	.13	-.01
23 If I cannot exercise I feel anxious	**.74**	.20	.06	.11	-.09
20 If I cannot exercise I feel angry and/or frustrated	**.70**	.04	.07	.12	.05
10 I feel extremely guilty if I miss an exercise session	**.68**	-.07	-.02	-.02	.22
9 If I cannot exercise I feel low or depressed	**.64**	.11	.04	.12	-.05
11 I usually continue to exercise despite injury or illness, unless I am very ill or too injured	.48	-.34	-.05	-.04	.15
15 If I miss an exercise session, I will try and make up for it when I next exercise	.36	-.28	.09	.16	.29
Factor 2					
5 I find exercise a chore	-.03	**.82**	.05	.14	.20
21 I do not enjoy exercising	.18	**.77**	-.01	-.11	-.04
12 I enjoy exercising	-.01	**.65**	-.01	-.34	-.14
Factor 3					
13 I exercise to burn calories and lose weight	-.03	-.02	**.82**	.11	.06
8 I do not exercise to be slim	-.07	-.05	**.70**	-.23	-.20
2 I exercise to improve my appearance	-.10	.05	**.68**	.24	.24
18 If I cannot exercise, I worry that I will gain weight	.36	.12	**.63**	.02	.04
6 If I feel I have eaten too much, I will do more exercise	.27	.03	**.52**	.02	.15
Factor 4					
14 I feel less stressed and/or tense after I exercise	.14	-.12	.09	**.73**	-.10
4 I feel less anxious after I exercise	-.02	.04	.03	**.68**	.22
24 I feel less depressed or low after I exercise	.22	.18	-.11	**.62**	-.08
1 I feel happier and/or more positive after I exercise	-.10	-.24	.07	**.59**	.27
17 Exercise improves my mood	.16	-.33	.04	**.58**	.03
Factor 5					
7 My weekly pattern of exercise is repetitive	.08	-.02	-.02	-.04	**.81**
19 I follow a set routine for my exercise sessions e.g. walk or run the same route, particular exercises, same amount of time, and so on	.13	.04	.01	-.07	**.77**
3 I like my days to be organised and structured of which exercise is just one part	-.01	.10	.11	.17	**.67**
Eigenvalue	7.89	2.71	1.96	1.11	1.07
% Variance	32.88	11.28	8.17	4.62	4.46

The five factors retained explained 61.4% of the variance. Interpretation of the components suggested that the first factor (8 items) was related to avoidance of affective withdrawal symptoms and rule-driven behaviour (“If I cannot exercise I feel anxious”; “I feel like I have let myself down if I miss an exercise session”) and was consistent with the CET subscale of ‘Avoidance and Rule-Driven Behaviour’. Factor 2 (3 items) related to individuals reporting a lack of enjoyment for their exercise behaviour (“I find exercise a chore”), and was in line with the ‘Lack of Exercise Enjoyment’ subscale. Factor 3 (5 items) contained all items from the ‘Weight Control Exercise’ subscale, with items pertaining to exercise for weight and shape reasons (“I exercise to burn calories and lose weight”). Factor 4 (5 items) contained items that referred to exercising for positive mood regulatory reasons (“I feel happier and/or more positive after I exercise”) and was in line with the CET’s ‘Mood Improvement’ scale. The final factor, Factor 5 (3 items), contained the items of the ‘Exercise Rigidity’ subscale, referring to exercising in a consistent and repetitive fashion (“My weekly pattern of exercise is repetitive”).

Internal Consistency of the CET in Adolescents

The internal consistency of the identified factors on the CET was subsequently established. The Cronbach’s alpha coefficients of the factors were .87 (Avoidance and Rule-Driven Behaviour), .77 (Weight Control Exercise), .79 (Mood Improvement), .71 (Lack of Exercise Enjoyment), and .75 (Exercise Rigidity). The total CET score had a reliability value of .88. These values are all regarded as acceptable (Nunnally, 1978), and were largely similar to the adult sample tested in the original development paper (Taranis et al., in press).

Concurrent and Convergent Validity of the CET in Adolescents

Prior to running tests for validity, potential gender differences on the CET were assessed. A two-tailed independent samples t-test was used to compare total CET scores for males and females. No significant difference was found ($t = .17$, $p > .05$), and therefore all further validity tests were conducted on the whole sample.

Concurrent and convergent validity was assessed by computing correlation coefficients (one-tailed; Spearman’s rho) between the CET and the CES, and the

CET and EDI-2 subscales, respectively. All correlation coefficients were calculated non-parametrically, as the Kolmogorov-Smirnov test suggested that only the total CET score had a normal distribution. The means and standard deviations (SD) for total scale and subscale scores of the measures can be seen in Table 3.2.

Table 3.2 Characteristics of the sample (N = 1012)

	Minimum	Maximum	Mean (SD)
Total CES	.00	10.00	4.39 (2.18)
Total CET	.20	20.96	10.04 (3.77)
CET - Avoidance and Rule-Driven Behaviour	.00	5.00	1.51 (1.10)
CET - Weight Control Exercise	.00	5.00	2.44 (1.21)
CET - Mood Improvement	.00	5.00	2.62 (1.18)
CET - Lack of Exercise Enjoyment	.00	5.00	1.32 (1.16)
CET - Exercise Rigidity	.00	5.00	2.15 (1.31)
EDI-2 - Drive for Thinness	.00	21.00	4.63 (5.30)
EDI-2 – Bulimia	.00	21.00	2.16 (3.35)
EDI-2 - Body Dissatisfaction	.00	27.00	7.96 (7.69)
Total Exercise Frequency[a,b]	.00	244.00	60.20 (32.74)

Note: [a] N = 1006; [b] Measured in Metabolic Equivalents (METS); CES = Commitment to Exercise Scale; CET = Compulsive Exercise Test; EDI-2 = Eating Disorder Inventory-2.

The range of the scores on all CET subscales, as well as all EDI-2 subscales, suggests that this sample contained a wide range of compulsive exercising and eating disordered attitudes. Across all CET subscales, the means were lower than the means found for the same scales in the adult sample used by Taranis and colleagues (in press). Noticeably, the relative size of each scale's mean concurred with the figures found in the original development of the measure, with Avoidance and Rule-Driven Behaviour recording the smallest mean and Mood Improvement recording the highest mean. The means for the EDI-2 subscales found here are also largely similar to the means found in other adolescent populations of the same age range (e.g., Striegel-Moore et al., 2000).

Results support the concurrent validity of the CET, with the total CET score being significantly and positively correlated with the total CES score (r = .54, p < .01). Additionally, the CES was significantly associated (p < .01) with all CET subscales (Avoidance and Rule-Driven Behaviour: r = .65; Weight Control Exercise: r = .27; Mood Improvement: r = .54; Lack of Exercise Enjoyment: r = -.33; Exercise Rigidity: r = .56) and all associations were in a positive direction, with the exception of Lack of Exercise Enjoyment which showed a negative association with the CES.

Convergent validity was confirmed with significant positive correlations (p < .01 in all cases) between the total CET score and the EDI-2 subscales; Drive for Thinness (DT; r = .48), Bulimia (B; r = .21), and Body Dissatisfaction (BD; r = .24). The subscales of each measure were related differently. Specifically, Avoidance and Rule-Driven Behaviour was significantly correlated in a positive direction with Drive for Thinness (r = .27, p < .01), Bulimia (r = .14, p < .01), and Body Dissatisfaction (r = .07, p < .05). Weight Control Exercise also showed significant positive correlations (p < .01) with all three EDI-2 subscales (DT: r = .68; B: r = .24; BD: r = .49), as did Lack of Exercise Enjoyment (DT: r = .13; B: r = .18; BD: r = .24). Exercise Rigidity was only significantly positively correlated with Drive for Thinness (r = .26, p <.01) and Bulimia (r = .07, p <.05). Mood Improvement Exercise was only significantly related to Drive for Thinness (r = .17, p < .01).

CET and Exercise Frequency in Adolescents

The relationship between the CET and Total Exercise Frequency was assessed by computing correlation coefficients (one-tailed; Spearman's rho). Extreme outliers on the Total Exercise Frequency variable (n = 6) were identified on the boxplots and were removed from the analyses, as they were unduly influencing the variable's mean. Missing cases were deleted using listwise deletion.

Total Exercise Frequency was positively and significantly associated with the total CET score (r = .15, p < .01), as well as with the subscales of Avoidance and Rule-Driven Behaviour (r = .25, p < .01), Mood Improvement (r = .21, p < .01), and Exercise Rigidity (r = .19, p < .01). Lack of Exercise Enjoyment reported a significant negative association with Total Exercise Frequency (r = -.23, p < .01).

No significant association was found between Weight Control Exercise and Total Exercise Frequency (r = .05, p > .01).

DISCUSSION

The key aims of this study were to confirm the factor structure of the Compulsive Exercise Test (CET) within a general adolescent population, and to validate its use within this population. The results confirm the five factor structure of the measure, with all original items and subscales being retained. The presence of an Avoidance and Rule-Driven Behaviour subscale, as well as a scale related to exercise rigidity, is in line with previous research that has highlighted the links between compulsive exercise attitudes and obsessive-compulsiveness (Davis et al., 1997; Gulker et al., 2001).

Traditionally, exercising within the context of eating disorders is predominantly seen as a method of weight control only (Fairburn et al., 2003; Shroff et al., 2006). However, it has been more recently demonstrated that this may not always be the case (Thome & Espelage, 2007) and, as such, it is important that compulsive exercise assessment is multidimensional (Taranis et al., in press). The factor structure shown in this study supports this multidimensionality by the presence of a five factor solution, of which exercising for weight control is just one factor.

The aim of providing satisfactory concurrent and convergent validity of the CET within an adolescent sample was also achieved. The CET demonstrated a moderate, significant correlation with an established measure in the field, the Commitment to Exercise Scale (Davis et al., 1993). The CET was also significantly associated with the EDI-2 subscales, demonstrating good convergent validity. The association appeared stronger with the Drive for Thinness scale, which is analogous to features of AN, than with the Bulimia scale, which is related to features of BN. This is in line with previous research that has linked compulsive exercise more closely with AN than with BN (Davis & Claridge, 1998; Penas-Lledo et al., 2002).

The study had an additional aim of examining the relationship between compulsive exercise attitudes and exercise behaviour. Previous research has found that exercise behaviour is not a valid marker of compulsive exercise attitudes (Boyd, Abraham, & Luscombe, 2007; Lipsey et al., 2006). This was supported by the findings in this study. In this sample, total CET was significantly associated with Total Exercise Frequency but the strength of the correlation was extremely small (r = .15). Indeed, the statistical significance obtained here is likely a result of the large sample size used in the analysis. Therefore, this lack of a meaningful association between compulsive exercise attitudes and total exercise frequency concurs with previous findings (Ackard et al., 2002; Adkins & Keel, 2005; Mond et al., 2006; Mond et al., 2004a) and calls for any assessment of compulsive exercise to incorporate the cognitive and affective features of the construct and not solely the behavioural aspects.

Interestingly, the Weight Control Exercise subscale of the CET did not report any significant associations with the Total Exercise Frequency scores. This would suggest that an individual with highly weight- and shape-related exercising attitudes would not necessarily exercise more frequently. This supports previous research that demonstrated a low correlation between exercise frequency and eating disorder psychopathology (Mond et al., 2006).

These results have several implications for research and clinical practice. In research, prevalence figures of compulsive exercise within the eating disorders have varied considerably (e.g., Davis, 1997; Shroff et al., 2006). These equivocal prevalence figures could be linked to the different methods of assessment used (Solenberger, 2001), as well as being due to the multifactorial nature of compulsive exercise, which the CET uncovers. Clinically, this could be problematic. Clinicians that have defined compulsive exercise using only behavioural markers (e.g., Brewerton et al., 1995), such as hours per week of exercise, may erroneously ignore the issue of exercise in individuals who do still have problematic exercise cognitions. Clinicians need to be aware of this discrepancy and utilise comprehensive multidimensional measures of compulsive exercise, such as the CET, in order to improve treatment options.

The use of multidimensional measures would also be advocated in early identification and prevention. Certainly, the CET could provide a useful tool with which to monitor potentially detrimental behavioural, cognitive, and affective exercise features in a population at risk of developing eating disorders. Among adolescents who often engage in greater activity than adults (Telama & Yang, 2000), and via unstructured activity such as play, identifying an individual who is potentially developing compulsive exercise by observation alone would likely be difficult. Instead, identifying any maladaptive attitudes towards exercise within a non-eating disordered adolescent population is likely to be of great value, as it could be used as a marker for risk of developing an eating disorder (Yates et al., 2001). The CET's theoretical grounding in the context of eating disorders (see Taranis et al., in press), and its sufficient reliability and validity found within this study among an adolescent population, make it well-placed to fulfil this role.

A limitation of the current study, however, is that the CET was only validated with a measure of eating, weight and shape attitudes and not of clinical eating disorders. Therefore, its use as a screening tool warrants further investigation in adolescent research which utilises a clinical eating disorder measurement, such as the Eating Disorder Examination (EDE; Fairburn & Cooper, 1993). The results would also need to be replicated in a clinical eating disordered adolescent population.

Further, longitudinal studies that use the CET as a predictor of eating disorder psychopathology need to be conducted to substantiate the findings of this current study and justify the suggested use of the CET as a screening tool for eating disorders in an adolescent setting. Longitudinal studies also need to be conducted to further examine the development of compulsive exercise, and the development of its specific components, over time in order to identify whether any of these components can predict later disordered eating. The temporal stability of the factor structure would also be tested in the longitudinal designs, which would be useful to identify whether it varies across time in different populations, such as adolescents, at risk individuals, and eating disorder patients.

Another limitation of this study is that the CET is a self-report inventory. Although the findings report satisfactory reliability and validity for its use, the problems of self-report measures in any field of research are well documented (see Razavi, 2001). To minimise the risk, the psychometric strength of the measure needs to be further assessed. Therefore, future research should look to examine properties such as the test-retest reliability of the CET, to identify whether there is temporal consistency of the concept of compulsive exercise, as measured by this tool. There is also the need to validate the CET with an interview assessment of compulsive exercise, encompassing the broad range of attitudes and emotions captured by the compulsive exercise construct.

In summary, the Compulsive Exercise Test has retained its factor structure in an adolescent population. It has demonstrated that it is a useful and comprehensive measure of compulsive exercise that is reliable and valid for use in an adolescent population aged between 12 and 14 years old. These results need to be replicated among older adolescents and amongst an adolescent eating disordered population.

PART 2: Correlates of Compulsive Exercise

Chapters 4 – 6: Psychological, Socio-Cultural, and Behavioural Correlates of Compulsive Exercise

Chapter 4

Psychological Correlates of Compulsive Exercise

Studies 2 and 3

4 Psychological Correlates of Compulsive Exercise

Chapter 3 supported the CET's factor structure and demonstrated that it is a valid and reliable measure for use among adolescents. Therefore, the CET can now be used in the subsequent risk factor research reported in this thesis. The first stage of the risk factor research process is to conduct cross-sectional studies to establish the correlates of the outcome of study (Kazdin et al., 1997). Therefore, the current chapter consists of two empirical studies that have used cross-sectional designs, and the aim of this current chapter is to provide the first examination of the correlates of the CET in an adolescent population.

This chapter focuses on the psychological characteristics that are hypothesised to be associated with compulsive exercise. In the systematic review (see 1.4.2), eating disorder psychopathology (including body dissatisfaction), obsessive-compulsiveness, perfectionism, anxiety and depression were all found to be related to problematic exercise in clinical eating disorder samples. In addition, the general review of risk factors for compulsive exercise (see 1.5) also highlighted the potential link of social physique anxiety with compulsive exercise. Therefore, the first study will test these hypothesised personality and psychological correlates for their cross-sectional prediction of compulsive exercise. This study has been submitted for publication in the International Journal of Eating Disorders, and is entitled: "*Goodwin, H., Haycraft, E., Willis, A., & Meyer, C. (under review). Compulsive exercise: The role of personality, psychological morbidity, and disordered eating. International Journal of Eating Disorders"*.

The second study in this chapter focuses on the role of emotion regulation and its hypothesised association with compulsive exercise. Exercise behaviour in general has demonstrated mood regulatory properties (2001). Further, a recent study suggested that eating disorder patients were using exercise as a means of managing negative affect (Bratland-Sanda et al., 2010). However, the emotion regulation properties of compulsive exercise (as measured by the CET) have not been established, particularly in an adolescent population. Therefore, the second study in this chapter aimed to identify whether compulsive exercise was associated with emotion regulation styles. This study formed the basis of a conference presentation that was entitled: *"Goodwin, H., Haycraft, E., & Meyer, C.*

(2010). Compulsive exercise and emotion regulation. Presented at the Eating Disorders International Conference, March 2010, London."

This chapter will present both studies with a discussion for each of them provided at the end of each study. An overall discussion regarding the associations between psychological characteristics and compulsive exercise will be given in the general discussion at the end of the thesis (see Chapter 9).

Study 2: Compulsive exercise: The role of personality, psychological morbidity, and disordered eating

Abstract

Objective: Compulsive exercise has been closely linked with eating disorders, and has been widely reported in both clinical and non-clinical settings. It has been shown to have a negative impact on eating disorder treatment and outcome. However, the risk factors for compulsive exercise have not been examined. This study aimed to provide a first step in identifying potential cross-sectional predictors of compulsive exercise. **Method:** The sample consisted of 1488 male and female adolescents, aged 12-14 years old, recruited from schools in the United Kingdom. Participants completed measures of compulsive exercise, personality, psychological morbidity, and disordered eating attitudes during a school class period. **Results:** Multiple stepwise regressions showed that the strongest cross-sectional predictors of compulsive exercise were a drive for thinness, perfectionism, and obsessive-compulsiveness. **Discussion:** These results are discussed in terms of the role that psychological factors may play in the development of compulsive exercise.

Compulsive exercise: The role of personality, psychological morbidity, and disordered eating

Eating disorders comprise a variety of problematic behaviours, including bingeing, purging, and restricting food consumption (APA, 1994). Another such problematic behaviour that has been widely reported in both clinical and non-clinical settings is that of compulsive exercise. Compulsive exercise has been defined as an intense drive to be active, often in a rigid, routine-like fashion that is predominantly performed to manage weight and shape, as well as alleviating negative emotions (Goodwin et al., in press; Taranis et al., in press). It has been found in as many as 39% of AN patients and 23% of BN patients at admission to an eating disorder clinic (Brewerton et al., 1995) and has been linked with greater treatment time, poorer outcome, and increased chance of relapse (Solenberger, 2001; Strober et al., 1997).

Additionally, compulsive exercise has been found in community samples (Taranis et al., in press) and has been implicated in the aetiology of eating disorders (Davis et al., 1997). The development of eating disorders predominantly occurs around early adolescence (Striegel-Moore & Bulik, 2007), and yet little to no research on compulsive exercise has been conducted among adolescent samples. This age-group represents an important population to study in risk factor research into eating disorders and compulsive exercise and, as such, investigations are required to identify whether a compulsive drive to exercise is directly linked to disordered eating attitudes at this early age.

Importantly, not all individuals with eating disorder pathology display a compulsive drive to exercise. Therefore, it is likely that there are specific psychological and personality differences that render an individual at risk of specifically developing compulsive exercise. However, the risk factors for compulsive exercise are poorly understood.

A thorough review of previous research has identified several personality traits (including perfectionism and obsessive-compulsiveness) and psychological states (including anxiety) as potential maintaining factors for compulsive exercise (Meyer et al., in press), but these relationships with compulsive exercise have yet to be tested in adolescents. It is also not clear which of these potential predictors of compulsive exercise are the most potent risk factors for its development.

One possible personality trait linked to the development of compulsive exercise is perfectionism, which has been reported as a risk factor for both AN (Tyrka et al., 2002) and BN (Fairburn et al., 1997). Perfectionism has already been found to be an antecedent to obligatory exercise (Coen & Ogles, 1993), as well as exercise dependence (Hagan & Hausenblas, 2003); terms which encompass similar, if not the same constructs as compulsive exercising.

Obsessive-compulsiveness has also been strongly linked with compulsive exercise in both clinical and non-clinical eating disorder samples. Compulsive exercise has been related to obsessive-compulsiveness in a sample of health club exercisers (Wyatt, 1997), and to weight preoccupation and excessive exercise in a clinical eating disorder group (Davis & Claridge, 1998). In studies that have used the term exercise dependence, obsessive-compulsiveness (Adams & Kirkby, 2002) and rigidity (Adams et al., 2003) have also been proposed as common characteristics of exercise dependent individuals.

A key feature of compulsive exercise is a negative mood, such as, experiencing feelings of anxiety, depression, and guilt, when deprived of exercising (see Hausenblas & Symons Downs, 2002b). However, other studies have found negative affect, in its various forms (i.e., anxiety and depression), to be related to continued exercise and not simply a resultant state of exercise deprivation. For example, Coen and Ogles (1993) found that compulsive exercisers scored higher on anxiety than non-compulsive exercisers. Similarly, greater levels of depression have been related to compulsive exercise in both clinical and non-clinical samples (Penas-Lledo et al., 2002; Yates et al., 1983).

In addition to general anxiety, social anxiety has been implicated in the development of eating disorders (Halmi et al., 1991). Women with eating disordered behavioural tendencies are more likely to be fearful of negative evaluation and have greater sensitivity to the impressions of others (Mack et al., 2007a). Specific to exercise, a tendency towards social comparisons has been shown to have a stronger impact on adolescent boys' exercising than on their eating (Ricciardelli et al., 2000). Previous research has also found that social physique anxiety, a body specific form of social anxiety, is positively related to greater exercise frequency (Frederick & Morrison, 1996). However, no study has focused on the role of social physique anxiety in the development of compulsive exercise.

In summary, compulsive exercise is a problematic behaviour that affects many individuals with eating disorders. The risk factors for compulsive exercise are unknown and require investigation. The few studies that have considered exercise within the eating disorders have found potential risk factors to be obsessive-compulsiveness, perfectionism, general anxiety, body-specific anxiety, depression, and greater levels of disordered eating attitudes (Davis, Katzman et al., 1999; Penas-Lledo et al., 2002; Shroff et al., 2006). However, it is important to investigate compulsive exercise in non-clinical samples first, given that it has been shown to play a role in the development of the eating disorders and therefore is present, to some degree, in non-clinical samples. The development of eating disorders often occurs during adolescence (Sands, 2000; Striegel-Moore & Bulik, 2007), and therefore, research into compulsive exercise among non-clinical adolescents is required. Studying this age group will also help to inform any prevention and early intervention work into compulsive exercise.

Using a non-clinical adolescent sample, this study aims to identify which personality, psychological and disordered eating factors are the best cross-sectional predictors of compulsive exercise. It is hypothesised that all significant predictors will be positively associated with compulsive exercise. Given the paucity of previous research, no predictions were made regarding which variable would be the best predictor of compulsive exercise.

METHODS

Participants

This research was conducted in nine schools across the United Kingdom as part of an ongoing larger scale research project. This study reports on a sample of 1488 participants, aged 12-14 years old. The sample had a mean age of 12.98 years (SD = .73), and gender was equally distributed (girls = 54.1%; boys = 45.9%). The sample predominantly (95.3%) classified their ethnicity as “White British”, and all the schools were from areas of average to low levels of economic deprivation (Office for National Statistics, 2008). Self-reported height and weight information was converted into Body Mass Index (BMI) for each participant, which was then converted into a z score, so that they were standardised for both age and gender (Child Growth Foundation, 1996). The mean values for BMI z scores were .32 (SD = 1.39) for boys and .08 (SD = 1.34) for girls.

Measures and Procedure

Institutional Review Board ethical approval was granted before questionnaire packs were sent to the participating schools. A point of contact (who was a member of staff on the senior management team) distributed the questionnaire packs to pupils aged between 12 and 14 years old, and pupils then completed the measures during a school class period. Instructions were provided for the teacher to ensure that packs were completed consistently. Upon completion, pupils returned their packs to the administering teacher, who subsequently returned them to the research team.

The participants first provided background information on nationality, ethnicity, age, gender, height and weight. The following validated measures were completed subsequently:

Compulsive Exercise Test (CET; Taranis et al., in press) The CET is a 24-item measure that assesses the level of compulsive exercise. It has five subscales that represent the five core features of the behaviour, namely: Avoidance and Rule-Driven Behaviour; Weight Control Exercise; Mood Improvement; Lack of Exercise Enjoyment; and, Exercise Rigidity. Responses are scored on a six-point Likert scale, anchored with '0 – never true' and '5 – always true'. The level of compulsive exercise is then identified by creating a total CET score, which is calculated by summing the mean item score for each of the five subscales. Higher scores represent greater levels of compulsive exercise. A psychometric evaluation of the CET in these adolescents has already supported its use (Goodwin et al., in press). In the current sample, the total CET had a Cronbach's alpha of .88.

Eating Disorder Inventory-2 (EDI-2; Garner, 1991)The Drive for Thinness, Bulimia, and Body Dissatisfaction subscales of the EDI-2 assessed disordered eating attitudes. This measure has been described in Study 1. The Cronbach's alpha values found in this study were .84 (Drive for Thinness), .72 (Bulimia), and .90 (Body Dissatisfaction), which are in line with previous studies that have used the EDI within adolescent samples (Buchholz et al., 2007; Strien, Engels, Van Leeuwe, & Snoek, 2005).

Child and Adolescent Perfectionism Scale (CAPS; Flett & Hewitt, 1992) The CAPS is a 22-item, two-scaled measure of perfectionism specifically worded for use within child and adolescent samples. The two scales are Self-Orientated

Perfectionism and Socially-Prescribed Perfectionism. The former subscale assesses the degree to which an individual imposes self-directed levels of perfectionistic standards and behaviours on to his or her self (e.g., "I try to be perfect in everything I do", "I feel that I have to do my best all the time"). The latter subscale assesses the degree to which an individual feels that their perfectionism is imposed on them by others, such as parents, friends, and/or teachers (e.g., "There are people in my life who expect me to be perfect", "My teachers expect my work to be perfect"). The items are answered using a five-point Likert scale, anchored with "1 – False – not at all true of me" and "5 – Very true of me", with higher scores representing greater levels of perfectionism. It has been previously used with adolescents and demonstrated good reliability (Hewitt, Newton, Flett, & Callander, 1997). The Cronbach's alpha for this sample was .81 for Self-Orientated Perfectionism and .87 for Socially-Prescribed Perfectionism.

Spence Child Anxiety Scale – Obsessive Compulsive Subscale (SCAS; Spence, 1997; 1998) The SCAS is a measure of anxiety symptoms among children. Only the Obsessive-Compulsive subscale was used in this study. It comprises six items assessing levels of obsessive-compulsiveness, which includes items such as "I can't seem to get bad or silly thoughts out of my head", and "I have to do some things in just the right way to stop bad things happening". Respondents are asked how often each of the statements relates to them and the questions are answered on a four-point Likert scale, ranging from "0 – never" to "3 – always". Greater scores equate to higher levels of obsessive-compulsiveness. The SCAS has previously been used with adolescents (Spence, 1998), displaying good psychometric properties, including a Cronbach's alpha of .73 for the Obsessive-Compulsiveness subscale. The internal reliability figure for the Obsessive-Compulsiveness subscale for the current sample was .79.

Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) The HADS is a 14-item measure of anxiety and depression that is widely used in clinical and non-clinical research and practice. Respondents are given a series of statements and answer each one on a four-point Likert scale. Example statements measuring anxiety include: "Worrying thoughts go through my mind" and "I get sudden feelings of panic", whilst example statements measuring depression include: "I feel as if I am slowed down" and "I feel cheerful" (reverse scored). The items are summed, with higher scores representing greater degrees of anxiety and depression. The HADS has been validated for use with adolescents (White et al., 1999), and provided Cronbach's alpha values of .73 for anxiety and .56 for depression for this sample.

Social Physique Anxiety Scale (SPAS; Hart et al., 1989) The SPAS is a 9-item scale measuring a respondent's level of social physique anxiety. Responses are answered using a five-point Likert scale that ranges from "0 – not at all characteristic of me" to "5 – extremely characteristic of me". Example questions include: "In the presence of others, I feel apprehensive about my physique/figure" and "Unattractive features of my physique/figure make me nervous in certain social settings". Responses are summed to form a total score, with higher scores representing greater levels of social physique anxiety. The SPAS has displayed good psychometrics among adolescents (Gillison et al., 2006; Smith, 2004), and obtained a Cronbach's alpha level of .87 for the sample in this current investigation.

Data Analysis

Data were first screened for normality. As expected, a Kolmogorov-Smirnov test showed that all variables were non-normally distributed, with the exception of the dependent variable, the CET Total score. Importantly, the residuals were normally distributed and, therefore, no transformations were made for the following analyses and non-parametric tests were used, where possible.

Preliminary analysis demonstrated that age appropriate Body Mass Index (BMI z-scores) were not significantly correlated with CET Total score for either boys ($r = .02$, $p > .05$) or girls ($r = .06$, $p > .05$). Therefore, BMI z scores were not included in any subsequent analysis as a control variable. In addition, and as expected, there were significant differences between boys and girls on the majority of the study variables (Mann Whitney U; Table 1). Therefore, subsequent regression analyses were conducted separately for boys and girls.

For each gender, a multiple stepwise regression was conducted to examine relationships between compulsive exercise and the predictor variables (self-orientated perfectionism, socially-prescribed perfectionism, obsessive-compulsiveness, anxiety, depression, social physique anxiety, drive for thinness, bulimic attitudes, and body dissatisfaction). Significance was set at .001 due to the large sample size.

RESULTS

Characteristics of the Sample

The means, standard deviations, and tests of difference of the scale scores can be seen in Table 4.1.

Table 4.1 Means and standard deviations for study variables by gender

	Mean (SD)		Test of Difference
Variables	Boys	Girls	z
Compulsive Exercise Total	10.01 (4.08)	9.94 (3.66)	.32
Drive for Thinness	2.82 (3.98)	6.13 (5.90)	10.40*
Bulimia	1.99 (3.18)	2.41 (3.49)	3.06*
Body Dissatisfaction	4.97 (5.67)	10.56 (8.13)	13.02*
Self-Orientated Perfectionism	34.05 (7.66)	32.91 (8.35)	2.81*
Socially-Prescribed Perfectionism	25.15 (8.17)	23.70 (8.33)	3.51*
Obsessive Compulsiveness	0.91 (0.63)	1.00 (0.67)	2.21
Anxiety	7.48 (3.65)	8.67 (3.65)	6.23*
Depression	4.24 (2.91)	3.92 (2.74)	3.64*
Social Physique Anxiety	21.61 (6.98)	28.01 (7.98)	15.11*

Note: * $p < .001$ (two-tailed); Samples sizes differed between test due to missing data

The mean CET Total score represents a mid-point scoring average for boys and girls, and is noticeably less than has been reported in clinical samples. The EDI subscale scores also represent average to low levels of disordered eating attitudes. Using the suggested clinical cut-off of >14 on the Drive for Thinness subscale (McGrane & Carr, 2002), it was found that approximately 10% of girls and 3% of boys recorded above this suggested cut-off value. Similarly, Grylli, Hafferl-Gattermayer, Schober, & Kawautz (2004) provided clinical cut-offs for the Bulimia subscale (≥5) and the Body Dissatisfaction subscale (≥15). For Bulimia, approximately 13% of boys and 15% of girls scored above this cut-off, whilst for

Body Dissatisfaction, approximately 5% of boys and as much as 25% of girls scored above the cut-off value.

The HADS subscale scores demonstrate normal levels of depression (i.e., none), whilst the anxiety subscale mean indicates mild levels of anxiety, according to suggested norms (Snaith & Zigmond, 1994). SPAS scores, Self-Orientated and Socially Prescribed Perfectionism scores and SCAS Obsessive Compulsiveness scores all represent normal levels for this age group (Mack et al., 2007a; Spence, 1998).

Regression Analysis

The final model of the multiple stepwise regression for boys can be seen in Table 4.2. The final model of the multiple stepwise regression as a whole was significant, accounting for 39% of the variance of total CET score. In the final model, Drive for Thinness, Self-Orientated Perfectionism, Obsessive-Compulsiveness, and Socially-Prescribed Perfectionism were the significant predictors. The CET total was not statistically predicted by HADS-Anxiety, HADS-Depression, Social Physique Anxiety, EDI-Bulimia, or EDI-Body Dissatisfaction.

Table 4.2 Final model for multiple stepwise regression of personality, psychological and disordered eating variables (predictor variables) on to CET Total Score (outcome) for boys

Predictors	*F (df)*	*Adjusted R^2*	*Beta*	*T*
Model	80.99 (4, 508)*	.39		
Drive for Thinness			.29	7.48*
Self-Perfectionism			.27	6.64*
Obsessive-Compulsiveness			.17	4.29*
Social Perfectionism			.14	3.45*

Note: * p <.001; CET = Compulsive Exercise Test

Table 4.3 Final model for multiple stepwise regression of personality, psychological and disordered eating variables (predictor variables) on to CET Total Score (outcome) for girls

Predictors	F (df)	Adjusted R^2	Beta	T
Model	108.47 (3, 621)*	.34		
Drive for Thinness			.34	9.69*
Self-Perfectionism			.31	8.77*
Obsessive-Compulsiveness			.15	3.97*

Note: * $p < .001$; CET = Compulsive Exercise Test

The final model of the multiple stepwise regression for the girls can be seen in Table 4.3. The regression model was significant, and it accounted for 34% of the variance of total CET score. The final model produced three significant unique predictors. These were Drive for Thinness, Self-Orientated Perfectionism, and Obsessive-Compulsiveness. For girls, the CET total was not statistically predicted by Socially-Prescribed Perfectionism, HADS-Anxiety, HADS-Depression, Social Physique Anxiety, EDI-Bulimia, or EDI-Body Dissatisfaction.

DISCUSSION

This study aimed to examine the best cross-sectional predictors of compulsive exercise among a sample of adolescents. The results indicate that for both boys and girls a drive for thinness was the best predictor, along with self-perfectionism, and then obsessive-compulsiveness. For boys only, social perfectionism was also an additional predictor, although it did not explain as much variance as the other significant variables. The hypothesis that all significant predictors would be positively associated with compulsive exercise was supported.

The significance of a drive for thinness supports the existing literature linking compulsive exercise closely with the eating disorders (Bamber, Cockerill, & Carroll, 2000; Brewerton et al., 1995). A key finding in this sample, though, was that only a drive for thinness, rather than bulimic attitudes and body dissatisfaction, was a significant predictor of compulsive exercise, for both boys and girls. This drive for thinness is analogous to symptoms of AN, and so this finding concurs with existing literature identifying compulsive exercise as more prevalent among AN patients than other eating disorder diagnoses (Brewerton et al., 1995; Davis et al., 1997). This compulsivity towards exercise could be a key marker in the development of AN, particularly as this association with a drive for thinness has been found in a generally healthy, non-clinical group of young adolescents. Further research is needed to identify how compulsive exercise interacts with a drive for thinness over time, and whether the exercise compulsivity puts individuals at increased risk of subsequently developing AN.

High levels of perfectionism and obsessive-compulsiveness were also linked to compulsive exercise. However, the psychological factors of anxiety and depression, as well as social physique anxiety, were not significant predictors. This is contrary to previous literature that has found a significant relationship between compulsive exercise and anxiety (Penas-Lledo et al., 2002). However, the aim of this study was to identify the best cross-sectional predictors of compulsive exercise, and it is likely that these psychological factors are still linked to compulsive exercise when considered on their own. It is possible that in a non-clinical adolescent sample, the level of anxiety may not yet be closely linked with exercising, with mood regulation not scoring highly among adolescents' reasons for engaging in physical activity (Gillison et al., 2006). Further research would be needed to identify whether the association between compulsive exercise and anxiety only occurs in specific samples, such as in a clinical eating disordered or adult population. The notion of compulsive exercise as a mood regulator also needs further longitudinal investigation to help explain the lack of finding here with anxiety levels.

The finding that perfectionism was among the best predictors of compulsive exercise is consistent with previous investigations (Hall et al., 2007). Although both scales of perfectionism were significant for the boys, there was a greater association with the self-orientated form of perfectionism. Likewise, for the girls, it was self-perfectionism and not social perfectionism that was found to be a significant predictor of compulsive exercise. Castro and her colleagues (2004) found that self-orientated perfectionism was more strongly associated with eating disorders than socially-prescribed perfectionism. This is also in accordance with a previous study that had shown AN patients to experience their perfectionism as self-imposed (Bastiani, Rao, Weltzin, & Kaye, 1995). Therefore, it would suggest that there is something about self-perfectionism that could be influential in the development of eating disorders, and specifically AN, and which could be operating through compulsive exercise. The results from the current study demonstrate that this association of self-perfectionism and compulsive exercise occurs even in an adolescent school-based population, where levels of disordered eating symptoms were relatively low. Therefore, if replicated longitudinally, this finding could represent a key area for early intervention and/or prevention work of compulsive exercise attitudes, whereby the individual’s self-imposed high standards could be targeted with the aim of reducing the compulsivity towards exercise.

The close link between compulsive exercise and obsessive-compulsiveness has been widely established in previous research (Davis & Claridge, 1998; Davis Katzman et al., 1999). The findings from this investigation demonstrate that a compulsivity towards exercise is associated with obsessive-compulsive symptoms even in a community sample of adolescent boys and girls. This close and direct association could indicate another possible area for prevention work of compulsive exercise; work that could target certain individuals with greater levels of obsessive-compulsiveness. However, it is uncertain whether the compulsivity towards exercise actually develops into a wider obsessive-compulsiveness, or whether the causal direction is in fact the reverse, with individuals with obsessive-compulsive symptoms being at greater risk for developing compulsive exercise. Future research adopting a longitudinal design needs to be conducted to identify the temporal precedence of both obsessive-compulsiveness and compulsive exercise.

Overall, these findings support a model where drive for thinness, perfectionism, and obsessive-compulsiveness all predict compulsive exercise (Figure 4.1). The amount of variance accounted for by these personality predictors was large, with almost 40% of compulsive exercise in boys being explained by these variables. This suggests that compulsive exercise is largely a self-driven behaviour that is affected by psychological attributes and, as such, any potential prevention work needs to target the individual’s existing personality motivations and general beliefs.

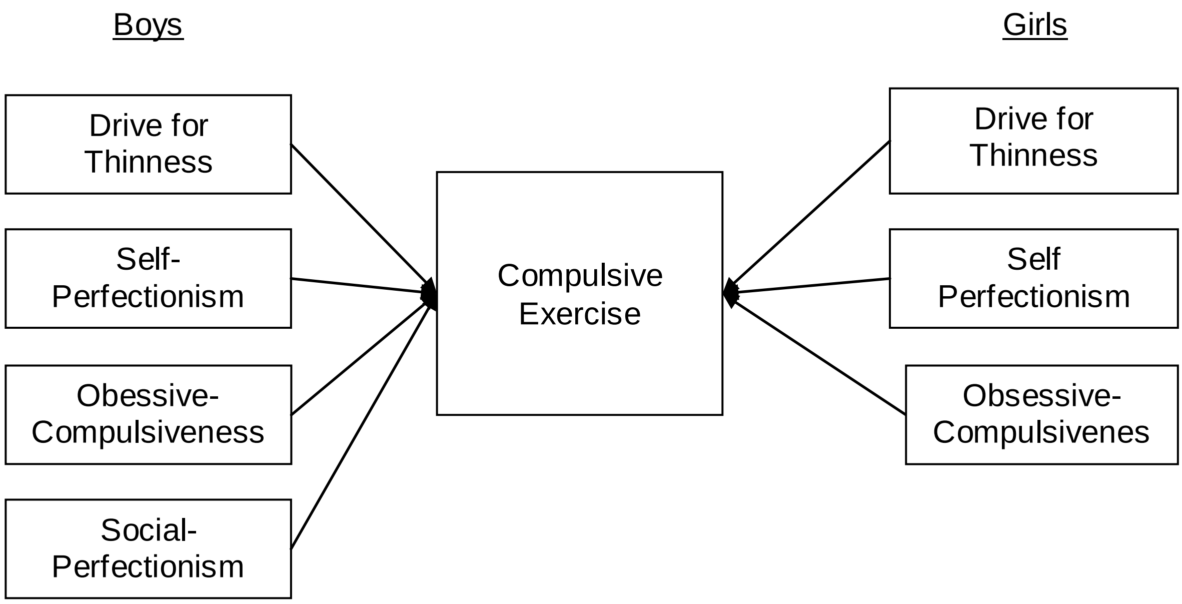


Figure 4.1 Model of compulsive exercise and cross-sectional predictors

This study, however, has several limitations that need to be highlighted. Firstly, the cross-sectional nature of the design prevents causal attributions. Future research needs to replicate these findings using a longitudinal and/or experimental design to further establish causality. Secondly, the self report nature of the measures could have been susceptible to reporter bias, as well as response error, particularly given the relatively young age of the sample. This limitation could be rectified by follow-up investigations using interview-based data collection, which would be especially useful in the ‘diagnosis’ of actual eating disorder pathology.

Conclusions

Compulsive exercise is most closely associated with a drive for thinness, as well as perfectionism and obsessive-compulsiveness, in a non-clinical adolescent sample. It is suggested that these in combination could lead to the development of further compulsive exercise, which could in turn lead to be implicated in the development of an eating disorder, specifically AN. Further research is required to test this suggestion, preferably with a longitudinal design, to identify whether these personality traits play a causal role in the development of compulsive exercise, and whether compulsive exercise is indeed a risk factor for the eating disorders.

Study 3: Compulsive exercise and emotion regulation in adolescents

Abstract

Objective: In the eating disorders, exercise can become compulsive in nature, and it is suggested that compulsive exercise represents a maladaptive emotion regulation strategy. However, this suggestion has never been studied in a sample of adolescents. Therefore, this study aimed to examine the cross-sectional association between emotion regulation and compulsive exercise attitudes. **Method:** A sample of 1630 adolescent boys and girls were studied, as part of ongoing research into exercise and eating attitudes in adolescents. Self-report measures of compulsive exercise, emotion regulation, and disordered eating attitudes were completed during a timetabled school class period. **Results:** Compulsive exercise was significantly associated with emotion regulation, after controlling for disordered eating attitudes. Specifically, among boys, compulsive exercise was associated with External Functional emotion regulation, whilst in girls, Internal Functional and Internal Dysfunctional emotion regulation predicted compulsive exercise. **Discussion:** Adolescents' compulsivity towards exercise is positively associated with different styles of emotion regulation. These associations differ between boys and girls. More work is needed to identify whether emotion regulation longitudinally predicts compulsive exercise.

Compulsive exercise and emotion regulation in adolescents

The use of eating-disordered behaviours to functionally manage negative emotions is well established (e.g., Lacey, 1986; Slade, 1982; Stice, 1994; Whiteside et al., 2007). One such behaviour is exercise, with several studies reporting that eating disordered patients use exercising as a means of managing their negative emotions (Bratland-Sanda et al., 2010a; Long, Smith, Midgley, & Cassidy, 1993; Penas-Lledo et al., 2002). It is not unusual for exercise to be associated with mood regulation in the general population as well, as many individuals choose to exercise in order to reduce stress and to regulate their mood (Cash, Novy, & Grant, 1994; Thayer, Newman, & McLain, 1994). The anxiolytic and anti-depressant properties of exercise are well-documented (e.g., Biddle et al., 2000; Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991; Salmon, 2001), and exercise has even been used in the treatment of depression (Daley, 2007; Mental Health Foundation, 2005).

Exercise has also been regarded as functional for those with eating disorder psychopathology (Lipsey et al., 2006), and a relatively recent review of the literature on the clinical application of exercise in the treatment of eating disorders concluded that participating in exercise during treatment for eating disorders can attenuate levels of distress and improve symptoms (Hausenblas, Cook & Chittester, 2008). However, the use of exercise within eating disorder patients can often become compulsive in nature (Davis et al., 1997). This compulsive exercise is associated with greater psychological morbidity (Shroff et al., 2006) and it is this compulsive drive to exercise that has been regarded as a maladaptive coping strategy (Penas Lledo et al., 2002), associated with an avoidance of negative affect (Taranis & Meyer, 2007). Such avoidance of negative emotion has been linked with psychological distress, health problems and psychiatric symptomatology (Endler & Parker, 1990), including eating psychopathology (Ghaderi & Scott, 2000; Koff & Sangani, 1997).

It could be argued that it is the compulsive cognitive and affective attitudes towards exercise, rather than the behaviour per se, that is more closely linked to dysfunctional emotion regulation. Indeed, a recent theoretical model of compulsive exercise supports this by suggesting that dysfunctional emotion regulation is an important aspect in the maintenance cycle of maladaptive exercise attitudes (Meyer et al., in press). Therefore, although exercise per se may be associated with positive, functional emotion regulation, *compulsive* exercise, as measured multidimensionally to include cognitive and affective aspects, is likely to be associated with a dysfunctional style of emotion regulation. However, this assumption of compulsive exercise has not been tested.

In summary, little is known regarding the development of compulsive exercise and whether it is linked to emotion regulation during adolescence. In order to provide information for potential prevention and treatment protocols, the current study aims to investigate the association between compulsive exercise and emotion regulation among adolescents, as there have been few studies replicating emotion regulation and eating disorder findings among this important age group (Garcia-Grau et al., 2002; 2004). The few adolescent studies investigating coping and eating disorders appear to suggest that emotion focused coping, increased stressors, intropunitive avoidance, low assertiveness, and low social coping can be associated with dieting or maladaptive eating attitudes (Fryer, Waller, & Kroese, 1997; Garcia-Grau et al., 2002; Garcia-Grau et al., 2004; Huon et al., 1999). This age group is important to study, as adolescence represents a key age for the onset of the eating disorders (Striegel-Moore & Bulik, 2007).

Therefore, the current study aims to determine whether compulsive exercise is linked with emotion regulation styles among a community sample of adolescents. This association will be tested whilst controlling for disordered eating attitudes, as emotion regulation strategies have also been associated with the eating disorders (e.g., Garcia-Grau et al., 2002; 2004). It is hypothesised that compulsive exercise will be significantly associated with emotion regulation, and that the greatest association will be with the dysfunctional emotion regulation subscales.

METHODS

Participants

One thousand six hundred and thirty participants, aged 12-14 years old, were recruited from secondary schools across the United Kingdom. Nine secondary schools were contacted and all agreed to participate in a wider study about eating and exercise-related attitudes. The sample had a mean age of 12.99 years (SD = .73), and gender was evenly spread (male = 46.4%; female = 53.6%). The sample was predominantly British (98.6%), and 95.1% of the sample classified their ethnicity as “White British”. Only “Other white background” scored above 1% of the sample (n = 21, 1.3%). Information on socioeconomic status (SES) was taken from the Office for National Statistics’ figures on deprivation (Office for National Statistics, 2008). The sample of schools represented areas of average to low levels of economic deprivation. Mean Body Mass Index (BMI) (age and gender-adjusted into z scores; Child Growth Foundation, 1996) for boys was 0.32 (SD = 1.37, range = -6.11 – 2.99) and for girls it was 0.07 (SD = 1.33, range = -5.25 – 3.39).

Measures and Procedure

Institutional Review Board ethical approval was given prior to questionnaire packs (including consent forms and parent letters) being sent to the participating schools. The packs were distributed to pupils within the required age range (12-14 years old) during a regular timetabled class period. Instructions were given to the administering teacher to ensure correct and consistent completion of the questionnaires. Completed questionnaires were returned to the administering teacher, and were subsequently sent to the research team.

The questionnaire packs consisted of an introductory background information sheet, asking questions on age, gender, nationality, and ethnicity. The following validated measures were then completed in the following order:

Compulsive Exercise Test (CET; Taranis et al., in press). The CET is a 24-item measure that assesses compulsive exercise cognitions and attitudes and has been described in Study 1. In the current sample, the total CET had a Cronbach’s alpha of .88.

Eating Disorder Inventory-2 (EDI-2; Garner, 1991). The Drive for Thinness, Bulimia, and Body Dissatisfaction subscales of the EDI-2 were administered in order to assess eating and shape-related attitudes. The EDI-2 was described in Study 1. The reliability of the three subscales reported in the current sample was .84 for Drive for Thinness, .73 for Bulimia, and .90 for Body Dissatisfaction.

Regulation of Emotions Questionnaire (REQ; Phillips & Power, 2007). The REQ is a 21-item self-report measure assessing a person’s emotion regulation strategies. It has four factors, each representing a general style of emotion regulation. First, Internal Dysfunctional emotion regulation describes a style where an individual deals with the situation by themselves (internal), which incorporates such negative behaviours as self-harm, rumination, and repression (e.g., "*I harm or punish myself in some way*"). Second, Internal Functional emotion regulation refers to more adaptive behaviours, such as positive re-appraisal, planning, and putting the situation into perspective (e.g., "I review/rethink my thoughts or beliefs"). Third, maladaptive behaviours such as bullying others physically or verbally, making others feel bad, or lashing out at objects all form part of the External Dysfunctional style of emotion regulation (e.g., "I take my feelings out on other people physically, e.g., fighting, lashing out"). Finally, External Functional also refers to interacting with others, but in a positive way, such as advice seeking, physical contact, or doing something nice with friends and family (e.g., "I talk to someone about how I feel"). Responses are scored on a five-point Likert scale, ranging from '0 – never' to '4 – always', with higher scores on a subscale representing a greater tendency to use that particular strategy. The reliability of these factors in this sample were .69 (Internal Dysfunctional), .74 (Internal Functional), .79 (External Dysfunctional), and .72 (External Functional).

Data Analysis

Preliminary analysis suggested that there were significant differences between boys and girls on some of the study variables (see Table 1; Mann Whitney U, $p <.001$). Therefore, all analyses were conducted separately for boys and girls. A series of Kolmogorov-Smirnov tests reported non-normal distributions for the majority of the study variables. Therefore, non-parametric tests were used where appropriate. The subsequent use of multiple regressions was deemed satisfactory as inspections of all residuals demonstrated normal distributions (Field, 2005). Initial correlation analyses (Spearman's rho, one-tailed) found that BMI z scores were not correlated with CET Total ($p >.05$) and therefore they were not included as a control variable in the main study analyses.

The study aim was analysed using a hierarchical multiple regression, with CET Total entered as the dependent variable. The predictor variables were the three EDI-2 subscales entered in the first step and the four REQ subscales of Internal Dysfunctional, Internal Functional, External Dysfunctional and External Functional entered as the predictor variables in the second step. This procedure allows for the unique contribution of emotion regulation styles above and beyond the contribution of disordered eating attitudes. The sample was very large and therefore, in order to reduce the chances of a Type I error, the significance was set at .001. All tests were one-tailed.

RESULTS

Characteristics of the Sample

The means, standard deviations, and tests of difference between boys and girls for all study variables can be seen in Table 4.4.

Table 4.4 Descriptive statistics for boys (n = 756) and girls (n = 874) and Mann-Whitney U test of difference between boys and girls for all study variables

	Boys' Mean (SD)	Girls' Mean (SD)	Z
CET Total	10.01 (4.08)	9.94 (3.66)	0.32
Internal Dysfunctional	1.02 (0.72)	1.27 (0.78)	6.61*
Internal Functional	1.81 (0.81)	1.76 (0.75)	1.19
External Dysfunctional	0.90 (0.73)	0.85 (0.74)	1.97
External Functional	1.86 (0.77)	2.27 (0.80)	9.80*
EDI-2 Drive for Thinness	2.87 (4.01)	6.14 (5.89)	10.37*
EDI-2 Bulimia	2.02 (3.21)	2.43 (3.53)	3.00
EDI-2 Body Dissatisfaction	5.06 (5.76)	10.60 (8.15)	12.92*

Note: * = $p < .001$ (one-tailed); CET = Compulsive Exercise Test; EDI-2 = Eating Disorder Inventory-2

The CET Total mean for the whole sample represents mid-point scoring of the measure ("sometimes true"), and therefore suggests low levels of compulsive exercise in this non-clinical sample. There was no difference between boys and girls on CET Total score. The EDI-2 subscale scores also suggest low levels of disordered eating, as expected in the non-clinical sample, with all means for boys and girls being below suggested clinical cut-off values (Grylli et al., 2004; McGrane & Carr, 2002). In addition, as expected, girls reported significantly greater drive for thinness and body dissatisfaction than boys, although there was no difference on bulimia scores. The means for the REQ subscales were slightly lower than other research that has used the REQ in an adolescent sample (Phillips & Power, 2007). The two functional emotion regulation styles were more frequently reported than the two dysfunctional styles, which is in accordance with the existing literature (e.g., Phillips & Power, 2007). Girls reported significantly greater means than boys on Internal Dysfunctional and External Functional.

Emotion Regulation Prediction of Compulsive Exercise

The hierarchical multiple regressions examining the predictive ability of emotion regulation on to compulsive exercise, after controlling for disordered eating attitudes, can be seen in Tables 4.5 (boys) and 4.5 (girls).

Table 4.5 Hierarchical multiple regression of CET Total score (outcome) for boys

Model	F (df)	R^2	Adj R^2	Beta	t
1.	45.11* (3, 509)	.21	.21		
EDI-2 Drive for Thinness				.43	8.95*
2.	29.69* (7, 505)	.29	.28		
EDI-2 Drive for Thinness				.35	7.35*
External Functional				.16	3.59*

Note: *p <.001; Only significant unique predictors are reported here; Adj = Adjusted; CET = Compulsive Exercise Test; EDI-2 = Eating Disorder Inventory-2

Table 4.6 Hierarchical multiple regression of CET Total score (outcome) for girls

Model	F (df)	R^2	Adj R^2	Beta	t
1.	56.17* (3, 621)	.21	.21		
EDI-2 Drive for Thinness				.49	9.98*
2.	34.34* (7, 617)	.28	.27		
EDI-2 Drive for Thinness				.44	8.97*
Internal Functional				.19	4.59*
Internal Dysfunctional				.16	3.82*

Note: *p <.001; Only significant unique predictors are reported here; Adj = Adjusted; CET = Compulsive Exercise Test; EDI-2 = Eating Disorder Inventory-2

For boys, the final model was significant and accounted for 29% of CET Total variance. The addition of the REQ subscales had collectively added 8% of the CET Total variance accounted for, which was a significant change (R^2 change = .08; $Fchange_{(4, 505)} = 14.52$, $p <.001$). Examination of the unique significant predictors found that only Drive for Thinness was a significant predictor in the first step. In the second step, Drive for Thinness was still significant and External Functional was also a significant unique predictor of CET Total. No significant association was found between CET Total and Bulimia, Body Dissatisfaction, Internal Dysfunctional, Internal Functional, or External Dysfunctional.

For girls, the final model accounted for 28% of the variance of CET Total and this was statistically significant. The REQ subscales collectively accounted for 7% of the CET Total variance, which was also significant (R^2 change = .07; $Fchange_{(4, 617)} = 14.35$, $p <.001$). In the first step, only Drive for Thinness was a significant unique predictor. In the second step, Drive for Thinness remained a significant predictor and Internal Dysfunctional and Internal Functional were the only two additional significant unique predictors of CET Total. There were no significant associations between CET Total and Bulimia, Body Dissatisfaction, External Dysfunctional or External Functional.

DISCUSSION

This investigation of emotion regulation and compulsive exercise hypothesised that compulsive exercise would be significantly and positively associated with emotion regulation. The findings from the current study confirmed this hypothesis by finding a significant collective association between compulsive exercise and the emotion regulation styles, suggesting that (compulsive) exercise could be being used as a way of managing difficult emotions. This link with emotion regulation concurs with previous studies which have suggested that compulsive exercise is performed for mood regulation (Bratland-Sanda et al., 2010a; 2010b; Penas-Lledo et al., 2002).

The current study also predicted that the dysfunctional emotion regulation styles would have the greatest association with compulsive exercise. This hypothesis was not supported as external functional emotion regulation was the largest unique predictor for boys, and internal functional emotion regulation was the largest predictor for girls. This was an unexpected finding, but could be a result of the non-clinical levels of disordered eating in the total sample. Indeed, the use of exercise to manage emotions has been for positive mood reasons in non-clinical samples but has been used to avoid negative mood in clinical eating disorder samples (De Young & Anderson, 2010b). Therefore, the community adolescent sample used in the current study could still be functionally using exercise to manage their emotions (Lipsey et al., 2006). Alternatively, the association between functional emotion regulation and compulsive exercise may also have been a result of the non-clinical levels of compulsive exercise, which were only at mild to low levels on average. Therefore, the exercise behaviour among this sample may not be generally performed compulsively and may still be regarded as a functional way to manage emotions (Cash et al., 1994; Thayer et al., 1994).

A further explanation for the positive finding between compulsive exercise and functional emotion regulation may have been methodological. Specifically, one of the items in the External Functional subscale of the REQ actually refers to the use of exercise to regulate emotions, and is thus suggesting that it is a positive behaviour. However, the REQ authors did state that this exercise item was a weak item in the External Functional scale, and that actually for those with compulsive exercise attitudes, it could be also be regarded as a dysfunctional strategy (Phillips & Power, 2007). Therefore, this potential ambiguity of the exercise question in the External Functional subscale could perhaps explain the finding in the current study between external functional emotion regulation and compulsive exercise in boys.

Importantly, despite a stronger association between compulsive exercise and functional styles of emotion regulation than was expected, there was still a significant link between internal dysfunctional emotion regulation and compulsive exercise in girls. This finding suggests that those with compulsive exercise attitudes (defined as an eating disorder symptom; see 1.3.1.2) could be trying to deal with their emotions on their own and in a dysfunctional manner, such as avoidance of affect, or rumination. This internalised and dysfunctional style of regulating emotions is in line with previous adolescent findings that found that individuals with maladaptive eating attitudes also tended to avoid social forms of coping (Huon et al., 1999), and also the fact that an eating disorder is often associated with social withdrawal and a non-assertive, submissive interpersonal style (Hartmann, Zeeck, & Barrett, 2009).

Indeed, this close link between compulsive exercise attitudes and the eating disorders was further supported by the finding in the current study that demonstrated a link between compulsive exercise and a drive for thinness. Ultimately, this combination of emotion regulation styles and a drive for thinness may then lead individuals who have eating and shape-related concerns to use exercise to help deal with the negative emotions associated with such concerns (Hubbard et al., 1998). This use of exercise may represent a short term fix of a negative mood, which may develop into long term compulsive behaviour if a tolerance is developed and if there are no other coping strategies (Adams et al., 2003). This is particularly worrying given that compulsive exercise was linked with functional styles of emotion regulation (and not just dysfunctional emotion regulation). Further work is needed to investigate the complex relationship between emotion regulation, compulsive exercise attitudes and clinical eating disorders using a longitudinal design to identify the temporal order of each variable's development.

The results here have several practical implications. Firstly, regardless of whether the emotion regulation style was functional or dysfunctional, there were associations with compulsive exercise, which is an eating disorder symptom that can have negative consequences on the individual's quality of life (Mond et al., 2004a). Therefore, adolescents presenting with compulsive exercise attitudes may benefit from being taught alternative ways to regulate their emotions. For example, Dialectical Behaviour Therapy (DBT) has been used to help treat individuals with binge eating disorder (BED) by providing them with a wider range of emotion regulating skills (Safer et al., 2001). The use of DBT among individuals with eating disorders to target their emotion regulation has had promising results (Telch, Agras, & Linehan, 2000). Therefore, given the association between emotion regulation and compulsive exercise attitudes found in this study, future research should look to investigate the potential use of DBT to treat compulsive exercise.

Prevention programmes could also benefit from these results. Previous studies have regarded a maladaptive coping style as a possible risk factor for eating disorders (Koff & Sangani, 1997). The association between compulsive exercise and dysfunctional emotion regulation style in girls found in the present study could also suggest a possible risk factor of dysfunctional emotion regulation in the development of compulsive exercise. Further longitudinal research to identify temporal precedence, as well as experimental studies assessing direct causality, are required to test this suggestion. Nonetheless, the inability to manage negative emotions in functional ways may have profound effects on future psychological and physical health (Blechman, 1998). Therefore, teaching young adolescents how to effectively and functionally manage their emotions may be a useful programme in preventing the onset of compulsive exercise attitudes.

There were several limitations of this study. Firstly, the use of a self-report measure of emotion regulation has its wider inherent limitations (e.g., Gross, 1998). This may be particularly true among adolescents, who may have difficulty accurately reporting the strategies that they regularly utilise (Phillips & Power, 2007). Furthermore, recognising the mood modulation effects of exercise is rather difficult given their subtlety (Hsaio & Thayer, 1998). Nonetheless, the REQ does help in furthering the understanding of adolescents and their methods for dealing with negative emotions. Future research should perhaps look to use a variety of measures to cross-validate the procedure.

The study also suffered from the absence of a measure of anxiety levels among the sample, which could be a potentially confounding variable that could have influenced the results. Additionally, the absence of an anxiety measure also precludes the results from identifying whether functional styles of emotion regulation were actually more anxiolytic than the dysfunctional styles. Further, the study also had no measure of actual exercise behaviour, which makes it difficult to identify whether the emotion regulation associations with compulsive exercise attitudes were in fact due to their relationship with general exercise behaviour, which has been linked to mood regulatory properties (Salmon, 2001). However, the connection between compulsive exercise attitudes and compulsive exercise behaviours has been shown to be surprisingly weak in relation to the eating disorders in previous studies (Brehm & Steffen, 1998; Goodwin et al., in press; Seigel & Hetta, 2001). Therefore, exercise behaviour was not assessed in this investigation. Nonetheless, future research should aim to replicate the findings from the current study and assess the link between emotion regulation styles and actual exercise behaviour.

In summary, compulsive exercise can be regarded as tool for regulating emotions in adolescents, even after controlling for disordered eating attitudes. This regulation of emotion can be either functional or dysfunctional. Specifically, compulsive exercise is associated with an internalised style of emotion regulation among girls. Future research should investigate whether an internalised emotion regulation style combined with a drive for thinness is a longitudinal risk factor for compulsive exercise in girls.

Chapter 5

Socio-Cultural Correlates of Compulsive Exercise

Studies 4 and 5

5 Socio-cultural Correlates of Compulsive Exercise

The previous chapter demonstrated personality and disordered eating correlates of compulsive exercise. Specifically, Chapter 4 reported that among boys, compulsive exercise was correlated with a drive for thinness, self- and social-perfectionism and obsessive-compulsiveness; whilst among girls compulsive exercise was correlated with a drive for thinness, self-perfectionism, and obsessive-compulsiveness. This concurred with previous literature that had shown compulsive exercise to be associated with AN, obsessive-compulsiveness and greater perfectionism (e.g., Dalle Grave et al., 2008; Davis et al., 1997; Shroff et al., 2006). However, there has been little research conducted on socio-cultural correlates of compulsive exercise.

Therefore, in accordance with the second aim of this thesis (see 1.7.1), the current chapter explores the socio-cultural correlates of compulsive exercise. A recent model of compulsive exercise proposed that socio-cultural pressures to lose weight and increase muscle mass were associated with a compulsive need to exercise (White & Halliwell, 2010). However, the same study found that this relationship was fully mediated by body image disturbance and investment in appearance. Therefore, the current chapter aims to replicate these associations between socio-cultural pressures and compulsive exercise, using the CET among an adolescent population.

Chapter 5 consists of two studies. The first aims to examine the cross-sectional association between socio-cultural messages to lose weight and build muscle, as well as a pressure to be thin from family, friends and the media, with compulsive exercise. This first study (Study 4) has been submitted for publication as: Goodwin, H., Haycraft, E., & Meyer, C. (under review). Socio-cultural correlates of compulsive exercise: Is the environment important in fostering a compulsivity towards exercise among adolescents? *Journal of Applied Social Psychology*.

The second study also looks at the socio-cultural correlates of compulsive exercise, but follows on from the general exercise literature. Specifically, it has been previously found that physical activity support, such as parental modelling of activity, as well as parental logistic support for physical activity, is positively associated with adolescent exercise behaviour (Davison, 2004). However, it has not yet been studied whether the physical activity support is associated with compulsive exercise, as measured multidimensionally using the CET. It could be argued that the increased physical activity support from friends and family actually provides protection from the isolated, rigid and driven exercise often seen in compulsive exercisers (Beumont et al., 1994). However, the physical activity support could also represent a potential risk factor for compulsive exercise via the parental and peer groups implicitly providing stronger exercise messages, which have been shown to increase adolescent exercising for weight and shape (Ricciardelli et al., 2000). Therefore, the second study of Chapter 5 examines the association between physical activity support from friends and family and compulsive exercise. This study has been submitted for publication, and is cited as: *"Goodwin, H., Haycraft, E., & Meyer, C. (under consideration). Family and friends: The relationship between physical activity support and compulsive exercise among adolescents. Journal of Pediatric Psychology."*

Similar to the previous chapter, this current chapter will present both studies with a discussion for each of them provided at the end of each study, and an overall discussion regarding the socio-cultural correlates of compulsive exercise as a whole will be given in the general discussion chapter at the end of the thesis (see Chapter 9).

Study 4: Socio-cultural correlates of compulsive exercise: Is the environment important in fostering a compulsivity towards exercise among adolescents?

Abstract

Objective: Socio-cultural factors hypothesised to be influential in eating disorders were assessed for their relationship with compulsive exercise. **Method:** A sample of 828 adolescent boys and girls completed measures assessing socio-cultural messages to change body shape as well as pressure to be thin, and also measures of compulsive exercise and disordered eating. **Results:** Results showed that the socio-cultural influences differed slightly between boys and girls. Hierarchical regressions showed that, after controlling for disordered eating and BMI, Messages to become More Muscular and Media Pressure to be Thin significantly predicted compulsive exercise in boys, whilst the same regression in girls identified Media Pressure to be Thin as a significant predictor of compulsive exercise. **Discussion:** These findings demonstrate the influence of the media in boys' and girls' compulsive exercising, as well as highlighting the influence of body shape messages to become more muscular on boys' compulsive exercise.

Socio-cultural correlates of compulsive exercise: Is the environment important in fostering a compulsivity towards exercise among adolescents?

The environment has been implicated in the development of eating disorders (Polivy & Herman, 2004; Stice, 1998), with socio-cultural factors being closely linked to eating disorder symptomatology (Kiang & Harter, 2006). Further, in the dual pathway model of BN, a social pressure to be thin was shown to contribute to bulimic symptoms, and this perceived pressure to be thin has predicted the onset of specific bulimic behaviours (Stice & Agras; 1998; Stice, Nemeroff, & Shaw, 1996). One such eating disordered behaviour, which was not included in those studies nor many other studies, but which is widely found in both AN and BN patients (Davis et al., 1997), is compulsive exercise. Compulsive exercise has been defined as a problematic drive to exercise closely associated with disordered eating, which is often performed in a rigid fashion, and invariably carried out against medical advice (Taranis et al., 2010). It has been regarded as problematic in the development, treatment, and outcome of eating disorders (Davis et al., 1997; Solenberger, 2001), and yet little to no research has investigated the risk factors for this behaviour.

Risk factor research into eating disorders in general has highlighted factors that can be categorised into individual and socio-cultural risks (e.g., Striegel-Moore & Bulik, 2007). A recent study of adolescents identified certain individual personality variables that were significantly associated with reports of compulsive exercise (see Chapter 4; Goodwin et al., under consideration). However, few studies have specifically studied socio-cultural factors in the development of compulsive exercise. These socio-cultural factors can be separated into three key environmental sources, namely the family, peers, and more cultural messages through the media (Keery, van den Berg, & Thompson, 2004). These different sources of environmental factors have all been implicated in the development of disordered eating behaviours and weight concerns (Dunkley, Wertheim, & Paxton, 2001), although their role in compulsive exercise remains unclear.

Firstly, parental and family effects have been widely researched in the eating disorders. Interestingly, although dysfunctional family dynamics have been related to eating disorder pathology (Casper & Troiani, 2001), the results are not conclusive. Indeed, some studies have reported no link between family functioning and eating disordered behaviours (Young, McFatter, & Clopton, 2001), whilst others found only a weak protective factor of positive family functioning against disordered eating (Beato-Fernandez & Rodriguez-Cano, 2005). However, it could be that it is not the general functioning that is important in the development of disordered eating attitudes and behaviours, but rather the direct family communication and attitudes around appearance, eating, and exercise (Young, Clopton, & Bleckley, 2004). Indeed, attitudes specific to weight and shape communicated by family members have been found to be related to the bulimic behaviours of young women (Young et al., 2004). Weight and shape concerns transmitted from parents can also affect boys, with parental pressure to be thin being related to adolescent boys' body satisfaction (Muris et al., 2005). Further, parents have been shown to influence children's eating directly, through an encouragement of dieting behaviours (Benedikt, Wertheim, & Love, 1998; Edmunds & Hill, 1999; Muris et al., 2005), as well as through more indirect ways such as criticism and comments about weight and shape (Keel, Heatherton, Harnden, & Hornig, 1997; Schwartz, Phares, Tantleff-Dunn, & Thompson, 1999).

In addition to the effects of the family environment, the influence of peers on eating disturbances has also been researched (e.g., Farrow, Haycraft, & Meyer, 2009; Shroff & Thompson, 2006a), albeit to a lesser extent in the early adolescent age group (Hutchinson, Rapee, & Taylor, 2009). The adolescent research conducted suggests that the peer environment is important in influencing adolescents' weight-related attitudes and behaviours (Hutchinson & Rapee, 2007). For example, Paxton, Schultz, Wertheim, & Muir (1999) found that friendship groups were highly influential in affecting adolescent girls' body image concerns and their extreme weight-loss behaviours. In addition, other research found that the greater the emphasis a peer group placed on thinness, the more likely that an adolescent girl would engage in purging behaviours (Field et al., 1999). Likewise, for boys, the peer group is seemingly important in shaping their body image and dieting behaviours (Muris et al., 2005).

These dieting and weight control behaviours could occur as a result of the internalisation of the "thin ideal" that is present in the Western culture, as it leads to greater weight and shape dissatisfaction (Knauss et al., 2007). Messages from peers about weight and shape can be internalised by the individual, although moreover, the cultural thin ideal also can be translated strongly by media messages, which is a risk factor for the development of adolescent girls' weight concerns and disordered eating behaviours (Field et al., 1999). Indeed, the reading of fashion magazines has been shown to increase the desire for thinness among adolescent girls (Levine, Smolak, & Hayden, 1994), whilst media information about weight loss methods has also been linked to dietary restraint among girls of a similar age (Dunkley et al., 2001). This media effect is not restricted to girls. Among boys, the media influence on shaping eating and exercise behaviours (such as to increase muscle size) has also been demonstrated (McCabe & Ricciardelli, 2003a; McCabe, Ricciardelli, Mellor, & Ball, 2005; Ricciardelli & McCabe, 2003), as has the media's role in developing boys' weight and shape self-perceptions (Field et al., 2001).

In summary, compulsive exercise is seen as a problematic behaviour in relation to the eating disorders, negatively impacting on treatment outcome, as well as being a key factor in increasing relapse. Compulsive exercise has also been shown to be influential in the development of eating disorders. However, it is unknown whether the risk factors for eating disorders can be applied specifically to compulsive exercise, or whether the exercise element of the eating disorders has a different aetiological path.

Previous investigations of compulsive exercise have shown that parental and peer support is significantly associated with compulsive exercise (Study 5; Goodwin et al., under review), but this could be a proxy relationship, which is more accurately demonstrated by other parental and peer-related variables. In order to identify further socio-cultural factors associated with a compulsivity towards exercise, a cross-sectional study of compulsive exercise and socio-cultural factors previously shown to be influential in the development of more general eating disordered attitudes will be investigated. Identifying early risk factors is important in the early intervention and prevention of eating disorders (Jacobi et al., 2004). Therefore, given that adolescence represents a key risk for the development of eating disorders (Striegel-Moore & Bulik, 2007), a sample of adolescents will be used in this study, with a view to identifying risk factors during this early and key age for the development of disordered eating concerns (Shisslak et al., 1995). Given the close link between compulsive exercise and disordered eating attitudes which has already been identified in adolescents (Goodwin et al., in press), disordered eating will be controlled for in the analysis, in order to ensure that any relationships found with socio-cultural factors are direct associations with compulsive exercise, and not simply through a link with more general disordered eating attitudes. Further, the effects of socio-cultural influences on weight concerns and dieting among adolescents have been shown to be gender-specific (Field et al., 2001). Therefore, relationships will be studied separately for each gender.

The study aims to identify whether socio-cultural factors are related to compulsive exercise in an adolescent sample, after controlling for disordered eating attitudes. It is hypothesised that socio-cultural factors (pressure to be thin from family, peers and the media; messages to lose weight; messages to be more muscular) will be significantly and positively associated with compulsive exercise. The study also aims to identify which is the best cross-sectional predictor of compulsive exercise. Due to a lack of current evidence, no a priori hypotheses will be given for this second aim.

METHODS

Participants and Procedure

Participants were pupils recruited from secondary schools across the United Kingdom, with schools invited to participate as part of a wider study investigating exercise and eating attitudes. Following institutional review board approval, participating schools were sent questionnaire packs for distribution. The packs contained background information questions and established measures, which assessed the study’s variables of interest (see *Measures* section below). Questionnaire packs were distributed to all pupils aged between 13 and 15 years old, who completed them during a single class period. The completed packs were returned to the research team.

The final sample comprised 828 adolescents, with boys and girls being evenly represented (boys n = 371, girls n = 457). The participants ranged from 13 to 15 years old (m = 14.07, SD = .71), and the sample consisted of 98.6% British adolescents. The self-reported height and weights were converted to Body Mass Index (BMI) scores, which in turn were converted to age and gender appropriate BMI z scores (Child Growth Foundation, 1996). The mean BMI z score for boys was 0.37 (SD = 1.37, range = -6.99 – 2.90) and -.00 (SD = 1.13, range = -4.24 – 2.74) for girls.

Measures

Background information, including adolescent age, gender and nationality, as well as self-reported height and weight, was gathered before the following established questionnaires were administered in the order presented below:

Perceived Sociocultural Pressure Scale (PSPS; Stice & Bearman, 2001)

The PSPS is a measure of the perceived pressure to be thin that the respondent feels from socio-cultural sources. The three sources are family (e.g., "I've felt pressure from my family to lose weight"), friends (e.g., "I've felt pressure from my friends to lose weight"), and the media (e.g., "I've noticed a strong message from the media to have a thin body"). The 10-item measure is answered using a 5-point Likert scale that is anchored with "1 = none" and "5 = a lot", and responses are averaged to form a single total scale score. Higher scores represent greater perceived pressure to be thin from socio-cultural influences. Previous studies have shown the PSPS to be a reliable scale for use with adolescents (e.g., Presnell et al., 2004; Stice & Whitenton, 2002). As this study aimed to identify which were the key sources of socio-cultural messages influencing adolescents' compulsive exercising, the items relating to family pressure, peer pressure, and media pressure were separated to form three subscales. The reliability figures for these subscales were .72, .78, and .88, for family, peer, and media respectively.

Compulsive Exercise Test (CET; Taranis et al., in press)

The CET comprises five subscales that sum together to form a total CET score (average item score), which is a measure of an individual's compulsivity towards exercise. The CET has been described in Study 1. The reliability for this sample was .89 for CET Total score.

Modified Perceived Sociocultural Influences on Body Image and Body Change Questionnaire (mSCIQ; McCabe & Ricciardelli, 2001)

The SCIQ was modified in a previous investigation (Meesters et al., 2007), and the modified version was used in this study. The mSCIQ used in this study consisted of six items assessing perceived encouragement from the respondent's father, mother, and best friend, to lose weight and/or to become more muscular. Socio-cultural messages have been shown to emphasise a thin body for both boys and girls, as well as a more muscular body for boys (McCabe & Ricciardelli, 2003b). Therefore, to identify which message was more influential for compulsive exercise, the items relating to losing weight (e.g., "Does your mother encourage you to lose weight?") were averaged to form one subscale (mSCIQ Lose Weight), whilst the items relating to becoming more muscular (e.g., "Does your father encourage you to become more muscular?") were averaged to form another subscale (mSCIQ More Muscular). Responses were given on a 6-point Likert scale ranging from "1 = Never" to "6 = Always", with higher scores equating to a greater socio-cultural influence to lose weight or to become more muscular. The reliability of the scales were shown by adequate Cronbach's alphas (SCIQ-Lose Weight = .78; SCIQ More Muscular = .78).

Eating Disorder Inventory-2 (EDI-2; Garner, 1991)

The short form of the EDI-2 provided a measure of disordered eating attitudes. The three subscales comprising the short form of the EDI-2 are Drive for Thinness, Bulimia, and Body Dissatisfaction. The EDI-2 has been described in Study 1. The current sample reported good reliability, with Cronbach's alphas of .85 for Drive for Thinness, .69 for Bulimia, and .91 for Body Dissatisfaction.

Data Analysis

All analyses were conducted separately for boys and girls, as socio-cultural influences have been shown to be gender-specific (Field et al., 2001), and this was supported by gender differences found in the current sample (see Table 5.1). It has been previously shown that socio-cultural pressures to be thin are also related to BMI, given that those individuals who are further from the societal norm would feel greater pressure to lose weight and be thin (Stice et al., 1999). Therefore, preliminary investigations assessed the relationship between BMI z scores and the study variables, to see whether BMI z scores needed to be controlled for in the regression analyses. Correlation coefficients (Spearman's rho) showed that BMI z scores were indeed significantly correlated ($p < .01$) with the majority of the study variables, albeit reporting rather weak correlations (significant r ranging from .12 to .32). Therefore, BMI z scores were entered into the regression as a control variable.

A hierarchical multiple regression was performed with Total Compulsive Exercise (CET Total) as the dependent variable. In the first step, the three EDI-2 subscales of Drive for Thinness, Bulimia, and Body Dissatisfaction, as well as BMI z scores, were entered to control for their effect on compulsive exercise. The second step then had the socio-cultural predictors (i.e., PSPS and mSCIQ subscales) entered to identify their unique contribution to compulsive exercise, having already controlled for the effects of disordered eating attitudes and BMI. The aim of this analytic technique was to identify the specific and direct link between socio-cultural factors and compulsive exercise.

Finally, correlations (Spearman's rho, one-tailed) were conducted on the individual items of the mSCIQ subscales (relating to messages from father, mother, or best friend) with CET Total to establish whether the source of the messages came from one or more significant others. These correlations were only run if an mSCIQ subscale (lose weight or more muscular) had shown a significant unique prediction of Total Compulsive Exercise in the previous hierarchical regressions. Significance levels were set at $p < .01$ for all tests and all tests were one-tailed.

RESULTS

Descriptives

The descriptive statistics and tests of difference between boys and girls can be seen in Table 5.1. The descriptive results for the mSCIQ subscales were similar to the previous study that used this measure (Meesters et al., 2007). Boys scored significantly higher than girls on BMI z scores and mSCIQ More Muscular, while girls scored significantly greater than boys on mSCIQ Lose Weight, PSPS Media, PSPS Family, PSPS Peers, EDI Body Dissatisfaction, EDI Drive for Thinness, and CET Total. There was no gender difference on EDI Bulimia. The EDI means were all well below suggested cut-offs for clinical severity (e.g., Grylli et al., 2005) and in general were slightly lower than a previous study of adolescents (Kostanski & Gullone, 1998). The CET means represent a mid-point scoring average for both boys and girls.

Table 5.1 Descriptive statistics for study variables and tests of difference (Mann Whitney U) between boys and girls

Variable	Boys Mean (SD)	Girls Mean (SD)	Test of Difference Z
BMI z score	.37 (1.37)	-.00 (1.23)	4.03*
mSCIQ More Muscular	2.19 (1.15)	1.44 (.71)	11.28*
mSCIQ Lose Weight	1.61 (1.02)	1.68 (.88)	2.97*
PSPS Media	1.52 (.93)	2.50 (1.31)	11.76*
PSPS Family	1.44 (.70)	1.62 (.84)	3.46*
PSPS Peers	1.44 (.65)	1.58 (.72)	3.80*
EDI Body Dissatisfaction	4.39 (5.68)	10.83 (8.23)	11.86*
EDI Bulimia	1.85 (3.09)	2.18 (3.25)	1.84
EDI Drive for Thinness	2.27 (3.88)	5.28 (5.65)	8.69*
CET Total	8.57 (3.79)	9.52 (3.57)	3.50*

Note: * p < .001 (one-tailed); BMI = Self-reported Body Mass Index; mSCIQ = Modified Perceived Socio-cultural Influences on Body Image and Body Change Questionnaire; PSPS = Perceived Socio-cultural Pressure Scale; EDI = Eating Disorder Inventory; CET = Compulsive Exercise Test

Socio-cultural predictors of CET Total

Boys

The final hierarchical multiple regression can be seen in Table 5.2. The regression model showed that, after controlling for BMI z scores and EDI subscales, socio-cultural factors collectively predicted CET Total, accounting for 31% of CET Total variance (R^2). The socio-cultural factors alone had added a significant increase of 16% of additional variance (R^2 change = .16, F change $_{(5, 223)}$ = 10.49, p <.001) in the second step of the regression. In the initial step, when the EDI variables and BMI z scores were entered, only EDI Drive for Thinness was significantly associated with CET Total. When the socio-cultural factors were entered in the second step, mSCIQ More Muscular and PSPS Media were significant predictors, along with EDI Drive for Thinness, which remained significant. There were no other significant predictors of CET Total.

Table 5.2 Significant predictors of CET Total score (outcome) for boys using a hierarchical multiple regression

Model	F (df)	R^2	Adj R^2	Beta	T
1.	9.74** (4, 228)	.15	.13		
Drive for Thinness				.38	4.51**
2.	11.06** (9, 223)	.31	.28		
Drive for Thinness				.25	3.05*
mSCIQ More Muscular				.31	4.90**
PSPS Media				.19	2.89*

Note: *p <.01, ** p <.001; Only significant unique predictors are reported here; CET = Compulsive Exercise Test; Adj = Adjusted; mSCIQ = Modified Perceived Socio-cultural Influences on Body Image and Body Change Questionnaire; PSPS = Perceived Socio-cultural Pressure Scale

Subsequent correlations (Spearman's rho, one-tailed) between Total CET and the mSCIQ More Muscular items, revealed that all three sources of influence (i.e., Father, Mother, and Best Friend) were significantly correlated with Total CET, although it was the influence from the Father that recorded the greatest correlation coefficient ($r = .39$, $p < .001$).

Girls

The final hierarchical multiple regression for girls can be seen in Table 5.3. The model produced a significant prediction for CET Total and accounted for 39% ($R^2 = .37$) of CET Total variance. The socio-cultural factors alone had added a significant increase of 10% of additional variance (R^2 change = .10, F change $_{(5, 244)}$ = 8.26, $p < .001$) in the second step of the regression. Only EDI Drive for Thinness was a significant predictor of CET Total in the first step. In the second step, when the socio-cultural factors were entered into the model, EDI Drive for Thinness remained a significant predictor and PSPS Media was an additional significant predictor. No other predictors reported a significant relationship with CET Total.

Table 5.3 Significant predictors of CET Total score (outcome) for girls using a hierarchical multiple regression

Model	F (df)	R^2	Adj R^2	Beta	T
1.	24.87** (4, 249)	.29	.27		
Drive for Thinness				.57	7.51**
2.	17.25** (9, 244)	.39	.37		
Drive for Thinness				.45	6.01**
PSPS Media				.20	3.26**

Note: **p <.001; Only significant unique predictors are reported here; CET = Compulsive Exercise Test; Adj = Adjusted; PSPS = Perceived Socio-cultural Pressure Scale

DISCUSSION

This study aimed to identify whether socio-cultural factors were related to compulsive exercise in an adolescent sample, after controlling for disordered eating attitudes and BMI. The results suggest that compulsive exercise is aligned more with a drive to be thin, i.e. anorexic attitudes, than it is with bulimic attitudes, and this is true for both boys and girls, regardless of current body size. Importantly, this study demonstrated that the messages that adolescents receive from different socio-cultural sources are associated with their compulsive exercise, which itself can be used as an extreme weight loss behaviour. Importantly, the socio-cultural influences differed slightly between boys and girls.

For boys, it would appear that messages from significant others to become more muscular could lead to a greater compulsivity towards exercise. In addition, these messages from close others, particularly from fathers, seem to be reinforced by more general media messages about having a thinner body and losing weight, as well as being strengthened through their own drive to be thinner. These environmental pressures to achieve an ideal body could potentially lead to a downward spiral of disordered eating concerns and compulsive exercise attitudes, which could lead to an engagement in negative health-risk behaviours such as food restriction and/or compulsive exercise behaviour.

The same risks could be present for the girls. These adolescent girls reported that a pressure to be thin from the media, as well as their own drive for thinness, contributed to a compulsivity towards exercise. These findings support previous investigations demonstrating that the Western culture of the “thin ideal” is being reinforced by media messages (Field et al., 2001) which, these findings suggest, are then being picked up by adolescent girls. It is possible that these messages are then contributing to the development of potentially detrimental exercise attitudes, which could be physically and psychologically harmful to the individual in the medium- and long-term.

The practical implications of these findings centre around those professionals working with adolescents. Previous studies have found that social reinforcement of the thin-ideal can facilitate eating disordered behaviours, such as bingeing and purging (Stice, 1998). The findings from the current study demonstrate that the pressure to achieve this largely unobtainable Westernised ideal about body weight and shape may also lead to unhealthy and potentially dangerous compulsion towards exercise, both among girls and boys. Importantly, this risk from the cultural messages is relevant to all adolescents regardless of their current weight status. Therefore, school teachers, parents, and professionals working with any children and adolescents need to be aware of the messages that they are transmitting, particularly around exercise. Encouragement of exercise is predominantly a good thing, and shouldn’t be avoided. However, it requires adults to be cognisant of the messages that they are transmitting to adolescents and not to reinforce nor promote the potentially dangerous compulsivity to exercise. This is particularly true of promoting messages to boys to become more muscular, as these findings suggest that this could lead to a detrimental compulsivity to exercise.

The limitations of this study are apparent in its cross-sectional design, as causality cannot be established. Indeed, it remains uncertain as to whether an individual develops compulsive exercise cognitions and attitudes as a result of socio-cultural pressures, or whether an individual with an existing compulsivity towards exercise simply feels greater pressure from these socio-cultural sources than someone without such a compulsive drive to exercise. An investigation with a longitudinal design assessing the temporal precedence of these factors needs to be conducted.

Conclusions

The media appears to play an important role in fostering a desire to become thinner and lose weight among adolescent boys and girls, and this environment could potentially lead to greater compulsive exercising. Messages to become more muscular from significant others, particularly fathers, could also be influential in the development of a tendency towards more compulsive exercise among boys. These findings need to be replicated using a longitudinal design to establish true cause and effect of these possible socio-cultural risk factors.

Study 5: Friends and family: The relationship between physical activity support and compulsive exercise among adolescents

Abstract

Objective: This study aimed to replicate previous findings between physical activity support and exercise behaviour and endeavoured to assess whether physical activity support was also linked to adolescents' compulsive exercise cognitions. **Method:** A sample of 1623 male and female adolescents, aged between 12 and 14 years old, completed measures of physical activity support, exercise behaviour, and compulsive exercise cognitions. **Results:** Multiple stepwise regressions found that for boys and girls, physical activity support was significantly and positively related to exercise behaviour. There were also significant relationships between physical activity support and compulsive exercise cognitions in both boys and girls. **Discussion:** Activity support from fathers and peers seems to be particularly important in predicting adolescents' exercise attitudes and behaviours. Healthcare professionals working with adolescents who are displaying disordered eating symptoms may wish to consider the activity support received from fathers and friends. Further research is needed to replicate these cross-sectional relationships.

Friends and family: The relationship between physical activity support and compulsive exercise among adolescents

Physical activity has been the focus of much research due to the surge in obesity levels (Rennie & Jebb, 2005) and other lifestyle-related diseases in recent years, and exercise is therefore portrayed as a healthy, normal behaviour (Cavill, Biddle, & Sallis, 2001). However, some individuals can develop an unhealthy, compulsive drive to exercise, which can be detrimental to their health and well being (e.g., Hausenblas & Symons Downs, 2002b; Iannos & Tiggemann, 1997). The risk factors for the development of such compulsive exercise are currently not well understood.

There have been many terms used to describe compulsive exercise behaviours and cognitions, such as ‘exercise addiction’ (e.g., Terry et al., 2004), ‘exercise dependence’ (Veale, 1987) and ‘obligatory exercise’ (Thompson & Pasman, 1991), but regardless of inconsistent terminologies, such pathological, driven exercise is consistently associated with disordered eating (Bamber, Cockerill, Rodgers, & Carroll, 2000; Davis et al., 1994; Goodwin et al., in press). While a great deal of research has focused on the development of disordered eating (e.g., Attie & Brooks-Gunn, 1989; Kluck, 2008; Leon et al., 1999), very little has examined the development of compulsive exercise behaviour and cognitions.

A recent multidimensional model of compulsive exercise has been proposed, which aims to unify the equivocal definitions surrounding compulsive exercise among the eating disorders (Taranis et al., in press). This model postulates that there are several interlinked facets that make up the higher order construct of compulsive exercise, including rule-driven behaviour, weight control exercise, mood improvement, lack of exercise enjoyment and exercise rigidity (Taranis et al., in press). These aspects contribute to a full definition of compulsive exercise. Developing an understanding of the individual and environmental predictors of compulsive exercise (e.g., personality and family attitudes towards exercise) is vital for informing early-intervention programmes. Such programmes are particularly important among an adolescent population, as this has been seen to be a key age in the onset of mental disorders (Kessler et al., 2005), such as eating disorders (Striegel-Moore & Bulik, 2007), and is likely to be a critical period in the development of compulsive exercise.

One possible environmental factor that could influence compulsive exercise among adolescents is the physical activity support received from family and friends. The family environment is influential in the eating behaviours of children (Haycraft & Blissett, 2009) and the corresponding development of disordered eating (Kluck, 2008). Given the close relationship that exists between eating psychopathology and compulsive exercise in both adults (Bamber, Cockerill, & Carroll, 2000) and adolescents (Goodwin et al., in press), it is plausible that family and peer influence might also be linked to the development of compulsive exercise.

Parental physical activity levels have been widely cited as influencing adolescent physical activity, both directly and indirectly (e.g., Sallis et al., 2000; Welk et al., 2003). Ricciardelli et al. (2000) reported that boys who received more exercise messages from fathers also engaged in more exercise to alter body shape and size. Exercising for weight and shape has been the exercise motivation most closely associated with eating disorder psychopathology (Mond et al., 2006). Children often model their parents and may be supported or discouraged to be active by parental exercise attitudes or behaviours (Sallis et al., 2000). For example, Davison (2004), among a community sample of adolescents, found that boys and girls who were more active reported greater amounts of physical activity support from their family. Davison (2004) also found that the adolescents' exercise levels were influenced by the amount of peer support they received. This association between exercise levels and peer involvement has been suggested in other studies (Anderssen & Wold, 1992; Smith, 2003). Additionally, peer influence on disordered eating has been well demonstrated (e.g., Farrow, Haycraft, & Meyer, 2009). However, no study has specifically investigated links between peer support in physical activity and compulsive exercise among adolescents.

In summary, compulsive exercise is reportedly a risk factor for the development of eating disorders (Davis et al., 1997), as well as being a physical and psychological health risk in itself (Iannos & Tiggemann, 1997). However, risk factors for the development of compulsive exercise are poorly understood. From the general physical activity literature, it is clear that parents' level of support is closely linked to children's activity levels (e.g., Anderssen & Wold, 1992; Davison et al., 2003; Prochaska et al., 2002), but this physical activity support has not been previously studied in relation to compulsive exercise. It is important to note that this relationship between physical activity support and compulsive exercise could either be positive or negative. Physical activity support from family and peers could act as a protective factor against the development of compulsive exercise via its role in social support, just as familial support can be protective against eating disorders (Attie & Brooks-Gunn, 1989). However, equally, activity support could also be a risk factor, through an over-emphasis of exercise messages displayed to the adolescent (e.g., Ricciardelli et al., 2000) which may reinforce any compulsive exercising within the individual.

Therefore, the current study will investigate whether physical activity support is associated with compulsive exercise in adolescents. The aims of the study are two-fold. First, to replicate previous findings (Davison, 2004), which have identified a link between physical activity support and self-reported exercise behaviour among adolescents. It is hypothesised that greater self-reported exercise frequency will be predicted by greater physical activity support. Based on previous findings (Davison, 2004), it is also hypothesised that there will be gender differences in levels of exercise and types of physical activity support reported. The second aim is to assess the predictive ability of physical activity support on to compulsive exercise. It is hypothesised that there will be a significant association between physical activity support and compulsive exercise. However, given that physical activity support in theory could be either protective from, or a risk factor for, compulsive exercise, no a priori hypothesis will be made about the direction of association between physical activity support and compulsive exercise.

METHODS

Participants:

Participants were recruited from secondary schools across the United Kingdom. As part of ongoing wider research into adolescent exercise and eating attitudes, and the further development of compulsive exercise measurement, which is reported elsewhere (see Goodwin et al., in press), a sample of 1623 adolescents, aged 12-14 years old, completed self-report measures for this study. There were 751 boys (46.3%) and 872 girls (53.7%). The mean age was 13.0 years for both the boys (SD = 0.73) and girls (SD = 0.72). For those who reported their nationality (n = 1587), 98.6% were British, and 95% of the sample classified their ethnicity as “white British”. Only “other white background” scored above 1%

of the sample (1.3%). Information on socioeconomic status (SES) was taken from the Office for National Statistics (2008), with all schools coming from average to low areas of economic deprivation.

Measures and procedure:

Twelve secondary schools across the United Kingdom were contacted via letter and nine agreed to participate in a broader longitudinal study concerning eating and exercise-related attitudes. Institutional review board ethical approval was granted, and questionnaire packs, consent forms and parent letters were sent to the schools. The schools' point of contact (member of staff on senior management team) distributed the questionnaire packs during a pre-determined school class period to pupils of the appropriate age. In addition, the administering teacher was provided with detailed instructions to ensure that packs were completed correctly and consistently.

Following informed consent, participants reported demographic information, including their nationality, ethnicity, age, and gender. Subsequently, they completed the following established questionnaires in the order presented below.

Physical Activity Support Scale (PASS; Davison, 2004)

The PASS is a 27-item measure that identifies the degree to which the individual receives social support related to their physical activity from both family and from peers. It contains seven subscales; General Family Support (e.g., "My family and I do active things together"), Paternal Modelling (e.g., "My father often exercises or does something active"), Paternal Logistic Support (e.g., "My father drives (or takes) me to places where I can be physically active"), Maternal Modelling (e.g., "My mother often exercises or does something active"), Maternal Logistic Support (e.g., "My mother drives (or takes) me to places where I can be physically active"), Sibling Support (e.g., "My sibling often plays sport or does something active"), and Peer Support (e.g., "My friends and I like to do active things together"). Higher scores represent a greater degree of perceived support. The PASS has been shown to be both reliable and valid for use with male and female adolescents (Davison, 2004). Cronbach's alpha values for the current sample were .69 (General Family Support), .81 (Paternal Modelling), .80 (Paternal Logistic Support), .81 (Maternal Modelling), .76 (Maternal Logistic Support), .85

(Sibling Support), and .84 (Peer Support). When referring to sibling support, 16% of the sample reported having no siblings.

Leisure Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985)

The LTEQ measures participants' current activity levels and was described in Study 1.

Compulsive Exercise Test (CET; Taranis et al., in press).

The CET is a 24-item measure that assesses five core features of compulsive exercise, and was described in Study 1. In this sample, the total CET had a Cronbach's alpha of .88. The reliability values of the subscales were .87 (Avoidance and Rule-Driven Behaviour), .76 (Weight Control Exercise), .80 (Mood Improvement), .69 (Lack of Exercise Enjoyment), and .74 (Exercise Rigidity).

Statistical Analyses:

Physical activity support and its relationship with exercise behaviour has been seen to differ between genders (Davison, 2004). Therefore, tests of difference between boys and girls were conducted on each of the variables to identify whether this was true of the current sample. A Mann-Whitney U test (non-parametric; one tailed) was used due to the majority of variables being non-normally distributed. Significant differences found between boys and girls on the majority of the physical activity support scales in this sample confirmed this gender difference (Table 1). Therefore, all subsequent analyses were conducted separately for boys and girls.

As expected, data were not normally distributed. However, inspection of the residuals statistics showed that the residuals were normally distributed. Therefore, no transformations were made for the following analyses. To achieve the first aim of determining the predictive ability of PASS subscales upon exercise frequency among adolescents, a multiple stepwise regression was conducted. The LTEQ Total frequency was entered as the dependent variable and the PASS subscales were entered as the predictor variables.

The study's second aim of identifying the predictive ability of physical activity support on to compulsive exercise was also tested using multiple stepwise regression analyses. Firstly, the PASS subscales were entered as the predictor variables and the total CET score was entered as the dependent variable. Following these analyses, regressions were repeated with the same predictor variables and with each CET subscale as the dependent variable in separate regression models. All tests were two-tailed, and significance values were set at $p < .001$, due to the large sample size and the number of regressions being conducted.

RESULTS

Descriptives

Mean scores and tests of difference between boys and girls can be seen in Table 5.4. The means reported are similar to other studies that have used the LTEQ (e.g., Gillison et al., 2006) and the PASS (e.g., Davison, 2004), and the CET scores were slightly lower than those found in adult exercisers who completed the CET (e.g., Taranis et al., in press).

In this sample, boys reported significantly more total exercise behaviour than girls. With respect to CET total scores, the overall levels of compulsive exercise were generally quite low, as is expected in an adolescent community sample. With regard to CET subscale scores, girls displayed a significantly higher mean score than boys on the Weight Control Exercise subscale of the CET, whilst boys scored significantly higher than the girls on the Avoidance and Rule-Driven Behaviour subscale.

In terms of physical activity support, there appeared to be a gender alignment, with boys reporting significantly greater Paternal Logistic Support and Paternal Modelling than girls, and girls reporting significantly greater Maternal Logistic Support and Maternal Modelling than boys. Boys reported a significantly greater amount of Peer Support than was reported among the girls. Using Cohen's (1988) criteria (.1 = small effect; .3 = medium effect), the majority of the effect sizes for the significant differences were small; meaning that statistical significance alone should be viewed with caution.

Table 5.4 Descriptive statistics and tests of difference (Mann-Whitney U) for boys (n = 751) and girls (n = 872)

	Mean (SD)		Mann-Whitney U
	Males	Females	Z
LTEQ Total (METS)	71.6 (44.4)	54.3 (28.9)	8.78*
CET Total	10.01 (4.08)	9.94 (3.66)	.32
CET Avoidance and Rule-Driven Behaviour	1.64 (1.15)	1.41 (1.07)	3.55*
CET Weight Control Exercise	2.25 (1.11)	2.58 (1.24)	4.91*
CET Mood Improvement	2.66 (1.21)	2.47 (1.18)	2.94
CET Lack of Exercise Enjoyment	1.30 (1.14)	1.39 (1.17)	1.35
CET Exercise Rigidity	2.19 (1.35)	2.08 (1.27)	1.59
General Family Support	2.55 (.64)	2.64 (0.62)	2.49
Paternal Modelling	2.82 (.71)	2.72 (.66)	3.39*
Paternal Logistic Support	2.97 (.82)	2.70 (.77)	6.86*
Maternal Modelling	2.55 (.65)	2.83 (.65)	8.90*
Maternal Logistic Support	2.74 (.79)	2.88 (.75)	3.48*
Sibling Support	2.73 (.76)	2.81 (.68)	2.10
Peer Support	3.18 (.61)	2.91 (.58)	9.21*

Note: * $p < .001$; LTEQ = Leisure Time Exercise Questionnaire; METS = Metabolic Equivalents; CET = Compulsive Exercise Test

Association between physical activity support and exercise behaviour

A multiple stepwise regression was conducted to identify the predictive effect of PASS subscale scores on total exercise frequency scores. For boys, the final model was significant ($F_{(1, 545)} = 19.25$, $p < .001$) and accounted for 3% of the total variance ($R^2 = .03$). General Family Support was the only significant predictor (Beta = .19, t = 4.39, $p < .001$). No other PASS subscales were significant predictors. For girls, the regression model was also significant ($F_{(1, 640)} = 38.75$, $p < .001$) and accounted for 6% of total exercise behaviour variance ($R^2 = .06$). Paternal Logistic Support was the only significant predictor (Beta = .24, t = 6.23, $p < .001$). No other significant predictors were found.

Association between physical activity support and compulsive exercise

The results of the regression analyses between physical activity support and compulsive exercise for boys and for girls can be seen in Table 5.5 and Table 5.6, respectively.

Boys

The multiple stepwise regression for the boys produced a final regression model that accounted for 11% of the variance in CET total score, and provided a significant predictive value. Peer Support and Paternal Logistic Support were significant individual predictors of boys' CET total. No other variables were significant predictors of the model.

Among the CET subscale regressions, all models produced significant findings, with the variances accounted for ranging between 3% (Lack of Exercise Enjoyment) and 14% (Avoidance and Rule-Driven Behaviour). From the individual PASS subscales, Peer Support was a significant, positive predictor for all of the CET subscales, with the exception of Lack of Exercise Enjoyment. Paternal Logistic Support was the second most frequently observed significant predictor, predicting three of the five CET subscales (Avoidance and Rule-Driven Behaviour, Mood Improvement, Exercise Rigidity). The only other significant individual predictor was Paternal Modelling, which was negatively associated with Lack of Exercise Enjoyment. For boys, no significant associations were found for any of the CET subscales with General Family Support, Maternal Logistic Support, Maternal Modelling, or Sibling Support.

Girls

Among the girls, PASS subscales significantly predicted total CET. The model accounted for 7% of total CET variance, which was slightly less than was found for the total CET model among the boys (R^2 = .11). Peer Support was found to be the only significant predictor. As was found for the boys, no other variables were significant predictors of total CET in the girls.

The CET subscales were all significantly predicted by PASS subscales. The results can be seen in Table 2. The variances accounted for in each model ranged from 3% (Weight Control Exercise) to 19% (Lack of Exercise Enjoyment). Peer Support significantly and positively predicted all of the CET subscales, with the exception of the Lack of Exercise Enjoyment, where the significant relationship was in the negative direction. Paternal Logistic Support was a significant predictor for three of the CET subscales, positively predicting Mood Improvement Exercise and Exercise Rigidity and negatively predicting Lack of Exercise Enjoyment. Maternal Logistic Support was found to be a significant positive predictor for Avoidance and Rule-Driven Behaviour. No significant associations were found between the CET subscales and the PASS subscales of General Family Support, Paternal Modelling, Maternal Modelling, and Sibling Support.

Table 5.5 Final models of multiple stepwise regressions on to compulsive exercise for boys (n = 751)

Dependent Variable	F(df)*	R^2	Individual Predictors	Beta	T*
CET Total	30.19 (2, 468)	.11	Peer Support	.23	4.92
			Paternal Logistic Support	.17	3.60
CET Avoidance & Rule-Driven Behaviour	42.53 (2, 506)	.14	Peer Support	.23	5.19
			Paternal Logistic Support	.22	4.97
CET Weight Control Exercise	20.23 (1, 506)	.04	Peer Support	.20	4.50
CET Mood Improvement	36.91 (2, 505)	.13	Peer Support	.24	5.20
			Paternal Logistic Support	.19	4.24
CET Lack of Exercise Enjoyment	15.82 (1, 491)	.03	Paternal Modelling	-.18	-3.98
CET Exercise Rigidity	35.84 (2, 482)	.13	Paternal Logistic Support	.22	4.84
			Peer Support	.21	4.48

Note: These are the final models of each stepwise regression; * denotes that all relationships found in the column are significant at p <.001 (two-tailed); CET = Compulsive Exercise Test

Table 5.6 Final models of multiple stepwise regressions on to compulsive exercise for girls (n = 872)

Dependent Variable	F(df)*	R^2	Individual Predictors	Beta	T*
CET Total	42.64 (1, 562)	.07	Peer Support	.27	6.53
CET Avoidance and Rule-Driven	34.86 (2, 599)	.10	Maternal Logistic Support	.19	4.58
Behaviour			Peer Support	.19	4.56
CET Weight Control Exercise	15.56 (1, 600)	.03	Peer Support	.16	3.94
CET Mood Improvement	54.07 (2, 598)	.15	Peer Support	.27	6.73
			Paternal Logistic Support	.20	4.91
CET Lack of Exercise Enjoyment	67.34 (2, 576)	.19	Paternal Logistic Support	-.33	-8.12
			Peer Support	-.19	-4.75
CET Exercise Rigidity	64.65 (2, 581)	.18	Paternal Logistic Support	.29	7.11
			Peer Support	.23	5.66

Note: These are the final models of each stepwise regression; * denotes that all relationships found in the column are significant at p <.001 (two-tailed); CET = Compulsive Exercise Test

DISCUSSION

This study investigated the relationship between physical activity support from family and friends and compulsive exercise among adolescents. The first aim was to replicate previous research that has found a link between physical activity support and exercise behaviour (Davison, 2004). In the current study, it was found that physical activity support did significantly predict total exercise frequency, and as hypothesised there were gender differences. General Family Support and Paternal Logistic Support were significant predictors for boys and girls respectively, but they only accounted for a small amount of the variance of total exercise frequency. No other physical activity support scales were found to be significant statistical predictors of exercise frequency for either gender. The importance of parents' behaviour on boys' exercising has been previously shown (DiLorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998) and these results partly confirm the existing literature. The result for the girls specifies the paternal link and suggests that the more the father puts time and effort into his daughter's activity, the more active the daughter is likely to be. The result highlights the importance of fathers on the activity levels of daughters, which has not been widely researched. However, the small amount of variance accounted for by the significant physical activity support scales suggests that there are a wide range of other factors that predict adolescent activity behaviour.

The second aim was to examine the predictive ability of physical activity support from friends and family on to compulsive exercise. The results indicate that specific sources of physical activity support, predominantly peer support and paternal logistic support, have a significant relationship with compulsive exercise attitudes in male and female adolescents. Importantly, the direction of these relationships suggests that as these sources of physical activity support increase so does a compulsivity towards exercise. This aligns with previous literature which has demonstrated that greater physical activity support is a positive way to increase the activity levels of an increasingly sedentary adolescent population (Davison, 2004). However, for some individuals, the findings of this study could be a cause for concern as they may indicate that this increased support could be associated with the development of detrimental compulsive exercising. Given that these results are cross-sectional, then cause and effect cannot be attributed to either variable. Future studies should look to examine whether increased physical activity support actually leads to increased compulsive exercise attitudes over time or whether the compulsivity of an adolescent's exercising leads to parents, particularly fathers, and peers engaging in greater physical activity support with that individual.

The potential influence of fathers on both boys' and girls' compulsivity towards exercise is an interesting finding. It suggests that fathers could have a more crucial influence on the development of their children's compulsive exercise than mothers. The findings from this study support previous findings that fathers can influence their children's exercising (e.g., Ricciardelli et al., 2000), although more research that focuses on paternal influences specifically on compulsive exercise is required in order to fully elucidate the role of fathers in influencing their children's maladaptive exercise attitudes and behaviours.

This study is one of the first investigations into environmental influences, i.e. physical activity support, on compulsive exercise among adolescents. However, the study does have limitations, which need to be acknowledged. Firstly, the results only demonstrate cross-sectional associations, and therefore neither cause and effect, nor temporal precedence between the variables, can be established. Recommendations for future research begin with a need to replicate these findings longitudinally, to identify whether the increased peer and paternal logistic support actually leads to greater compulsive exercise, i.e. whether they could be considered as realistic risk factors for compulsive exercise among adolescents. The socioeconomic status (SES) of the participants' families was not recorded, and this too could be regarded as a limitation of the study. The findings may simply be a result of some families being in a more difficult financial position and therefore not being able to take their child to sporting clubs or activities (i.e., to provide logistic support). Therefore, it could be that the results were partly attributable to the families' SES and not just their level of physical activity support. These results need to be replicated with a measure of individual SES included.

Practical Implications

These results provide valuable information on the influence of activity-related support from family and peers on an adolescent's compulsive exercising. Traditionally, physical activity support has been regarded as a positive factor in encouraging youth to increase their exercise participation (Davison, 2004). The results of this study suggest that increased paternal and peer support could also be linked with a greater compulsivity towards exercise. Therefore, these findings need to be considered when promoting exercise in adolescent populations. A compulsivity towards exercise could present psychological and physical problems in itself (Iannos & Tiggemann, 1997). It could also be influential in the development of eating disorders (Davis et al., 1997). Therefore, those working in the field of health promotion need to be cognisant of a child's compulsivity towards exercise, and duly note the level of support that the adolescent receives, particularly from their father and their peers.

Importantly, these findings also showed that although statistical significance was achieved, the effect sizes were invariably small. This has practical importance in that it indicates that there are other risk factors that could be influencing an individual's level of compulsive exercise. Specifically, given that compulsive behaviours are largely solitary and self-directed (e.g., Schlosser, Black, Repertinger, & Freet, 1994), it could be that compulsive exercise is predominantly influenced by internal factors, such as personality. Therefore, early intervention work aimed at reducing a compulsivity towards exercise may need to take into account factors in addition to physical activity support, and perhaps focus on individual cognitions and attitudes.

Conclusions

These results are the first known evaluation of the relationship between physical activity support and compulsive exercise. The findings are a first step in reporting peer activity support and paternal logistic support as factors associated with compulsive exercise and total exercise frequency in both male and female adolescents. Further research is warranted to examine other social and familial influences on the development of a compulsivity towards exercise. Specifically, investigations need to identify whether a compulsive exerciser with a pre-existing compulsivity towards exercise chooses to socialise with a more highly exercising group of peers or whether the person's initial peer group environment itself can play a contributory factor in the development of compulsive exercise attitudes and behaviours.

Chapter 6

Behavioural Correlates of Compulsive Exercise

Study 6

6 Behavioural Correlates of Compulsive Exercise

The previous two chapters demonstrated the psychological and disordered eating correlates, as well as the socio-cultural correlates, of compulsive exercise. These correlates were examined with the CET, which ultimately is a cognitive and affective measure of compulsive exercise (Taranis et al., in press). However, previous research into compulsive exercise has highlighted that the compulsive cognitions and often excessive behaviours are not always strongly linked (see Chapter 3), and in relation to the eating disorders, it has been found that eating disorder psyschopathology has a stronger association with compulsive exercise cognitions than with exercise behaviour alone (Siegel & Hetta, 2001; Mond et al., 2006). Therefore, this chapter presents a study which further examines the link between the compulsive exercise cognitions and corresponding exercise behaviour. The previous association found between exercise behaviour and the CET only looked at total exercise frequency (see Chapter 3). In addition, a recent study found that compulsive exercise in eating disorder patients was specifically associated with moderate to vigorous exercise behaviour (Bratland-Sanda et al., 2010a), but they too did not examine more mild intensities of exercise behaviour. Therefore, the current chapter extends the existing findings by looking at the relationship between the CET and different intensities of exercise behaviour.

In addition to examining the link between the CET and exercise behaviour, the current chapter also focuses on sport participation as a possible correlate of compulsive exercise. This hypothesised link is grounded in the findings of the existing literature that has found eating disorder prevalence to be greater in athletes than non-athletes (e.g., Sundgot-Borgen & Torstveit, 2004), as well as the fact that participation in aesthetic sports at an early age is associated with heightened weight and shape concerns (Davison et al., 2002). Specifically, a previous investigation of adolescents did examine the link between competitive sport involvement and exercise dependency among adolescents, but did not find any association (McCabe & Ricciardelli, 2004a). However, the McCabe and Ricciardelli study did not use the recently derived current conceptualisation of compulsive exercise, which is being used in this thesis (see Chapter 1). Therefore, Chapter 6 aims to examine the specific link between sport participation and compulsive exercise attitudes, as assessed by the CET measure.

Study 6: Are sport participation and exercise behaviour associated with greater compulsive exercise cognitions and attitudes among adolescents?

Abstract

Objective: This study aimed to investigate the link between competitive sport, exercise behaviour, and adolescents' compulsive exercise cognitions, with a view to identifying behavioural correlates of compulsive exercise. **Method:** A sample of 828 adolescents aged 13-15 years old, completed measures of sport participation, exercise behaviour, and compulsive exercise. **Results:** Among boys, compulsive exercise was significantly associated with strenuous exercise behaviour but not with moderate or mild exercise behaviour. Among girls, compulsive exercise was strongly associated with strenuous and moderate exercise behaviour, as well as being weakly correlated with mild exercise behaviour. Exercise behaviour was not strongly associated with exercising to control weight. Compulsive exercise was also greater among those involved in competitive sport than those not involved in sport. There were no differences in compulsive exercise scores between those involved in lean sports compared to those involved in non-lean sports. **Conclusion:** The results suggest that compulsive exercise cognitions are generally associated with greater exercise behaviour, predominantly of higher intensities. Additionally, sport participation is associated with greater compulsive exercise cognitions, and this is not specific to weight-related sports, such as gymnastics, weight-category sports, or endurance sports.

Are sport participation and exercise behaviour associated with greater compulsive exercise cognitions and attitudes among adolescents?

Compulsive exercise is commonly reported in eating disorder samples (Dalle Grave et al., 2008; Davis et al., 1994). It is highly driven in nature and compulsive exercisers often feel compelled to engage in exercise even when it is contrary to their own physical and psychological well being (Meyer et al., in press). Compulsive exercise has also been reported at a non-clinical level, among community exercisers (Lipsey et al., 2006), as well as within athletic populations (Pierce, 1994). Regardless of the sample used, compulsive exercise can negatively affect an individual's quality of life (Mond et al., 2006).

Exercise behaviour is widely promoted as a healthy activity that can provide many positive health benefits (see Penedo, 2005). However, in the eating disorder literature, exercise behaviour has been implicated in the development of eating disorder pathology (Davis et al., 1990; Davis et al., 1994; Davis et al., 1997; Davis et al., 2005). This implication has been proposed based on the finding that the activity levels of patients, prior to the onset of their eating disorder, were significantly associated with current symptoms of their eating disorder, namely their current levels of compulsive exercising (Davis et al., 1997).

Sport participation is also regarded as a positive activity that can provide a variety of physical, psychological, and social benefits (Thompson & Sherman, 2010). However, levels of disordered eating have been shown to be consistently higher among athletes than among non-athletic groups (Hausenblas & Carron, 1999; Sundgot-Borgen & Torstveit, 2004). Other research has suggested that sport participation can render individuals at a greater risk for developing an eating disorder (Smolak, Murnen, & Ruble, 2000). More specifically, sports which emphasise leanness, i.e. aesthetic and weight-dependent sports such as gymnastics and combat sports, seem to report greater frequencies of eating concerns than more technical ball sports and non-athletic controls (Sundgot-Borgen, 1993; 1994a; 1994b). However, these studies have tended to focus on general eating pathology and attitudes, rather than examining differences between sport and non-sport groups on specific aspects of the eating disorders, such as compulsive exercising. One study that did consider involvement in competitive sport and exercise dependence was that of McCabe and Ricciardelli (2004a). Their study of adolescent boys and girls found that, although sport involvement was associated with greater disordered eating, it did not predict exercise dependency. However, theirs was the only study that has assessed this relationship and therefore requires replication, particularly using a multidimensional conceptualisation of compulsive exercise (Taranis et al., in press).

Despite the existing literature implicating sport participation in predicting weight concerns (Davison et al., 2002), as well as role of exercise behaviour in the development of eating disorders (Davis et al., 1994), other research has found more equivocal results. For example, adolescents who exercised hard and frequently, but who also had a positive attitude towards exercise, did not develop eating disorder pathology (Steffen & Brehm, 1999). The authors concluded that excessive exercise behaviour is less important to disordered eating than the individual's cognitions and attitudes towards exercise. Subsequently, this model was supported by Cook and Hausenblas (2008) who found that the exercise-eating pathology relationship was mediated by the individual's compulsion to exercise. Therefore, it would appear that compulsive exercise measurement needs specifically to target cognitions and attitudes, rather than behaviours.

The risk factors and behavioural concomitants for compulsive exercise cognitions need to be elucidated, in order to inform early intervention work. This early intervention work would arguably most benefit adolescents, as adolescence is a time of difficulty for many individuals, and represents a key time in the onset of the eating disorders (Striegel-Moore & Bulik, 2007).

In summary, exercise behaviour and sport participation are largely positive behaviours. However, given their identified risks for the development of eating disorders (Davis et al., 1994; Sundgot-Borgen, 1993; 1994a; 1994b), there is concern that these activities could also be detrimental to some individuals. It would appear that it is the exercise cognitions and not simply the volume of exercise that is important in relation to the eating disorders (Ackard et al., 2002; Cook & Hausenblas, 2008). These cognitions are usually compulsive in nature and are associated with poorer treatment outcome (Solenberger, 2001). Adolescence is a key time in the development of eating disorders (Striegel-Moore & Bulik, 2007), and therefore, could represent a crucial time for the development of compulsive exercising as well. Therefore, this study will examine the association between exercise behaviour, sport participation and compulsive exercise, as measured cognitively and attitudinally, in a sample of adolescents.

This study has the following aims. First, the relation between total exercise behaviour and compulsive exercise (as measured cognitively and affectively) has been previously reported in a similar adolescent sample (see Chapter 3). This will be extended here by examining different intensities of exercise behaviour. Based on the previous findings, it is hypothesised that each intensity of exercise behaviour will be positively and significantly associated with compulsive exercise. The second aim is specifically to focus on sport participation, and discover whether involvement in competitive sport is associated with a greater compulsivity towards exercise. Previous work has found general eating disorder psychopathology to be greater in athletes than in non-athletes (Sundgot-Borgen & Torstveit, 2004), and therefore, it is hypothesised that sport participants will have significantly greater levels of compulsive exercise than non-sport participants. In addition, the type of sport has also been linked to a greater focus on weight and shape among young girls (Davison et al., 2002) as well as disordered eating among athletes (Sundgot-Borgen & Torstveit, 2004). Therefore, the third aim of this study is to identify whether the type of sport (lean versus non-lean) will be related to compulsive exercise. In keeping with the eating disorder findings of Sundgot-Borgen (1993; 1994a; 1994b) among adults, it is hypothesised that among adolescents, lean sports participants will report significantly greater levels of compulsive exercise than the non-lean sports participants.

METHODS

Participants

A sample of 828 adolescents, attending secondary schools in the United Kingdom, was recruited as part of an ongoing research project into adolescent eating and exercise-related attitudes. Participants were aged between 13 and 15 years old, with a mean age of 14.07 years (SD = .71), and a roughly even gender distribution (boys n = 371, 44.8%; girls n = 457, 55.2%). The sample was mainly British (98.6%) and ethnicity was also homogenous ("White British" = 95.4%). Socioeconomic status was assessed by the location of the schools, which were all found in average to low levels of economic deprivation areas, as defined by the Office for National Statistics' figures on deprivation (Office for National Statistics, 2008). The self-reported height and weight information of participants were converted into Body Mass Index (BMI) values, which were then adjusted for age and gender into z scores (Child Growth Foundation, 1996). The mean BMI z score for boys was 0.37 (SD = 1.37), whilst it was -.00 (SD = 1.13) for girls.

Measures and procedure

Institutional Review Board ethical approval was granted, and questionnaire packs were distributed to the participating schools. Packs were distributed to the relevant age group of pupils (i.e., 13-15 years old) during a regular timetabled class period. Standardised instructions were provided to ensure that questionnaires were completed consistently. The following measures, included in the packs, were used for this study:

Competitive Sport Participation

In accordance with the work of McCabe and Ricciardelli (2004a), participants were asked whether or not they engaged in any competitive sport. A conditional follow-up item was then asked for those who had answered yes to participating in sport. This follow-up question asked which sport(s) they participated in. To ensure consistency with previous research that has studied eating disorders in sport, the type of sport was then categorised into lean sports or non-lean sports (Sundgot-Borgen, 1993; 1994a; 1994b). The lean sports included sports that were aesthetic (e.g., gymnastics, diving, figure skating), weight-dependent (e.g., martial arts, wrestling, boxing), and endurance-based (e.g., running, cycling, swimming); as aesthetic, weight-dependent, and endurance sports all emphasise leanness. Non-lean sports were ball games (e.g., basketball, football, volleyball) or technical sports (e.g., golf, sailing), where leanness is not generally emphasised in relation to performance.

Exercise Behaviour

Exercise behaviour was measured using the self-report Leisure Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985). The LTEQ was described in Study 1.

Compulsive Exercise

Compulsive exercise was measured using the 24-item Compulsive Exercise Test (CET; Taranis et al., in press). The CET has been previously described in Study 1. The reliability of the CET Total was .89 for this sample.

Data Analysis

Preliminary analyses was conducted to screen the data for normality and to test for gender differences. A series of Kolmogorov-Smirnov tests revealed that the majority of continuous variables (LTEQ and CET subscales) were not normally distributed. A preliminary test of difference (Mann-Whitney U test, two-tailed) was also performed to test for differences between the boys and girls in the sample on all of the study variables. Results confirmed that there were gender differences for the majority of study variables (see Table 6.1). These preliminary analyses meant that subsequent analyses were conducted separately for boys and girls and non-parametric tests were used where appropriate.

Analysis for the first hypothesis was conducted using a non-parametric correlation (Spearman's Rho), and was one-tailed. The second hypothesis was analysed using non-parametric tests of difference (Mann Whitney U test, one-tailed) between those who participated and those who did not participate in competitive sport. The third aim involved the sub-sample of those who had answered yes to the competitive sport question ($n = 469$, 56.6% of total sample). Participants who participated in lean sports were compared with those who participated in non-lean sports on the CET Total and the CET subscales. This aim was also analysed using a non-parametric test of difference (Mann Whitney U test, one-tailed). The size of the sample was relatively large and therefore to reduce the risk of Type I error, significance was set at a more stringent $p < .01$ for all tests.

RESULTS

Descriptive Results

The means and standard deviations for the exercise behaviour and compulsive exercise scales can be seen in Table 6.1. The tests of difference between boys and girls can also be seen in the same table.

The mean values for the CET Total and the CET subscales for both boys and girls on the whole represent mid-point scoring ("sometimes true"). Girls scored significantly higher than boys on CET Total. The means of the CET subscales differed between boys and girls significantly on Weight Control Exercise and Lack of Exercise Enjoyment, with girls scoring significantly greater than boys on both these scales. The exercise behaviour scores were slightly lower than previous studies that have used the LTEQ in this population (e.g., Cumming et al., 2008). Boys reported significantly greater strenuous and moderate exercise behaviour, although there was no gender difference on mild exercise behaviour.

Table 6.1 Descriptive statistics for exercise behaviour and compulsive exercise cognitions and attitudes (N = 828), and Mann-Whitney U Test of difference between boys (n = 371) and girls (n = 457)

Variable	Boys' Mean (SD)	Girls' Mean (SD)	Test of difference (z)
CET Total	8.57 (3.79)	9.52 (3.57)	3.50**
Avoidance and Rule-Driven Behaviour	1.37 (1.14)	1.20 (1.06)	2.04
Weight Control Exercise	1.79 (1.09)	2.54 (1.27)	8.41**
Mood Improvement	2.31 (1.20)	2.34 (1.18)	0.30
Lack of Exercise Enjoyment	0.99 (0.96)	1.46 (1.24)	5.36**
Exercise Rigidity	2.11 (1.35)	1.98 (1.29)	1.34
Strenuous Exercise Behaviour [a]	33.89 (23.49)	21.91 (19.41)	8.17**
Moderate Exercise Behaviour [a]	17.82 (13.61)	15.92 (15.58)	3.03*
Mild Exercise Behaviour [a]	10.60 (10.75)	10.77 (9.43)	0.88

Note: ** p <.001, * p <.01; [a] Measured in Metabolic Equivalents (METS); CET = Compulsive Exercise Test

As for sport participation, more boys than girls reported currently engaging in sport. For boys, 260 (out of 371) participants were involved in competitive sport (70.1%). For girls, 209 reported that they were in competitive sports (45.7%), whilst 247 said that they were not involved in competitive sports (one girl did not respond). In terms of principle sport participation, among the boys, the key sports were football (n = 110), rugby (n = 40), cricket (n = 17) and martial arts (n = 10). All other sports had fewer than 10 responses. Among the girls, the key types of sport reported were dance (n = 40), horse riding (n = 32), hockey (n = 26), swimming (n = 17), athletics (n = 16), football (n = 14), and cross country (n = 10). All other sports had fewer than 10 responses.

Exercise Frequency and Compulsive Exercise (Aim 1)

The results of the correlation analysis for aim 1 can be seen in Table 6.2 (boys) and Table 6.3 (girls). Among boys, no significant relationships were found between moderate and mild exercise behaviour with any CET scores. Weight Control Exercise was also not significantly correlated with strenuous exercise behaviour. Strenuous exercise behaviour was significantly and positively correlated with CET Total, Avoidance and Rule-Driven Behaviour, Mood Improvement, and Exercise Rigidity; and was significantly, negatively correlated with Lack of Exercise Enjoyment.

For girls, there were more significant associations between exercise behaviour and CET scores than for boys. In particular, strenuous exercise behaviour was significantly and positively correlated with CET Total and all CET subscales, with the exception of Lack of Exercise Enjoyment, where the significant correlation was in a negative direction. Moderate exercise behaviour was significantly and positively associated with CET Total, Avoidance and Rule-Driven Behaviour, Mood Improvement, and Exercise Rigidity; and it was negatively associated with Lack of Exercise Enjoyment. Mild exercise behaviour reported weaker correlations with CET scores in general, although it was significantly ($p < .01$) associated with CET Total, Mood Improvement, and Exercise Rigidity, all in a positive direction.

Table 6.2 Correlation coefficients (Spearman's Rho) between exercise behaviour and compulsive exercise cognitions and attitudes in boys (n = 371)

CET	Exercise Behaviour		
	Strenuous Exercise	Moderate Exercise	Mild exercise
CET Total	.14*	.08	.05
Avoidance and Rule-Driven Behaviour	.23**	.07	.06
Weight Control Exercise	.05	.05	.07
Mood Improvement Exercise	.25**	.07	.03
Lack of Exercise Enjoyment	-.37**	-.05	-.02
Exercise Rigidity	.18**	.07	.03

Note: ** p < .001, * p < .01; CET = Compulsive Exercise Test; Sample sizes differed slightly due to missing data on some variables

Table 6.3 Correlation coefficients (Spearman's Rho) between exercise behaviour and compulsive exercise cognitions and attitudes in girls (n = 457)

CET	Exercise Behaviour		
	Strenuous Exercise	Moderate Exercise	Mild exercise
CET Total	.26**	.19**	.13*
Avoidance and Rule-Driven Behaviour	.36**	.20**	.08
Weight Control Exercise	.12*	.06	.07
Mood Improvement Exercise	.34**	.20**	.12*
Lack of Exercise Enjoyment	-.43**	-.16**	-.03
Exercise Rigidity	.41**	.27**	.13*

Note: ** p < .001, * p < .01; CET = Compulsive Exercise Test; Sample sizes differed slightly due to missing data on some variables

Sport Participation and Compulsive Exercise (Aim 2)

There were significant differences between competitive sport participants and non-sport participants on several of the CET scores. For boys, competitive sport participants reported significantly greater scores than the non-sport participants on Avoidance and Rule-Driven Behaviour ($z = 7.48$, $p<.001$), Mood Improvement ($z = 5.25$, $p<.001$), Exercise Rigidity ($z = 5.46$, $p<.001$), and CET Total ($z = 4.78$, $p<.001$). Non-sport participants reported significantly greater Lack of Exercise Enjoyment than competitive sport participants ($z = 4.60$, $p<.001$). Additionally, competitive sport participants also reported significantly greater strenuous exercise behaviour ($z = 6.31$, $p<.001$) than the non-sport participants. No significant difference was found between the two groups on Weight Control Exercise, moderate exercise behaviour, or mild exercise behaviour.

For girls, sport participants reported significantly greater Avoidance and Rule-Driven Behaviour ($z = 7.00$, $p<.001$), Mood Improvement ($z = 5.15$, $p<.001$), Exercise Rigidity ($z = 8.17$, $p<.001$), and CET Total ($z = 3.69$, $p<.001$) than non-sport participants. Non-sport participants reported significantly greater Lack of Exercise Enjoyment ($z = 7.58$, $p<.001$) than competitive sport participants. Strenuous exercise behaviour ($z = 9.37$, $p<.001$) was also significantly greater among the competitive sport group than the non-sport participants. There were no group differences on Weight Control Exercise, moderate exercise behaviour or mild exercise behaviour.

Sport Type and Compulsive Exercise (Aim 3)

A Mann Whitney U test of difference found that there were no significant differences between lean sports and non-lean sports on any of the CET scores or exercise behaviour ($p >.01$). This was true for both boys and girls.

DISCUSSION

This study investigated the associations between sport participation, exercise behaviour, and compulsive exercise cognitions and attitudes among adolescents. The results partly supported the study hypotheses. Firstly, it was hypothesised that exercise behaviour would be positively correlated with compulsive exercise cognitions and attitudes. For boys, the results demonstrated that compulsive exercise cognitions were only associated with strenuous exercise behaviour and not moderate or mild intensity levels of exercise behaviour. This suggests that the greater the compulsivity towards exercise the harder and more frequently boys exercise. For girls, the results were largely similar, although moderate and mild levels of exercise behaviour were also linked with compulsive exercise attitudes. This suggests that a greater compulsivity towards exercise among girls would lead to greater volumes of exercise behaviour of varying intensities (which could include light exercise, such as walking), and not simply exercising harder.

One interesting finding was that among both the boys and the girls, there was little association between weight control exercise and any exercise behaviour. This is contrary to the traditional view of compulsive exercise in the eating disorders, which is that compulsive exercise is often a means to burn off calories (Fairburn et al., 2003; Shroff et al., 2006), and therefore, it would be expected that a person with strong weight control thoughts (e.g., weight control exercise) would want to do more exercise to burn off more calories. However, the finding that exercise behaviour was not linked with exercising for weight control reasons suggests that there are other reasons why a compulsive exerciser may increase their levels of exercise behaviour, and as such it shows the benefit of measuring compulsive exercise multidimensionally (Taranis et al., in press). For example, it was found that exercise behaviour was associated with mood improvement, as well as avoidance and rule-driven behaviour, elements of compulsive exercise. This implies that perhaps the greater exercise behaviour seen in compulsive exercisers is due to a need to regulate their mood (Penas-Lledo et al., 2002) and/or to avoid any negative affect if they do not exercise (Bratland-Sanda et al., 2010a; 2010b; De Young & Anderson, 2010a; 2010b).

The second focus of this study was to investigate the specific links between competitive sport participation and potentially detrimental compulsive exercise cognitions and attitudes. As expected, those involved in sport performed more exercise overall than the non-sport participants, as their sport would contribute to their self-reported exercise frequency. Importantly, those involved in sport also reported significantly greater levels of compulsive exercise cognitions and attitudes than did the adolescents who did not partake in competitive sport. This highlights an association between competitive sport and compulsivity towards exercise, even at this relatively young age. This association with compulsive exercise cognitions could represent the factor that puts competitive athletes at greater risk of developing eating disorders. However, this association between sport, compulsive exercise, and disordered eating requires further research. In addition, those adolescents involved in competitive sport would likely require greater parental support, such as through transportation to sports venues. This parental logistic support has also been associated with compulsive exercise in adolescents (Study 5). Therefore, further research replicating this current sport finding, whilst controlling for parental logistic support, is warranted.

The study had a third aim of investigating whether those involved in lean sports would report greater compulsive exercise cognitions than those involved in non-lean sports, given that previous studies have found a link between eating disorders and sports that emphasise leanness (Sundgot-Borgen & Torstveit, 2004). However, the findings from this study showed that there were no significant differences between the lean sport group and the non-lean sport group on any of the aspects of compulsive exercise attitudes. This may be due to the level of sport participation. For example, it has been previously shown that disordered eating attitudes are more prevalent at the elite end of sport participation than among more recreational participants (Holm-Denoma, Scaringi, Gordon, Van Orden, & Junior, 2009). The sample of adolescents in this study was still relatively young and therefore it is likely that their sport participation may not yet be at an elite level. As a result, their eating disordered attitudes (e.g., compulsive exercise cognitions) may not have been influenced by the type of sport they participated in, as those in the lean sports were not so highly driven towards their sporting performance as to be greatly influenced by the emphasis of their sport on leanness.

The findings from this study have some practical implications. There were several significant correlations between exercise behaviour and compulsive exercise cognitions for both boys and girls, as expected. Importantly, though, the strength of the correlations were largely small ($r = <.30$), and it is this weak association between compulsive exercise cognitions and exercise behaviour that could impact on research and clinical settings. For example, researchers that have used behavioural indicators to define compulsive exercise (e.g., Brewerton et al., 1995; Penas-Lledo et al., 2002) may miss out many individuals who have compulsive exercise cognitions but are not exercising in great volumes. Clinically, this could be problematic as defining compulsive exercisers based on exercise behaviour, such as hours per week of exercise, may mean that some compulsive exercisers who have strong cognitions around exercise may be overlooked and not receive the treatment they require. These results need to be replicated in a sample of clinical eating disorder patients first. Nonetheless, the findings do suggest that professionals working with eating disorder patients, and indeed any health professional dealing with compulsive exercisers, need to be aware of this unreliable importance placed on exercise behaviour alone. Instead, professionals need to use comprehensive multidimensional measures of compulsive exercise, such as the CET, and not simply volume of exercise behaviour.

An additional practical implication is the positive association between sport participation and compulsive exercise cognitions. This association was found in this relatively young sample of adolescents recruited from schools. Therefore, the positive association between sport and compulsive exercise could represent an at-risk group for the development of compulsive exercise. Additionally, given the close association of compulsive exercise with the eating disorders (e.g., Taranis & Meyer, 2010), then sport participants could also represent an at-risk group for the development of eating disorder psychopathology in general. Therefore, the current study findings suggest that perhaps screening of adolescent eating and exercise attitudes could take place at school sports clubs to help improve early intervention work.

Finally, it must be noted that this study did have some limitations. First, the exercise behaviour was assessed using a self-report measure in order to provide information in a large sample. However, the measurement of exercise behaviour using self-report scales has been questioned, and it is advocated that objective measures, such as accelerometers, are chosen instead (Sirard & Pate, 2001). Given the scale of this study, this technique was not possible here, however, future studies should look to replicate these findings with an objective measure of exercise behaviour. Second, the cross-sectional nature of the study precluded an ability to establish temporal precedence between the variables. As such, it was not possible to identify whether sport participation led to the increase in compulsive exercise cognitions, or whether those with an existing compulsivity towards exercise chose to partake in sport as a means of satisfying this compulsion. This question needs to be addressed using a longitudinal design.

Despite these limitations, this study does provide useful novel findings around compulsive exercise cognitions and attitudes and their relationship with exercise behaviour and sport participation. Ultimately, compulsive exercise cognitions and attitudes were significantly related to exercise behaviour. Therefore, professionals working in the exercise field, and/or professionals working in the eating disorders, need to focus more on the exercise cognitions of adolescents and not simply rely on behavioural markers as a measure of problematic exercise related to the eating disorders. Participation in competitive sport may further heighten an individual's compulsivity towards exercise, although this needs to be established longitudinally to identify whether sport does indeed represent a true risk factor for compulsive exercise.

PART 3: Prospective Risk Factors for Compulsive Exercise

Chapters 7 and 8: Psychological and Socio-Cultural Risk Factors for Compulsive Exercise

Chapter 7

Psychological Risk Factors for Compulsive Exercise

Studies 7 and 8

7 Psychological Risk Factors for Compulsive Exercise

The current chapter represents the first chapter in the third part of this thesis, which focuses on the longitudinal predictors of compulsive exercise. The previous part of this thesis (Part Two) had represented the first stage of the risk factor research process by identifying initial correlates of compulsive exercise, using cross-sectional study designs (Kazdin, 1998). Specifically, chapters 4-6 identified the psychological, socio-cultural, and behavioural correlates of compulsive exercise, as measured by the CET, in adolescent boys and girls. However, correlates do not establish temporal precedence, and therefore the next stage of the risk factor research process is to replicate these findings using longitudinal designs to identify risk factors, also known as variable markers (Kazdin, 1998; Kazdin et al., 1997; Kraemer et al., 1997).

Therefore, the current chapter aims to replicate the previous studies reported in Chapter 4, and to extend the findings by using a longitudinal design. In other words, this chapter aims to identify the psychological risk factors for compulsive exercise among adolescent boys and girls. To achieve this aim, two empirical studies are reported. First, personality variables, psychological morbidity, and disordered eating attitudes will be tested as longitudinal predictors of compulsive exercise. Second, the second study in this chapter will examine the role of emotion regulation styles in the development of compulsive exercise. The aim of this second study is to identify whether compulsive exercise is longitudinally predicted by any specific style of emotion regulation, and therefore, whether emotion regulation style can be regarded as a possible risk factor for compulsive exercise.

Finally, a key aim of the thesis is to identify specific risk factors for compulsive exercise, as opposed to identifying generic risk factors for more general eating disorder psychopathology. Therefore, in both of the empirical studies, the hypothesised risk factors will also be examined for their longitudinal predictive effects on general eating disorder psychopathology.

The following study has been prepared for publication as: Goodwin, H., Haycraft, E., & Meyer, C. (in preparation). Psychological risk factors for

compulsive exercise: A two-year prospective study among adolescents. International Journal of Eating Disorders.

Study 7: Psychological risk factors for compulsive exercise: A two-year prospective study among adolescents

Abstract

Objective: Compulsive exercise is a problematic behaviour that is implicated in the development of eating disorders. This study aimed to replicate previous cross-sectional work by considering specific psychological characteristics as longitudinal predictors of compulsive exercise. **Method:** A sample of 369 male and female adolescents completed self-report measures of compulsive exercise, eating disorder psychopathology, obsessive-compulsiveness, perfectionism, anxiety, depression, and social physique anxiety at baseline, and measures of compulsive exercise and eating disorder psychopathology two years later. **Results:** Greater self-orientated perfectionism and obsessive-compulsiveness longitudinally predicted compulsive exercise in boys, and displayed specificity by not predicting generic eating disorder psychopathology. In girls, psychological characteristics did not collectively predict compulsive exercise. **Discussion:** Prevention and early intervention work into reducing compulsive exercise in boys may benefit from targeting boys' levels of self-perfectionism and obsessive-compulsiveness. In girls, other factors not assessed in this study may be more important in the development of compulsive exercise.

Psychological risk factors for compulsive exercise: A two-year prospective study among adolescents

Eating disorders have one of the highest rates of mortality of all mental health disorders (Millar et al., 2005). A key feature for up to 70% of individuals with an eating disorder is a compulsive drive to exercise (Davis, 1997). This compulsive exercise can increase treatment time for an eating disorder (Strober et al., 1997), and is also a key cause of relapse following treatment (Solenberger, 2001). Importantly, compulsive exercise has also been found in non-clinical samples (Lipsey et al., 2006), and has also been implicated in the development of the eating disorders (Davis et al., 1994; Davis et al., 1997). Despite this obviously problematic symptom of the eating disorders, research into compulsive exercise is relatively scarce. Importantly, although the aetiology for eating disorders in general has been widely researched (e.g., Attie & Brooks-Gunn, 1989; Kluck, 2008; Stice et al., 2002), the specific risk factors and causes of compulsive exercise remain unknown.

Previous studies have found that perfectionism may be a possible risk factor for compulsive exercise. For example, Hall and colleagues (2007) studied 246 adult exercisers and reported that perfectionism was an antecedent of obligatory exercise. Likewise, recent cross-sectional studies of compulsive exercise in adolescents have found self-perfectionism and social perfectionism for boys, and self-perfectionism in girls to be associated with compulsive exercise (Goodwin, Haycraft, Willis, & Meyer, *under consideration*).

Goodwin and colleagues (*under consideration*; Study 2) also found that compulsive exercise was related to obsessive-compulsiveness and a drive for thinness in both boys and girls. These findings are strengthened by the existing literature that has revealed that, although compulsive exercise has been reported in non-clinical samples (Lipsey et al., 2006), it is very closely aligned with the eating disorders (Bamber, Cockerill, & Carroll, 2000; Bamber et al., 2003). Further, other studies have demonstrated the close relationship between the eating disorders, obsessive-compulsiveness, and compulsive exercise (Davis et al., 1995; Davis et al., 1998).

Additionally, compulsive exercise has been associated with general psychological morbidity (Bamber et al., 2003; Davis, Woodside et al., 1999; Vansteelandt et al., 2007). For example, Penas-Lledo and colleagues (2002) found that compulsive exercisers reported significantly greater anxiety and depression than non-compulsive exercisers. Similarly, Shroff et al. (2006) reported that compulsive exercise in the eating disorders is significantly associated with greater anxiety. However, these associations were found in clinical eating disorder patients, predominantly from an adult population and it is unknown whether these associations are present at the crucial adolescent age and at a non-clinical level (i.e., prior to the onset of any eating disorder).

Although many of the preceding associations of compulsive exercise with specific psychological characteristics and personality traits have been replicated, studies have invariably adopted cross-sectional designs. Indeed, it is impossible to examine temporal precedence from such designs (Kraemer et al., 1997), and therefore, it is uncertain as to whether these psychological factors are a result of the compulsive exercise or whether they actually play a role in its development. In order to identify risk factors for compulsive exercise, longitudinal designs need to be used to establish temporal precedence and for predictor variables to reach true risk factor status (Jacobi et al., 2004; Kraemer et al., 1997).

To summarise, compulsive exercise is a problematic symptom of the eating disorders that has been linked with the development of eating psychopathology (Davis et al., 1997) and has also been regarded as a key factor in the relapse of the disorder (Strober et al., 1997). However, despite its obvious importance in eating disorder development and outcome, the risk factors for compulsive exercise have not been examined. Previous investigations have proposed several psychological characteristics that may be associated with compulsive exercise but none have identified specific risk factors using longitudinal designs. Given that eating disorder onset is typically around early to mid-adolescence (Striegel-Moore & Bulik, 2007), it is important to study samples around early adolescence, recruited from non-clinical populations to ensure that compulsive exercise has not already developed to a clinical level.

Therefore, the primary aim of the current study is to examine the psychological risk factors for compulsive exercise among boys and girls in early adolescence. This investigation extends previous work into psychological correlates of compulsive exercise by adopting a longitudinal design. Using this design enables temporal precedence to be established and therefore allows for the identification of true risk factors. Risk factors will be examined separately for boys and girls in order to build gender-specific aetiological models. The second aim of the study is to examine the specificity of the risk factors for compulsive exercise by also identifying how many of the proposed variables are also risk factors for eating disorder psychopathology. It is hypothesised that the psychological risk factors will be positively associated with compulsive exercise. In particular, based on the cross-sectional findings reported on in Study 2, it is hypothesised that perfectionism, obsessive-compulsiveness, and a drive for thinness will significantly predict compulsive exercise in boys and girls.

METHODS

Participants

As part of ongoing research into exercise and eating attitudes among adolescents, Secondary schools across the United Kingdom took part in this longitudinal study of psychological risk factors for compulsive exercise. The initial data collection procedure recruited a sample of 878 adolescents at baseline across six schools. However, although all schools took part at T2, not all participants were present at T2 and other participants only partially completed the measures and therefore were not included in this study. A final sample of 369 adolescents (boys = 148; girls = 221) completed baseline (T1) and follow-up assessments 24 months later (T2). The sample, aged between 12-14 years old at T1 (M = 12.89, SD = .69), and 14-16 years old at T2 (M = 14.84, SD = .67), was predominantly British (98.6%) and the majority reported ethnicity as also being White British (95%). Mean age- and gender-adjusted Body Mass Index scores (BMI z scores; Child Growth Foundation, 1996) at T1 were 0.28 (SD = 1.67) for boys and -0.10 (SD = 1.31) for girls, and at T2 they were 0.48 (SD = 1.06) for boys and 0.17 (SD = 1.13) for girls.

Procedure

Approval was given for this longitudinal investigation by an institutional ethical review board. Questionnaire packs were then sent to the participating schools. Due to this study being interested in predictors of later compulsive exercise, a more comprehensive questionnaire pack was administered at T1 than at T2. At T1, the packs obtained background information on nationality, ethnicity, age, gender, height and weight, as well as the validated measures (described below in the measures section). At T2, the dependent variable measuring compulsive exercise was completed, as was information on age, height and weight. The T2 questionnaire pack also included a measure of eating disorder psychopathology. The questionnaire packs were given to pupils, aged between 12 and 14 years old at T1, during a school class period. Standardised instructions were given to all teachers administering the questionnaires. All completed packs were returned to the research team, and were given a unique identification code. The same procedure was repeated approximately 24 months later and completed questionnaires were matched using the specific identification code.

Measures

T1 measures

Compulsive Exercise Test (CET; Taranis et al., in press). The CET provides an assessment of an individual's compulsivity towards exercise (see Study 1, Measures section for full description). Reliability in this sample was demonstrated by Cronbach's alpha value of .89 at T1 for the total CET subscale.

Eating Disorder Inventory-2 (EDI-2; Garner, 1991). The short form of the EDI-2 was used to assess disordered eating attitudes, which included the subscales of Drive for Thinness, Bulimia, and Body Dissatisfaction (see Study 1, Measures section for full description). The Cronbach's alpha values for this sample were .86 (Drive for Thinness), .71 (Bulimia), and .90 (Body Dissatisfaction).

Child and Adolescent Perfectionism Scale (CAPS; Flett et al., 1992). The CAPS consists of two subscales. These two subscales are Self-Orientated Perfectionism (CAPS-Self), which measures self-directed high standards, and Socially-Prescribed Perfectionism (CAPS-Social), which measures the degree to which the individual feels they have to live up to the high standards and achievements placed upon them by significant others. The CAPS was described in Study 2. The CAPS demonstrated satisfactory reliability among this sample (Self-Orientated Perfectionism Cronbach's alpha = .82; Socially-Prescribed Perfectionism Cronbach's alpha = .87).

Spence Child Anxiety Scale – Obsessive Compulsive Subscale (SCAS-OC; Spence, 1997; 1998). The SCAS-OC comprises six items assessing levels of obsessive-compulsiveness, and was described in full in Study 2 (Measures section). The SCAS-OC demonstrated good reliability in the current sample (Cronbach's alpha = .79).

Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). The HADS measures anxiety and depression in two separate scales, and was described in Study 2. The HADS has been validated for use with adolescents (White et al., 1999) and demonstrated satisfactory reliability for this sample for anxiety, with a Cronbach's alpha value of .73. The Cronbach's alpha for Depression was .60. It is noted that Depression was slightly under the .7 level of acceptability (Pallant, 2007) for this sample.

Social Physique Anxiety Scale (SPAS; Hart et al., 1989). The SPAS measures levels of social physique anxiety (see Study 2, Measures section for full description). The SPAS demonstrated good reliability for the sample in this current investigation (Cronbach's alpha = .87).

T2 measures

Compulsive Exercise Test (CET; Taranis et al., in press). The total CET subscale achieved a Cronbach's alpha of .88 at T2.

Eating Disorder Examination Questionnaire (version 6) (EDEQ; Fairburn & Beglin, 1994). The EDEQ is a self-report measure based on the Eating Disorder Examination (EDE) interview (Fairburn & Cooper, 1993), and measures eating disorder psychopathology over the previous 28 days. The measure includes four subscales of: Eating Restraint; Eating Concern; Shape Concern; and Weight Concern. These subscales are summed and averaged to form a total EDEQ Global score. Higher scores on this equate to greater overall levels of eating disorder psychopathology. The EDEQ has been widely used in the literature (e.g., Binford, Le Grande, & Jellar, 2005; Goldfein, Devlin, & Kamenetz, 2005; Mond, Hay, Rodgers, & Owen, 2004b) and has been previously used among adolescents (e.g., Carter et al., 2001). Only the EDEQ Global score was used for this study and it yielded a Cronbach's alpha of .96.

Data Analysis

First, attrition analysis was conducted to identify whether there were systematic differences between those who were retained in the study at follow-up and those who dropped out of the study after baseline assessment. The attrition analyses revealed that the two-year follow up drop-outs ($n = 509$) scored significantly higher than the retained sample on measures of Depression and Body Dissatisfaction ($p < .01$, two-tailed). These attrition findings are similar to previous longitudinal studies of adolescents (e.g., Presnell et al., 2004) and so are not entirely unexpected. Nonetheless, these significant findings do suggest that there may be some systematic bias to the response rate at T2, and therefore findings should be generalised with due caution.

All analyses were conducted separately for boys and girls in order to examine gender-specific risk factors. Significance was set at $p < .05$ and tests were one-tailed, unless otherwise stated. Data were first screened for normality using Kolmogorov-Smirnov tests. Results demonstrated that almost all the variables were non-normally distributed. Importantly, inspection of the residuals on the subsequent regression analyses showed that residuals were normally distributed and, therefore, it was deemed satisfactory to conduct the regression analyses (Field, 2005). Non-parametric tests were used where necessary. As expected, significant differences between boys and girls were identified on the majority of the study variables (Mann Whitney U), and this confirmed the decision to assess risk factor models separately for boys and girls. Additionally, BMI z scores could be regarded as a potential confounding variable, although they were checked for their association with compulsive exercise in a set of multiple regressions (T1 and T2 BMI z scores) and no significant associations were found ($p > .05$). Therefore, BMI z scores were not entered into the subsequent study analyses.

To identify the risk factors for compulsive exercise, a hierarchical multiple regression was performed with the outcome variable being the T2 CET Total. It is appropriate to control for the initial levels of the outcome variable (i.e., baseline CET) as reported in previous longitudinal designs (e.g., Presnell et al., 2004; Spoor et al., 2006). Controlling for the initial levels will ensure that a true prospective prediction is obtained, over and above the temporal stability of the outcome variable (Spoor et al., 2006). Therefore, the T1 CET Total was entered in the first step of the hierarchical regression and then the T1 risk factors were entered in the second step. The T1 risk factors entered in the second step were: CAPS-Self-orientated Perfectionism, CAPS-Socially-Prescribed Perfectionism, SCAS-Obsessive-Compulsiveness, HADS-Anxiety, HADS-Depression, Social Physique Anxiety Scale, EDI-Drive for Thinness, EDI-Bulimia, and EDI-Body

Dissatisfaction. Any significant risk factors for T2 CET Total were then entered into subsequent regressions with the five T2 CET subscales as the outcome variables, in order to identify whether the risk factors were specific to certain elements of the compulsive exercise construct. Only the significant findings from the CET Total regression were used as entered into the CET subscale regressions due to the otherwise large numbers of predictors being entered into several regressions.

Finally, the specificity of the identified risk factors for compulsive exercise was also examined, by examining their predictive ability for more general eating disorder psychopathology. For this aim, a hierarchical regression was performed with T2 EDEQ Global score entered as the outcome variable. In the first step, baseline eating disorder psychopathology needed to be controlled for. However, because EDEQ had not been measured at T1, another general measure of disordered eating attitudes was used by summing the three EDI subscales of Drive for Thinness, Bulimia, and Body Dissatisfaction, to form a Total EDI variable. The creation of a single disordered eating score using the EDI subscales has been done in previous research (e.g., Adkins & Keel, 2005; Haycraft & Blissett, 2009). The Total EDI was therefore entered in the first step of this hierarchical regression. The hypothesised risk factors from T1 were entered in the second step.

RESULTS

<u>Descriptive Statistics of the Sample</u>

The means and standard deviations of the study variables for boys and girls, as well as the tests of difference between gender on the T1 risk factors can be seen in Table 7.1. The means for T1 CET Total and T2 CET Total for boys and girls demonstrate low to mid-point scoring ("sometimes true of me") and therefore do not reflect high levels of compulsive exercising. Overall, for all boys, the T1 CET Total was significantly, positively correlated (one-tailed) with T2 CET Total (Spearman's rho = .52, $p < .001$), demonstrating a high degree of temporal stability. Likewise for the girls, the same correlation was also significant (Spearman's rho = .43, $p < .001$).

The EDI subscale means were all beneath previously recommended clinical cut-offs (≥5 Bulimia and ≥15 Body Dissatisfaction; Grylli et al., 2004; ≥14 Drive for Thinness; McGrane & Carr, 2002), demonstrating the predominantly non-clinical nature of the sample. The EDEQ Global mean for girls is similar to previous norms for adolescent girls (Carter et al., 2001). Norms for boys have not been given in the literature, but the significantly lower scores (compared to the girls) were expected and both boys' and girls' scores indicate low levels of eating disorder psychopathology in this sample.

In comparison to suggested norms (Snaith & Zigmond, 1994), reported levels of anxiety were at a mild level, whereas levels of depression were at a healthy level (i.e., no depression). SPAS scores, Self-Orientated and Socially Prescribed Perfectionism scores and SCAS Obsessive Compulsiveness scores are similar to previously reported means for this age group (Mack et al., 2007a; Spence, 1998).

Table 7.1 Means and standard deviation for study variables by gender and Mann Whitney U test of difference between boys and girls on all study variables

	Mean (SD)		Test of Difference
Variables	Boys	Girls	z
CAPS-Self	34.90 (7.77)	33.48 (8.48)	1.67
CAPS-Social	25.37 (7.89)	23.28 (8.50)	2.55
SCAS-OC	0.95 (0.57)	1.01 (0.69)	0.46
HADS-Anxiety	7.96 (3.52)	8.22 (3.57)	0.69
HADS-Depression	4.28 (2.86)	3.53 (2.77)	2.98*
SPAS	22.16 (7.07)	27.80 (8.34)	6.14*
Drive for Thinness	2.94 (4.10)	5.28 (5.87)	3.39*
Bulimia	2.10 (3.24)	2.04 (3.06)	0.51
Body Dissatisfaction	5.04 (5.67)	9.14 (7.97)	4.67*
T1 Total EDI	10.09 (10.14)	16.45 (14.19)	4.16*
T1 CET Total	10.52 (4.12)	10.04 (3.89)	1.24
T2 CET Total	7.96 (3.42)	9.78 (3.38)	5.04*
T2 EDEQ Global	0.51 (0.80)	1.54 (1.38)	8.73*

Note: * $p < .01$ (two-tailed); CAPS = Child and Adolescent Perfectionism Scale; SCAS-OC = Spence Child Anxiety Scale – Obsessive-Compulsive Subscale; HADS = Hospital Anxiety and Depression Scale; SPAS = Social Physique Anxiety Scale; CET = Compulsive Exercise Test; EDI = Eating Disorder Inventory; EDEQ = Eating Disorder Examination Questionnaire; T1 / T2 = Time 1 / Time 2

Risk Factors for Compulsive Exercise

Boys

The hierarchical regression, controlling for CET total at T1, can be seen in Table 7.2. The final model for this hierarchical regression was significant and accounted for 38% of variance in the outcome variable (R^2). After controlling for T1 CET Total, the risk factors collectively accounted for an extra 10% of variance of T2 CET Total, and this change was significant (F $change_{(9, 106)} = 1.87$, $p <.05$). In the final model, significant unique predictors were T1 CET Total, SCAS-OC and CAPS-Self. No other risk factors in the model reported significant associations with T2 CET Total.

Table 7.2 Significant predictors of T2 CET Total score (outcome) for boys using a hierarchical multiple regression

Model	F (df)	R^2	Adj R^2	Beta	t
1.	45.29** (1, 115)	.28	.28		
T1 CET Total				.53	6.73**
2.	6.52** (10, 106)	.38	.32		
T1 CET Total				.52	5.19**
CAPS-Self				.21	2.27*
SCAS-OC				.21	2.23*

Note: ** p <.001, * p <.05; Only significant unique predictors at the second step are reported here; Adj = Adjusted; T1 = Time 1; CET = Compulsive Exercise Test; CAPS = Child and Adolescent Perfectionism Scale; SCAS-OC = Spence Child Anxiety Scale – Obsessive-Compulsive Subscale

Five separate hierarchical regressions were then conducted with the five T2 CET subscales each entered as outcome variables and the SCAS-OC and CAPS-Self entered as the predictor variables, after controlling for the T1 levels of the respective T2 CET subscale. Results from these regressions found that there were significant R^2 changes from the introduction of the two risk factors into the models of Avoidance and Rule-Driven Behaviour (R^2 change = .07, F $change_{(2, 125)} = 5.91$, $p <.01$), Mood Improvement (R^2 change = .04, F $change_{(2, 125)} = 3.07$, $p <.05$), and Exercise Rigidity (R^2 change = .05, F $change_{(2, 121)} = 4.03$, $p <.05$). Unique prediction was found for CAPS-Self for all three of these subscales (Avoidance and Rule-Driven Behaviour $p < .01$; Mood Improvement, Exercise Rigidity $p < .05$), whereas SCAS-OC was only significant for Exercise Rigidity ($p < .05$). These results suggest that self-orientated perfectionism is associated with several elements of compulsive exercise, specifically the mood regulatory aspects of avoidance and rule-driven behaviour and mood improvement. Obsessive-compulsiveness appears to predict compulsive exercise specifically by influencing the rigidity around the exercise cognitions.

<u>Girls</u>

The hierarchical regression with T1 CET Total entered in the first step can be seen in Table 7.3. The final model was significant and accounted for 24% of the variance of T2 CET Total (R^2). The introduction of the T1 risk factors to the model accounted for an additional 5% of T2 CET Total variance and this was not a significant change (F change (9, 159) = 1.23, $p > .05$). The final model had T1 CET Total as the main significant predictor, and HADS Depression also remained a unique significant (negative) predictor of T2 CET Total. No other risk factors were significant predictors of T2 CET Total.

Table 7.3 Significant predictors of T2 CET Total score (outcome) for girls using a hierarchical multiple regression

Model	F (df)	R^2	Adj R^2	Beta	t
1.	39.26** (1, 168)	.19	.19		
T1 CET Total				.44	6.27**
2.	5.08** (10, 159)	.24	.20		
T1 CET Total				.38	3.96**
HADS Depression				-.14	-1.77*

Note: ** $p < .001$, * $p < .05$; Only significant unique predictors at the second step are reported here; Adj = Adjusted; T1 = Time 1; CET = Compulsive Exercise Test; HADS = Hospital Anxiety and Depression Scale

Subsequent hierarchical regressions examining the predictive ability of HADS Depression on to each of the five CET subscales (after controlling for their respective baseline levels) found that HADS Depression only produced a significant R^2 change for Exercise Rigidity (R^2 change = .04, F $\text{change}_{(1,\ 180)}$ =

8.73, $p < .01$). HADS Depression's unique prediction of Exercise Rigidity was in a negative direction ($p < .01$). HADS Depression did not significantly predict any other of the CET subscales for girls. These results imply that depression's association with compulsive exercise is most strongly seen in its association with the rigid exercise cognitions. The negative association with Exercise Rigidity suggests that an individual with greater depression would perhaps be less likely to stick to the strict and rigid exercise behaviours that are typical of a compulsive exerciser.

Specificity of the effects: Risk factors for eating disorder psychopathology

Boys

A hierarchical regression, controlling for baseline levels of disordered eating attitudes, significantly predicted T2 EDEQ Global score ($F_{(7,\ 106)} = 8.20$, $p < .001$) and accounted for 31% (Adjusted R^2) of the variance of the outcome variable. Total EDI-2 significantly predicted T2 EDEQ Global in the first step (Beta = .55, t = 6.91, $p < .001$) and accounted for 29% of T2 EDEQ Global. The introduction of the hypothesised risk factors added 5% to the variance accounted for but did not produce a significant R^2 change ($p > .05$). The final model showed that Total EDI-2 (Beta = .51, t = 5.51, $p < .001$) and SPAS (Beta = .22, t = 2.35, $p < .05$) were the only significant unique predictors of T2 EDEQ Global. No other risk factors recorded a significant association with T2 EDEQ Global.

Girls

The hierarchical regression model predicting T2 EDEQ Global for girls, and controlling for T1 levels of disordered eating attitudes, was significant ($F_{(7,\ 172)}$ = 8.43, $p < .001$) and accounted for 23% (Adjusted R^2) of the variance in the dependent variable. In the first step, Total EDI-2 significantly predicted T2 EDEQ Global (Beta = .46, t = 6.85, $p < .001$), accounting for 20% (Adjusted R^2) of its variance. The addition of the risk factors collectively added 4% of the T2 EDEQ Global variance accounted for, but this addition was not significant ($p > .05$). The final model had two unique significant predictors: Total EDI-2 (Beta = .27, t = 2.76, $p < .01$) and SPAS (Beta = .26, t = 2.75, $p < .01$). No other risk factors were significant predictors of T2 EDEQ Global for girls.

DISCUSSION

This study aimed to identify risk factors for compulsive exercise in a two-year prospective investigation among a sample of adolescents. As expected, the results indicated different risk factors for compulsive exercise between boys and girls. The summary of the study findings can be seen in Figure 7.1.

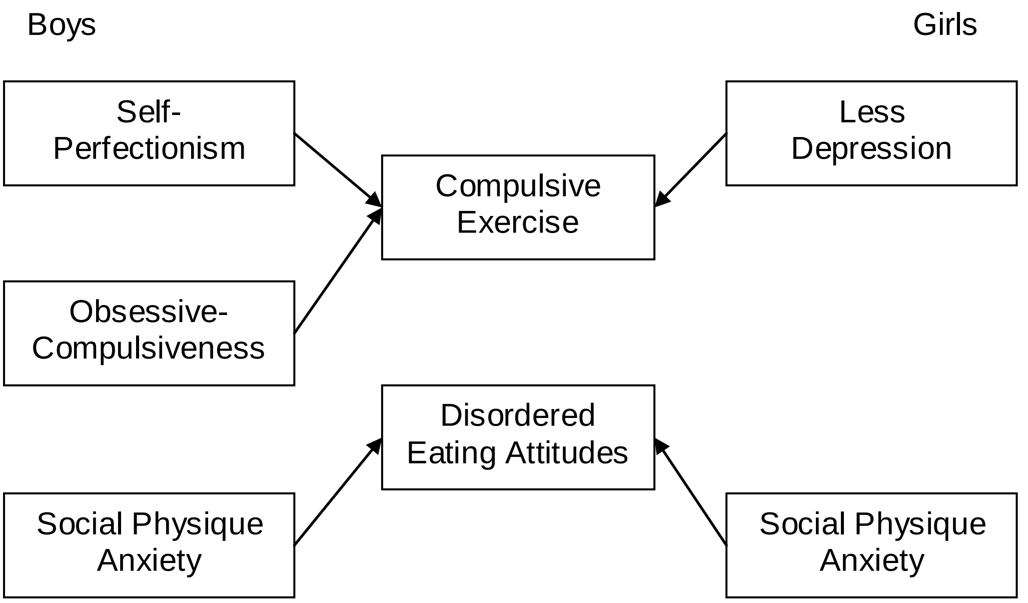


Figure 7.1 Summary of psychological risk factors for compulsive exercise in boys and girls

For boys, self-perfectionism and obsessive-compulsiveness were identified as risk factors for later compulsive exercise. This prediction was significant even after controlling for baseline levels of compulsive exercise. Specifically, when analysing the subscales of the CET, it was found that self perfectionism was a risk factor for the avoidance and rule-driven behaviour, mood improvement, and exercise rigidity elements of compulsive exercise, whilst obsessive-compulsiveness was only a risk factor for exercise rigidity. The fact that the risk factors for compulsive exercise are specific to certain elements of compulsive exercise requires further investigation, but does support the multidimensionality of the construct, and also helps in establishing the most parsimonious model of the aetiology of compulsive exercise.

The significant positive prediction of self-perfectionism and obsessive-compulsiveness replicates the previous cross-sectional investigations into correlates of compulsive exercise, which also found self-perfectionism and obsessive-compulsiveness to be associated with compulsive exercise (see Study 2; Davis, Woodside et al., 1999; Davis & Claridge, 1998). The results also concur with existing literature, which has reported perfectionism to be an antecedent of obligatory exercise (Hall et al., 2007), and with the work of Castro and her colleagues (2004) who found that it was self-orientated perfectionism rather than socially-prescribed perfectionism that was more strongly associated with eating disorders. However, the current study advances the existing knowledge by demonstrating that there is a longitudinal association, and therefore, self-orientated perfectionism and obsessive-compulsiveness could be classed as risk factors for compulsive exercise.

The findings for girls suggested that after controlling for baseline levels of compulsive exercise, there was minimal predictive ability of the hypothesised psychological risk factors of subsequent compulsive exercise. This suggests that, for girls, risk factors for compulsive exercise could be less about psychological characteristics, such as perfectionism, obsessive-compulsiveness, or anxiety, and instead be more about socio-cultural environment factors. This suggestion requires subsequent investigation to examine the potential socio-cultural risk factors for compulsive exercise (see Chapter 8).

Interestingly, in girls, despite the lack of a collective significant prediction of compulsive exercise by the psychological risk factors, depression did remain a significant unique predictor, after controlling for baseline compulsive exercise. Therefore, depression could still represent a risk factor for compulsive exercise in girls. However, this finding requires some explanation, particularly as depression's role as a risk factor was in the opposite direction to the hypothesis. Previous investigations have found that compulsive exercisers report greater levels of depression than non-compulsive exercisers (Penas-Lledo et al., 2002), and therefore, it was expected that greater depression would be associated with greater compulsive exercise. However, the study by Penas-Lledo and colleagues (2002) was in a clinical eating disorder sample, and the reason for the unusual (negative) finding in the current study could be a non-clinical phenomenon related to motivation. Exercise requires active motivation in order to be performed, regardless of levels of exercise compulsivity. However, depression is characterised by a loss of interest and loss of energy (Whisman, Perez, & Ramel, 2000). Therefore, it could be that girls with greater levels of depression may be less inclined to exercise and instead, they may turn to rumination or engage in other body and mood regulation strategies, which require less intensity. Alternatively, given that compulsive exercise is closely associated with greater eating disorder psychopathology (e.g., Bamber, Cockerill, & Carroll, 2000; Shroff et al., 2006; Solenberger, 2001), then those with greater depression could also use alternative eating disordered behaviours that require less energy, such as bingeing and vomiting behaviour.

Importantly, for boys and girls, the results demonstrated the specificity of these risk factors for compulsive exercise. The results found that, after controlling for initial levels of disordered eating attitudes, social physique anxiety was the only psychological risk factor which predicted eating disorder psychopathology two years later. The fact that this finding is different from the predictors of compulsive exercise demonstrates that self-perfectionism and obsessive-compulsiveness are specific risk factors for compulsive exercise and not simply more generic risk factors for eating disorders in this sample. This has important practical implications for clinicians, health professionals and adults working with adolescent, in particular with boys. It implies that generic prevention work into the eating disorders, such as targeting social physique anxiety, would not work on reducing a boy’s compulsivity towards exercise. This in turn could lead to the individual developing a full clinical eating disorder, based on the current assumption that compulsive exercise could play a role in the development of eating disorders (Davis et al., 1998). Instead, practitioners should look to reducing boys’ self-perfectionism and obsessive-compulsiveness in an attempt to reduce their compulsivity towards exercise.

In addition, it is noteworthy that the baseline levels of compulsive exercise were significantly related to compulsive exercise two years later in boys and girls, indicating a degree of temporal stability for compulsive exercise in adolescence. Indeed, this temporal stability, coupled with the greater number of correlates identified in the cross-sectional study of psychological correlates reported on in this thesis (Study 2), could suggest that these risk factors are still related to compulsive exercise, but that their association occurred prior to the baseline assessments, i.e. before the age of 12 years old. Indeed, although eating disorders have typically reported adolescent onset (Striegel-Moore & Bulik, 2007), there are incidences of eating disorders occurring prior to adolescence, such as early onset eating disorders that occur in childhood (Cooper, Watkins, Bryant-Waugh, & Lask, 2002). Therefore, given that compulsive exercise has been regarded as the first symptom of eating disorders to appear, with many people with eating disorders reporting that their exercising problems occurred prior to any eating problems (Davis et al., 1994), it is reasonable to hypothesise that compulsive exercise could be occurring at an earlier age than was sampled in the current study. Therefore, if correct, any future risk factor research into compulsive exercise would be advised to target an earlier age group, prior to the onset of adolescence.

This study had several limitations. First, the longitudinal design employed in this study is a standard approach seen in many previous longitudinal investigations (e.g., Calam & Waller, 1998; Presnell et al., 2004; Stice & Whitenton, 2002). However, although self-perfectionism and obsessive-compulsiveness predicted later compulsive exercise in boys, it is uncertain whether the levels of the predictor variables also increased. In other words, it is unknown whether the baseline compulsivity towards exercise also led to increased self-perfectionism and obsessive-compulsiveness. Given that these two predictor variables are generally regarded as traits (Cassin & von Ranson, 2005; Hewitt & Flett, 1991), then this is unlikely, but nonetheless, future research examining the exact temporal precedence of obsessive-compulsiveness, self-perfectionism and compulsive exercise needs to be conducted to replicate and strengthen the findings from the current investigation.

A second limitation could explain the lack of risk factors founds in girls. As mentioned earlier, the age group chosen for this study may already be too old to examine compulsive exercise, as it may already have stabilised. Therefore, to rectify these limitations, future studies should look to sample younger age groups, as well as following them up using more assessment points and study their samples over a greater period of time.

A final limitation of this study was the notable reduction in sample size after those that had initially been assessed at T1 then dropped-out or did not complete all the measures. Importantly, there were significant differences between these drop-outs and the retained sample and so this weakens the generalisability of the current findings. Additionally, the final sample size for the boys and girls separately was relatively small, coming close to the minimum sample required for multiple regression given the number of predictor variables that had been entered (Tabachnick & Fidell, 2007). Therefore, it is suggested that the findings are replicated in larger samples.

In summary, this is the first known investigation to assess specific longitudinal predictors of compulsive exercise. The findings indicate that self-perfectionism and obsessive-compulsiveness are specific risk factors for compulsive exercise among adolescent boys, whilst higher levels of depression could in fact decrease the compulsivity towards exercise among adolescent girls. These findings could help inform potential prevention and early intervention work into compulsive exercise. The results now need to be replicated, preferably using experimental designs to establish true causal risk factor status.

Study 8: Emotion regulation styles as longitudinal predictors of compulsive exercise

Abstract

Objective: This study examined whether emotion regulation styles longitudinally predict compulsive exercise among adolescents. **Method:** A sample of 572 adolescent boys and girls were recruited. At baseline, they completed self-report measures of compulsive exercise, emotion regulation, and disordered eating attitudes. Twelve months later they completed measures of compulsive exercise and disordered eating attitudes. **Results:** Compulsive exercise was longitudinally predicted by Internal Dysfunctional emotion regulation in girls. There were no significant associations between emotion regulation styles and compulsive exercise among boys. Emotion regulation styles did not significantly predict disordered eating attitudes in either boys or girls. **Discussion:** Girls displaying compulsivity to exercise require early intervention programmes aimed at altering their preferred strategy for regulating their emotions.

Emotion regulation styles as longitudinal predictors of compulsive exercise

Disordered eating behaviour has been widely reported as a method for functionally managing negative emotions (e.g., Lacey, 1986; Slade, 1982; Stice, 1994; Whiteside et al., 2007). Similarly, in the general exercise literature, emotion regulation is also associated with exercise (e.g., Cash et al., 1994; Thayer et al., 1994). Specifically, the anxiolytic and anti-depressant properties of exercise are well-documented (e.g., Biddle et al., 2000; Petruzzello et al., 1991; Salmon, 2001), and exercise has been used previously in the treatment of depression (Daley, 2007; Mental Health Foundation, 2005).

In the eating disorders literature, patients have also been shown to use exercise to manage emotions (Long et al., 1993; Penas-Lledo et al., 2002). The moderate use of exercise in this population could be regarded as being a positive behaviour (Lipsey et al., 2006), as participating in exercise during eating disorder treatment attenuates levels of distress and can improve symptoms (e.g., Hausenblas et al., 2008; Touyz, Lennerts, Arthur, & Beumont, 1993). However, engagement in exercise by individuals with eating disorders can often become compulsive in nature (Davis et al., 1997). As such, it is when exercise becomes compulsive that it poses a physical and psychological risk (Meyer et al., in press). Indeed, it is this compulsive drive to exercise that has been regarded as a maladaptive coping strategy (Penas Lledo et al., 2002), being specifically associated with an avoidance of negative affect (Taranis & Meyer, 2010). Such avoidance of negative emotion has been previously linked with psychological distress, health problems and psychiatric symptomatology (Endler & Parker, 1990), including eating psychopathology (Ghaderi & Scott, 2000; Koff & Sangani, 1997).

Few studies have investigated the connection between emotion regulation and compulsive exercise among adolescents. A recent cross-sectional study of compulsive exercise among adolescents found that compulsive exercise was associated with emotion regulation styles, and that this association held true after controlling for disordered eating attitudes (see Chapter 4, Study 3). Specifically, compulsive exercise was linked with external functional emotion regulation in boys (such as using exercise to positively manage emotions), whereas in girls compulsive exercise was linked with an internalised style of regulating emotions (i.e., dealing with things by oneself) that could be both functional and dysfunctional. However, it is unknown whether these particular styles can actually lead to the future development of compulsive exercise. Therefore, prospective designs are required to inform prevention strategies for compulsive exercise, which is particularly relevant in this adolescent age group (Garcia-Grau et al., 2002; 2004), given typical adolescent age of onset of eating disorders (Striegel-Moore & Bulik, 2007).

In summary, emotion regulation has been previously associated with exercise behaviour, as well as with eating disorder psychopathology. Additionally, exercise in the eating disorders can become compulsive in nature and it is this compulsive exercise that has been regarded as a possible dysfunctional emotion regulation strategy. However, it remains unclear whether emotion regulation styles play a role in the development of compulsive exercise, and as such, whether they can be regarded as risk factors for compulsive exercise.

Therefore, this study aims to extend the cross-sectional findings of Study 3 by identifying whether there is a specific longitudinal association between emotion regulation styles and compulsive exercise. The study has two hypotheses. First, it is hypothesised that emotion regulation will be positively related to compulsive exercise, after controlling for disordered eating attitudes. Second, the study aims to assess whether any specific emotion regulation style can be regarded as a risk factor in the aetiology of compulsive exercise in adolescence. For this aim, based on the extant literature, it is hypothesised that dysfunctional styles of emotion regulation will longitudinally predict compulsive exercise in a positive direction. Finally, the specificity of this relationship will be tested by examining the longitudinal association between emotion regulation and general disordered eating attitudes. It is hypothesised that emotion regulation will be positively related to disordered eating attitudes and that the internal dysfunctional style will be a significant positive unique predictor of the disordered eating attitudes.

METHODS

Participants and Procedure

As part of the wider research into eating and exercise attitudes among adolescents, a sample of 572 adolescents was recruited for this study. Participants were all aged 12-14 years old at baseline assessment (T1), with a mean age of 13.16 years (SD = .73). The sample consisted of boys and girls (boys n = 252;

girls n = 320) and it was predominantly British (98.6% of sample), as well as being ethnically homogenous ("White British" = 95.4%). Self reported height and weight information was converted to Body Mass Index (BMI) values, which were age- and gender-adjusted into BMI z scores (Child Growth Foundation, 1996). At T1, the BMI z score mean for boys was 0.38 (SD = 1.51) and for girls it was 0.10 (SD = 1.25). At T2, boys' mean BMI z score mean was 0.27 (SD = 1.37) and was 0.04 (SD = 1.06) for girls.

Institutional Review Board ethical approval was granted for the study of exercise and eating attitudes of adolescents. Subsequently, participating schools were sent questionnaire packs (including consent forms and parent letters), which were given to all pupils aged within the required age range of the study (12-14 years old at T1). Questionnaires were then completed during a regular timetabled class period. All returned questionnaires were assigned a specific identification code in order for them to be matched to the longitudinal follow-up. A follow-up assessment, using the same procedure as at T1, was conducted approximately 12-months later (T2).

Measures

For the purposes of this study, background information was collected at T1 on age, gender, nationality, ethnicity and self-reported height and weight, followed by the subsequent validated measures. At T1, these measures included assessment of the hypothesised risk factors of emotion regulation styles. At T2, similar background information was collected (in order to aid identification of follow-up participants), plus the Compulsive Exercise Test (Taranis, Touyz, & Meyer, in press) and the Eating Disorder Inventory-2 (Garner, 1991).

Compulsive Exercise Test (CET; Taranis et al., press). The CET assesses compulsive exercise cognitions and attitudes and was fully described in Study 1. In the current sample for this study, the T1 CET Total had a Cronbach's alpha of .89. The CET was measured at T1 and at T2.

Regulation of Emotions Questionnaire (REQ; Phillips & Power, 2007). The REQ assesses a person's emotion regulation tendencies (see Study 3 for full description). The Cronbach's alpha coefficients of the four subscales of the REQ in this sample were .71 (Internal Dysfunctional), .73 (Internal Functional), .77

(External Dysfunctional), and .74 (External Functional). The REQ was measured at T1 only.

Eating Disorder Inventory-2 (EDI; Garner, 1991). The Drive for Thinness, Bulimia, and Body Dissatisfaction subscales of the EDI-2 were used to measure disordered eating attitudes at T1 and at T2. A composite score of disordered eating was calculated by summing the three subscale scores, with a greater score representing greater disordered eating attitudes. This approach has been used in previous research (e.g., Adkins & Keel, 2005). The EDI has been previously used among adolescents (e.g., Grylli et al., 2004) and the EDI Total reported a Cronbach's alpha of .92 for this sample at T1. The EDI was measured at T1 and T2.

Data Analysis

Firstly, attrition analyses compared the retained sample ($n = 572$) with those individuals who had provided initial data at T1, but then dropped out of the study due to not being present at T2 ($n = 272$). Results showed that drop-outs scored significantly higher than the retained sample on External Dysfunctional and T1 EDI Total, and significantly lower than the retained sample on Internal Functional ($p < .01$, two-tailed). This suggests that there may be some systematic bias to sample recruitment using the longitudinal design, and therefore results need to be generalised with due caution.

The study aimed to create a risk factor model for boys and girls separately, and therefore all analyses were conducted separately for boys and girls. Initial investigations found that T1 BMI z score and the study variables were not correlated (Spearman's rho, $p > .01$). Therefore, T1 BMI z score was not entered into the regression models as a control variable. Preliminary analyses using Kolmogorov-Smirnov tests also demonstrated non-normal distribution of the majority of the study variables. Therefore, non-parametric tests were used where appropriate. However, residuals on the regression analyses showed normal distribution, and so no transformations of the variables were made before performing the subsequent regression analyses (Field, 2005).

Longitudinal risk factors for compulsive exercise were investigated using a hierarchical regression, with T2 CET Total as the outcome variable and Internal Dysfunctional, Internal Functional, External Dysfunctional and External Functional as the predictor variables. It has been reported that baseline levels of the outcome variable must also be controlled for, to ensure that true change in the outcome is being predicted (Presnell et al., 2004; Spoor et al., 2006). Therefore, the T1 CET Total was entered in the first step. In addition, previous cross-sectional associations between emotion regulation and compulsive exercise controlled for disordered eating attitudes and found that a drive for thinness significantly predicted compulsive exercise (Study 3). Therefore, T1 EDI Drive for Thinness was entered in the second step as an additional control variable. Finally, the T1 risk factors (the four REQ subscales) were entered in the third step of the hierarchical regression.

Importantly, the CET is a multidimensional measure, comprising five subscales, one of which is Mood Improvement. Therefore, subsequent hierarchical regressions, using the same procedure as described above, were repeated with each CET subscale as the outcome variable, to identify whether the emotion regulation styles predicted specific elements of the CET.

Finally, the specificity of risk for compulsive exercise needed to be assessed, and so the same set of risk factors were examined for their predictive ability of more general disordered eating attitudes. Therefore, a hierarchical regression was performed with T2 EDI Total entered as the outcome variable, T1 EDI Total entered in the first step, and the four REQ subscales entered as the predictor variables in the second step. Significance was set at $p < .05$.

RESULTS

Descriptive Statistics of the Sample

Table 7.4 shows the means and standard deviations for the study variables for boys and girls, as well as a test of difference between boys and girls on all study variables (Mann Whitney U). The means for T1 CET Total and T2 CET Total for boys and girls equate to low to mid-point scoring (“sometimes true of me”). Overall, for all boys, the T1 CET Total recorded a significant positive correlation (one-tailed) with T2 CET Total (Spearman’s rho = .52, $p < .001$), and for the girls, the same correlation was also significant (Spearman’s rho = .55, $p < .001$). Boys and girls did not report significantly different CET Total scores at T1, but at T2 girls reported a significantly greater CET Total than boys.

The EDI Total means at both T1 and T2 represented low levels of disordered eating attitudes, although inspection of the ranges of the individual subscales did suggest a sufficient spread of scores, incorporating possible clinical levels of disordered eating, based on previous recommended cut-offs (McGrane & Carr, 2002; Grylli et al., 2004). As expected, girls scored significantly greater T1 and T2 EDI-2 Total scores than boys. The means for the REQ subscales were all lower than in a previous study of adolescents using the same measure (Phillips & Power, 2007). The pattern of scores for the boys was identical to the previous study of Phillips and Power (2007), with Internal Functional recording the highest mean, followed by External Functional, then Internal Dysfunctional and the least reported emotion regulation style being External Dysfunctional. Among the girls, the pattern was the same except for External Functional recording a greater mean than Internal Functional.

Table 7.4 Means and standard deviations for study variables for boys and girls, and Mann Whitney U test of difference between boys and girls on study variables

Variable	Boys Mean (SD)	Girls Mean (SD)	Z
<u>REQ</u>			
Internal Dysfunctional	1.10 (0.75)	1.28 (0.80)	2.83*
Internal Functional	1.86 (0.78)	1.77 (0.72)	1.08
External Dysfunctional	0.83 (0.67)	0.81 (0.71)	0.84
External Functional	1.84 (0.77)	2.26 (0.82)	6.10**
<u>CET</u>			
T1 CET Total	9.76 (4.14)	10.08 (3.62)	0.92
T2 CET Total	8.33 (3.67)	9.43 (3.43)	3.62**
<u>EDI</u>			
T1 EDI Total	8.72 (9.32)	19.35 (15.48)	8.66**
T2 EDI Total	7.98 (10.38)	17.61 (14.02)	9.21**

Note: ** $p < .001$, * $p < .01$; REQ = Regulation of Emotions Questionnaire; CET = Compulsive Exercise Test; EDI = Eating Disorder Inventory; T1 / T2 = Time 1 / Time 2

Risk Factors for Compulsive Exercise

Boys

The hierarchical regression predicting T2 CET Total outcome can be seen in Table 7.5. The hierarchical regression final model found that collectively the predictors significantly predicted T2 CET Total and accounted for 31% (R^2) of the T2 CET Total variance. After controlling for T1 CET Total and T1 Drive for Thinness, the REQ subscales collectively only added 2% of the variance of T2 CET Total accounted for and this change was not significant (R^2 change = .02, F change$_{(4,\ 198)}$ = 1.29, p >.05). In the final model, only T1 CET Total was a significant unique predictor of T2 CET Total. There were no other significant predictors of T2 CET Total.

Table 7.5 Significant predictors of T2 CET Total score (outcome) for boys using a hierarchical multiple regression

Model	F (df)	R^2	Adj R^2	Beta	t
1.	77.41** (1, 203)	.28	.27		
T1 CET Total				.53	8.80**
2.	41.30** (2, 202)	.29	.28		
T1 CET Total				.45	6.56**
T1 Drive for Thinness				.14	2.01*
3.	14.70** (6, 198)	.31	.29		
T1 CET Total				.43	6.07**

Note: ** p <.001, * p <.05; Only significant unique predictors are reported here; Adj = Adjusted; T1 / T2 = Time 1 / Time 2; CET = Compulsive Exercise Test

Examination of the predictive ability of REQ subscales on to the CET subscales showed several significant findings. Results from these regressions only found a significant R^2 change from the introduction of the REQ subscales collectively for Lack of Exercise Enjoyment (R^2 change = .04, F change$_{(4,\ 202)}$ = 2.83, p <.05). Specifically, Internal Dysfunctional was a significant unique positive predictor of Lack of Exercise Enjoyment (beta = .14, t = 1.89, p <.05) and External Functional was a significant unique negative predictor of Lack of Exercise Enjoyment (beta = -.14, t = -1.94, p <.05). In addition, although the REQ subscales did not collectively add a significant change to the variance accounted for in any other CET subscale, Internal Functional was a significant unique positive predictor of Avoidance and Rule-Driven Behaviour (beta = .12, t = 1.85, p <.05). No other significant findings were found between the REQ subscales and the CET subscales. To summarise, the association between emotion regulation styles and different facets of compulsive exercise are not particularly strong among boys, although there was some association with the lack of exercise enjoyment subscale of the CET.

Girls

Table 7.6 shows the results of the hierarchical regression predicting T2 CET Total outcome from the REQ subscales, after controlling for T1 CET Total and T1 Drive for Thinness. The final model of the hierarchical regression found that T1 CET Total and the REQ subscales collectively predicted T2 CET Total and accounted for 35% of the T2 CET Total variance (R^2). The REQ subscales collectively only added 2% of the variance of T2 CET Total accounted for (after controlling for T1 CET Total and T1 Drive for Thinness), although this change was still significant (R^2 change = .02, F $\text{change}_{(4,\ 255)}$ = 2.13, p <.05). In the final model, T1 CET Total and Internal Dysfunctional were the only two significant unique predictors. There were no other significant predictors of T2 CET Total.

Table 7.6 Significant predictors of T2 CET Total score (outcome) for girls using a hierarchical multiple regression

Model	F (df)	R^2	Adj R^2	Beta	t
1.	122.81** (1, 260)	.32	.32		
T1 CET Total				.57	11.08**
2.	63.04** (2, 259)	.33	.32		
T1 CET Total				.53	9.31**
3.	22.80** (6, 255)	.35	.33		
T1 CET Total				.49	8.50**
Internal Dysfunctional				.13	2.03*

Note: ** p <.001, * p <.01; Only significant unique predictors are reported here; Adj = Adjusted; T1 / T2 = Time 1 / Time 2; CET = Compulsive Exercise Test

Subsequent hierarchical regressions examining the predictive ability of the REQ subscales on to each of the CET subscales (after controlling for their baseline levels and T1 Drive for Thinness) were conducted. The results from these regressions found significant R^2 changes from the introduction of the REQ subscales collectively for Avoidance and Rule-Driven Behaviour (R^2 change = .03, F $change_{(4, 275)}$ = 2.98, p <.01), Weight Control Exercise (R^2 change = .03, F $change_{(4, 275)}$ = 2.99, p <.01) and Lack of Exercise Enjoyment (R^2 change = .02, F $change_{(4, 262)}$ = 2.41, p <.05). Internal Functional positively and significantly predicted Avoidance and Rule-Driven Behaviour (beta = .12, t = 1.85, p <.05), Weight Control Exercise (beta = .17, t = 2.94, p <.01), and Exercise Rigidity (beta = .14, t = 2.35, p < .05); and significantly predicted Lack of Exercise Enjoyment in a negative direction (beta = -.17, t = -2.90, p <.01). Internal Dysfunctional was a significant positive predictor for Weight Control Exercise (beta = .15, t = 2.49, p <.01), whilst External Functional was a significant negative predictor for Avoidance and Rule-Driven Behaviour (beta = -.13, t = -2.35, p <.05) and a significant positive predictor for Lack of Exercise Enjoyment (beta = .10, t = 1.83, p <.05). In summary, these results demonstrate the close association between internal emotion regulation and compulsive exercise, particularly a functional style of emotion regulation. However, specifically, exercise for weight control was also associated with a dysfunctional style of emotion regulation.

<u>Specificity of risk: Risk factors for disordered eating attitudes</u>

<u>Boys</u>

A hierarchical regression, including T1 EDI Total at step 1 and the four REQ subscales collectively as the predictors in step 2 significantly predicted T2 EDI Total ($F_{(5, 205)}$ = 17.16, p <.001), accounting for 30% (R^2 = .30) of its variance. T1 EDI Total significantly predicted T2 EDI Total in the first step (Beta = .52, t = 8.90, p <.001) and accounted for 28% (R^2 = .28) of T1 EDI Total. The introduction of the four REQ subscales however only added 2% to the variance accounted for and this was not a significant R^2 change (p >.05). The final model showed that T1 EDI Total (Beta = .50, t = 7.68, p <.001) and External Functional (Beta = -.14, t = -2.10, p <.05) were the only significant unique predictors of T2 EDI Total. No other emotion regulation styles were significant predictors of T2 EDI Total.

Girls

The final hierarchical regression model, including T1 EDI Total and the four REQ subscales was significant ($F_{(5, 268)} = 66.51$, $p < .001$) and accounted for 55% ($R^2 = .55$) of the variance of T2 EDI Total. In the first step, T1 EDI Total significantly predicted T2 EDI Total (Beta = .74, t = 18.18, $p < .001$), accounting for 55% ($R^2 = .55$) of its variance. The addition of the four REQ subscales collectively did not account for any extra variance of the T2 EDI Total, (R^2 change: $p > .05$). In the final model only T1 EDI Total was a significant unique predictor (Beta = .70, t = 14.37, $p < .001$). None of the REQ subscales were significant predictors of T2 EDI Total for girls.

DISCUSSION

The current study examined whether emotion regulation styles longitudinally predicted compulsive exercise, to assess whether they could be regarded as risk factors for compulsive exercise among adolescents. The results demonstrated that emotion regulation styles did not predict compulsive exercise in boys, but that they did significantly predict later compulsive exercise in girls, even after controlling for the initial levels of the outcome variable (i.e., compulsive exercise) and drive for thinness. This association supports previous studies suggesting that compulsive exercise is being used to regulate emotions in eating disorder patients (Penas-Lledo et al., 2002), and the maintenance model of compulsive exercise which postulates that dysfunctional emotion regulation is a maintaining factor of compulsive exercise (Meyer et al., in press). However, the current findings extend this association using a prospective design and implicate emotion regulation styles in the development of compulsive exercise in girls.

Specifically, among girls, an internal dysfunctional emotion regulation style was the only significant unique predictor of compulsive exercise. This style describes the management of emotions using such behaviours as rumination, repression and self-harm, and essentially represents emotion regulation that is conducted without social support. This is in line with previous adolescent research showing that an avoidance of social forms of coping were associated with greater maladaptive eating attitudes (Huon et al., 1999), as well as agreeing with the general eating disorders literature demonstrating that individuals with eating disorders often isolate themselves and tend to have interpersonal difficulties

(Hartmann et al., 2009). Therefore, the finding of the current study suggests that the eating disordered symptom of compulsive exercise may develop out of an underlying preference of the individual to deal with emotions on their own, but in a dysfunctional manner that does not address the problem. This was also shown by research that found that compulsive exercise was cross-sectionally linked to an avoidance of affect (Meyer & Taranis, 2007). Certainly, eating disorder patients may attempt to reduce negative emotions by food (e.g., bingeing), but this in turn exacerbates the disorder's symptomatology (Chesler, 1997). This same dysfunctional way of managing negative emotions could be true of compulsive exercise (Loumidis & Roxborough, 1995). In other words, it becomes a short term distraction, which may develop into long term compulsive behaviour if a tolerance is developed and if the individual has access to no other coping strategies (Adams et al., 2003).

Importantly, these associations were with overall compulsive exercise, and yet compulsive exercise is a multidimensional construct (Taranis et al., in press). Examination of the CET subscales found that there were different links between the four emotion regulation styles and the five elements of compulsive exercise. These associations did not account for large amounts of the variance in the CET subscales and therefore any significant findings may have been due to a product of the high statistical power of the study and the number of tests being performed. However, the different findings for the subscales does demonstrate the need for further research to more fully examine the complex interplay of risk factors for compulsive exercise and their relationships with the specific elements of compulsive exercise. For example, the two key elements of compulsive exercise most closely related to eating disorder psychopathology are Avoidance and Rule-Driven Behaviour and Weight Control Exercise (Taranis & Meyer, 2010). In the current study, these two subscales were positively predicted by internal styles of emotion regulation, both functional and dysfunctional. Therefore, once again, in relation to the eating disorders, it is perhaps an internalised strategy to regulate emotions that is most predictive of future eating disorder symptoms (e.g., Huon et al., 1999), such as compulsive exercise, rather than whether or not the strategy is functional or dysfunctional in dealing with the emotions. This interplay between emotion regulation and elements of compulsive exercise requires further exploration in relation to the development of clinical eating disorders.

A secondary aim of the current study was to assess the specificity of emotion regulation as a risk factor for compulsive exercise. This is because existing research has demonstrated that coping style is a possible risk factor for eating disorders in general (Koff & Sangani, 1997). The current study found that collectively there was no association between emotion regulation and disordered eating attitudes, after controlling for the baseline levels of disordered eating. This suggests then, along with the above link with compulsive exercise, that emotion regulation (specifically Internal Dysfunctional) is a specific risk factor for the development of compulsive exercise in both boys and girls. However, this contradicts previous literature, which suggested that emotion regulation was a possible risk factor for the eating disorders (e.g., Koff & Sangani, 1997). Therefore, the absence of a relationship between emotion regulation styles and disordered eating attitudes in the current study needs to be replicated using different samples.

Importantly, although there was no collective association between emotion regulation and disordered eating attitudes in general, for boys, External Functional did record a significant unique association with disordered eating attitudes. This association was in the negative direction, suggesting that those with a reduced tendency to adopt an External Functional style to regulate their emotions (i.e., interacting with others in a positive manner, such as utilising social support), were more likely to report greater levels of disordered eating attitudes approximately 12-months later. This is in line with the eating disorders literature suggesting that low perceived social support can be a risk factor for the development of the eating disorders (Ghaderi & Scott, 2001).

These results have several practical implications. First, individuals reporting compulsive exercise attitudes should be encouraged to deal with their emotions in more functional ways, preferably via the use of social support and interaction with others, which in itself could lead to psychological and physical health benefits (Blechman, 1998). Prevention programmes, for example, could look to reduce the risk of developing compulsive exercise in girls, by encouraging more varied coping skills, to avoid a reliance on exercise. Second, generic disordered eating prevention programmes targeting coping skills may not work for disordered eating attitudes, but the results from the current study do suggest that they may be more effective in reducing compulsive exercise in girls. Further research into emotion regulation, anxiety, compulsive exercise and the eating disorders is now warranted to more fully examine the complex interplay between these constructs.

It must be noted that there were several limitations of this study. The use of a self-report measure of emotion regulation in adolescents may be problematic as they may have difficulty accurately reporting the strategies that they regularly utilise (Phillips & Power, 2007). Nonetheless, the REQ does help in furthering the understanding of adolescents and their methods for dealing with negative emotions. Additionally, the follow-up period was only 12-months and this may not have been sufficient to establish true development of compulsive exercise. Indeed, the T1 and T2 compulsive exercise scores were significantly related, suggesting a high degree of temporal stability of this measure. Therefore, future studies should look to extend the time period for follow-ups, as well as including more follow-up assessments to examine the trajectory of compulsive exercise development. Finally, it was also not assessed whether the different styles of emotion regulation and the use of compulsive exercise actually differed in their efficacy at reducing negative emotions. Therefore, further research should look to see whether Internal Dysfunctional emotion regulation and the use of compulsive exercise actually leads to any short and/or long term reduction in negative emotions, such as anxiety, and what effect this has on a person's physical and psychological health.

Ultimately, the current study represents the first longitudinal investigation in adolescents of emotion regulation and compulsive exercise, as measured using the CET. The findings suggest that an internal dysfunctional emotion regulation style may be a specific risk factor for the development of compulsive exercise in adolescent girls, and so early intervention programmes aimed at reducing compulsive exercise may benefit from improving girls' emotion regulation style to a more functional and interactive style. More work is needed to fully examine the complex interplay between emotion regulation, anxiety, compulsive exercise and disordered eating attitudes.

Chapter 8

Socio-Cultural Risk Factors for Compulsive Exercise

Study 9

8 Socio-cultural Risk Factors for Compulsive Exercise

The current chapter aimed to extend the findings of Chapter 5 by identifying the specific socio-cultural risk factors for compulsive exercise in adolescent boys and girls, using a longitudinal design. Chapter 5's cross-sectional study of socio-cultural correlates (Study 4) demonstrated that messages to become more muscular, as well as media pressure to be thin both significantly predicted compulsive exercise in boys. The same study found that a media pressure to be thin was the only significant socio-cultural correlate of compulsive exercise in girls. These findings partly concurred with the previous socio-cultural model of compulsive exercise, which found that messages to become more muscular and lose weight were both cross-sectionally associated with a compulsive need to exercise in boys and girls (White & Halliwell, 2010). However, the socio-cultural risk factors for compulsive exercise remain unclear and warrant further research. Therefore, the current chapter consists of an empirical study, which extends previous research (e.g., White & Halliwell, 2010) and earlier cross-sectional findings (i.e., Study 4) by examining the predictive ability of socio-cultural factors on to compulsive exercise, using a longitudinal design. As conducted in the previous chapter (Chapter 7), the specificity of these hypothesised risk factors will be established, to ensure that any identified risk factors are specific to compulsive exercise and are not simply more generic risk factors for wider eating disorder psychopathology.

Study 9: Socio-cultural risk factors for compulsive exercise and disordered eating: A prospective study of adolescents

Abstract

Objective: This study aims to build on existing cross-sectional work by testing for the socio-cultural risk factors for compulsive exercise using a longitudinal design. **Method:** A sample of 332 male and female adolescents completed baseline measures and a 12-month follow-up assessment of socio-cultural risk factors, disordered eating and compulsive exercise. **Results:** Hierarchical regressions found that media pressure to be thin was a significant predictor of compulsive exercise in girls. In boys, peer pressure to be thin was a significant predictor of compulsive exercise, but this prediction was in the unexpected negative direction. Disordered eating attitudes in boys were positively predicted by peer pressure to be thin and negatively predicted by a family pressure to be thin. Socio-cultural risk factors did not predict disordered eating attitudes in girls. **Conclusion:** Findings suggest that socio-cultural risk factors might play a part in the development of compulsive exercise but this effect may occur at an earlier age, perhaps even prior to the onset of adolescence.

Socio-cultural risk factors for compulsive exercise and disordered eating: A prospective study of adolescents

Eating disorders are serious mental health issues that predominantly affect adolescents and young adults (Preti et al., 2009). The aetiology of these disorders is not entirely known, although multi-factorial models incorporating psychological and social factors have been proposed in the literature (see Polivy & Herman, 2002). Certainly, socio-cultural factors have been widely demonstrated to be important in the development of the eating disorders (Polivy & Herman, 2004; Striegel-Moore & Bulik, 2007). A variety of socio-cultural factors, such as a pressure to be thin (Stice, Maxfield, & Wells, 2003) and the influence of the media (Field et al., 2001), have been targeted for research, with parents, friends and the media all being implicated in the development of disordered eating and weight concerns (Dunkley et al., 2001). For example, the perceived pressure to aspire to the ‘thin ideal’ espoused by Western culture has been shown to be a potential risk factor for disordered eating (Stice & Agras, 1998). Likewise, parental messages around eating and weight and shape are linked to an increased risk for the development of adolescent eating disorders (Young et al., 2004). Finally, peer groups during adolescence have also been implicated in influencing adolescent weight and shape attitudes and weight control behaviours (Hutchinson & Rapee, 2007).

The majority of the above studies used female-only samples. However, weight and shape concerns transmitted from parents can also affect boys, with parental pressure to be thin being related to adolescent boys’ body satisfaction (Muris et al., 2005). Further, parents have been shown to influence children’s eating directly, through an encouragement of dieting behaviours (Benedikt et al., 1998; Edmunds & Hill, 1999; Muris et al., 2005), as well as through more indirect ways such as criticism and comments about weight and shape (Keel et al., 1997; Schwartz et al., 1999).

The outcome measure for the majority of these studies is general eating disorder psychopathology; either attitudes or behaviours, or a combination of both. However, some researchers have identified risk factors for specific symptoms (Nicholls, 2005), rather than general pathology, which is often weakened by the shortfalls of the nosology of the eating disorders (see Garfinkel, 2002). One key symptom that can affect up to 70% of patients with eating disorders is that of compulsive exercise (Davis et al., 1997). This behaviour is associated with greater psychological morbidity (Shroff et al., 2006) and can also have a detrimental effect on the treatment of the eating disorder as a whole (Solenberger, 2001). However, despite compulsive exercise's apparent importance in the eating disorders, the specific risk factors for its development have not been widely studied.

A recent study by White and Halliwell (2010) examined a socio-cultural model of excessive exercise in male and female adolescents. Their results suggested that socio-cultural pressures to lose weight and build muscle predicted compulsive exercise in adolescent boys and girls. However, this relationship was fully mediated by an investment in appearance and body image disturbance. Therefore, the socio-cultural risk factors for their measure of compulsive exercise did not demonstrate specificity for compulsive exercise, and instead appeared to be more risk factors for general disordered eating attitudes, namely body dissatisfaction. Additionally, their investigation was a cross-sectional study and needs to be replicated using a prospective design.

In summary, socio-cultural factors have been implicated in the development of disordered eating in adolescents (Field et al., 2001), and have also been associated cross-sectionally with compulsive exercise (White & Halliwell, 2010). However, no studies have considered those risk factors that are specific to compulsive exercise. It is useful to study this in an adolescent population as this is the age-period of greatest risk for the development of the eating disorders (Striegel-Moore & Bulik, 2007). This study therefore examines the socio-cultural risk factors (e.g., pressure to be thin, messages to be more muscular) for compulsive exercise using a longitudinal design in a sample of adolescents. It is expected that the hypothesised risk factors of pressure to be thin and messages to increase muscles as well as lose weight will be positively associated with compulsive exercise. However, given that the previous cross-sectional model of socio-cultural risk factors for compulsive exercise (White & Halliwell, 2010) demonstrated that these factors were mediated by general body dissatisfaction, the specificity of these risk factors for compulsive exercise will also be tested. It is expected that the socio-cultural risk factors for compulsive exercise will not be specific to compulsive exercise but will also predict more general eating disorder psychopathology.

METHODS

Participants and Procedure

Following institutional ethical review board approval a sample of schools in the United Kingdom was invited to participate in wider research into adolescent exercise and eating attitudes. Questionnaire packs, containing background information and established measures (see Measures section below), were sent to those schools who had agreed to participate. Questionnaire packs were completed at baseline assessment (T1) during a school class period by all pupils aged between 13 and 15 years old. The completed packs were returned to the research team. Identification codes were assigned to each pack to ensure that the individual could be matched at the follow-up assessment. Follow-up assessment took place approximately 12 months later (T2), using the same procedure.

The final sample for the current study was 332 adolescents (boys n = 146, girls n = 186). At T1, participants were aged between 13-15 years old (m = 13.97, SD = 0.69), and 97.8% of the sample recorded their nationality as British. Ethnicity was predominantly White British (93.8%). Body Mass Index (BMI) scores were calculated from self-reported height and weight information, and were then converted into age and gender adjusted BMI z scores (Child Growth Foundation, 1996). At T1, the mean BMI z score for boys was 0.25 (SD = 1.28, range = -2.95 – 2.74) and -.01 (SD = 1.03, range = -3.12 – 2.37) for girls. At T2, the sample age range was 14-16 years old (M = 14.90, SD = 0.69), and the BMI z score mean for boys was 0.56 (SD = 1.06, range = -2.32 – 2.79) and was 0.25 (SD = 1.05, range = -2.65 – 3.21) for girls.

Measures

As this study was nested in wider research into adolescent exercise and eating attitudes, the packs contained different measures at each time point. For the purposes of this study, background information (age, gender, nationality, height and weight) was gathered before the following established questionnaires were administered:

Compulsive Exercise Test (CET; Taranis et al., in press)

The CET measures an individual’s compulsivity towards exercise (see Study 1 for description), and this measure was used as one of the outcome variables in the current study. The reliability for the current sample was .88 for CET Total score at T1, and at T2 it was .88.

Modified Perceived Sociocultural Influences on Body Image and Body Change Questionnaire (mSCIQ; McCabe & Ricciardelli, 2001)

The Socio-cultural Influences on Body Image and Body Change Questionnaire was modified in a previous investigation (Meesters et al., 2007), and the modified version was used in this study at T1 (see Study 4 for full description of measure). Cronbach's alphas demonstrated good reliability for the mSCIQ subscales in the current sample (mSCIQ Lose Weight = .75; mSCIQ More Muscular = .77).

Perceived Sociocultural Pressure Scale (PSPS; Stice & Bearman, 2001)

The PSPS was used at T1 in the current study and measures the degree of pressure to be thin that the respondent feels from socio-cultural sources (see Study 4 for full description). The reliability figures for the measure's subscales were .72, .77, and .85, for PSPS Family, PSPS Peers, and PSPS Media respectively.

Eating Disorder Inventory-2 (EDI-2; Garner, 1991).

The EDI-2 subscales of Drive for Thinness, Bulimia and Body Dissatisfaction were used to assess disordered eating attitudes at T1 (see Study 1 for full description). A composite score was used in this study as a measure of general disordered eating attitudes. The Cronbach's alpha value for EDI Total was .91 for the current sample.

Eating Disorder Examination Questionnaire (version 6) (EDEQ; Fairburn & Beglin, 1994).

The EDEQ was administered at T2 as a self-report measure of eating disorder psychopathology relating to the previous 28 days (see Study 7 for description). The EDEQ was measured at T2 only, and only the EDEQ Global score was used for this study.

Data Analysis

Initial assessment had included 828 adolescents from T1 who could potentially take part in the current study. However, this number was reduced to the current sample reported in this study (N=332), as individuals were not included in the final sample if they did not take part in the study at T2. Attrition analyses revealed that drop-outs (n = 496) were not significantly different to the retained sample on any of the study measures (p >.05, two-tailed), suggesting no systematic bias to sample recruitment using the longitudinal design.

Socio-cultural influences have been shown to be gender-specific (Field et al., 2001) and therefore, all analyses were conducted separately for boys and girls. Socio-cultural pressures to be thin are also related to BMI (Stice & Whitenton, 2002). However, the earlier cross-sectional study in this thesis of socio-cultural correlates of compulsive exercise found that BMI was not a significant predictor of compulsive exercise (Study 4). Instead, Drive for Thinness was a significant predictor of compulsive exercise in the same study. Therefore, Drive for Thinness was included in the subsequent regression analyses as a control variable, whilst BMI was not entered as a control variable in the current investigation.

Preliminary analysis screened for normality using Kolmogorov-Smirnov tests. Results demonstrated that the majority of the study variables were non-normally distributed. Therefore, non-parametric tests were used where appropriate. Importantly, inspection of the residuals on the regression analyses showed normal distribution, and so it was deemed satisfactory to conduct the regression analyses with no transformations of the variables (Field, 2005).

Risk factors for compulsive exercise were examined using a hierarchical regression, with T2 CET Total entered as the outcome variable. Previous longitudinal designs have controlled for the initial levels of the outcome variable (e.g., Presnell et al., 2004; Spoor et al., 2006). Therefore, T1 CET Total was entered in the first step, whilst T1 Drive for Thinness was entered in the second step as an additional control variable. The hypothesised T1 socio-cultural risk factors of mSCIQ Lose Weight, mSCIQ More Muscular, PSPS Family, PSPS Peers, and PSPS Media were then entered in the final step as the predictor variables. Previous investigations into risk factors for compulsive exercise have found that there were different models for the separate CET subscales (see Study 7 and Study 8). Therefore, after the risk factors for overall compulsive exercise were established, the risk factors for each of the T2 CET subscales were then examined in separate regressions with each of the five T2 CET subscales as the outcome variables (controlling for the T1 levels of the outcome variable and the T1 Drive for Thinness in each regression).

Finally, the same set of risk factors were examined for their predictive ability of more general eating disorder symptomatology. This was performed in order to assess the specificity of the study risk factors for compulsive exercise. For this aim, T2 EDEQ Global score was entered as the outcome variable in a hierarchical regression. In the first step, EDI Total was entered to control for baseline eating disorder psychopathology because the EDEQ had not been measured at T1. The hypothesised risk factors were then entered in the second step. The T1 BMI z scores for boys and girls were not entered as a control variable in order to allow for a more parsimonious comparison with the hierarchical regression conducted with T2 CET as the outcome variable. Additionally, a lack of T1 BMI z score data would have rendered the sample size insufficient for regression analyses, based on suggested values (Tabachnick & Fidell, 2007). Therefore, it was deemed suitable not to enter BMI z score into the regression models. Significance was set at $p < .05$.

RESULTS

Descriptives

Means and standard deviations and a test of difference between boys and girls can be seen in Table 8.1. Boys scored significantly greater than girls on mSCIQ More Muscular. Girls scored significantly greater than boys on PSPS Family, PSPS Media, T2 CET Total, T1 EDI Total, and T2 EDEQ Global. The T1 and T2 CET Total means represented low to mid-point scoring averages ("sometimes true of me") for both boys and girls, suggesting generally low levels of compulsive exercise. The CET Totals were normally distributed, and so a Pearson correlation coefficient was used to show the temporal stability of the CET between baseline and follow-up. The correlation showed that T1 CET Total and T2 CET Total were significantly correlated in boys ($r = .65$, $p < .01$) and girls ($r = .59$, $p < .01$), which demonstrates that there was a degree of temporal stability in compulsive exercise across the 12-month period.

Table 8.1 Descriptive statistics for principle study variables and tests of difference (Mann Whitney U) between boys and girls

Variable	Boys Mean (SD)	Girls Mean (SD)	Test of Difference Z
mSCIQ More Muscular	2.38 (1.26)	1.46 (0.69)	7.83**
mSCIQ Lose Weight	1.72 (1.10)	1.64 (0.77)	1.09
PSPS Family	1.48 (.78)	1.60 (0.80)	1.91*
PSPS Peers	1.52 (0.70)	1.56 (0.70)	1.10
PSPS Media	1.59 (0.93)	2.47 (1.24)	7.06**
T1 CET Total	8.90 (3.73)	9.56 (3.52)	1.42
T2 CET Total	8.23 (3.61)	9.66 (3.13)	3.98**
T1 EDI-2 Total	9.75 (11.15)	15.28 (13.89)	4.13**
T2 EDEQ Global	0.51 (0.79)	1.36 (1.24)	8.05**

Note: ** p <.01, * p < .05 (one-tailed); mSCIQ = Modified Socio-cultural Influences on Body Image and Body Change Questionnaire; PSPS = Perceived Socio-cultural Pressure Scale; CET = Compulsive Exercise Test; EDI = Eating Disorder Inventory; EDEQ = Eating Disorder Examination Questionnaire; T1 / T2 = Time 1 / Time 2

<u>Socio-cultural risk factors for compulsive exercise</u>

<u>Boys</u>

A hierarchical regression predicting T2 CET Total from socio-cultural risk factors, whilst controlling for baseline levels of CET (T1 CET Total) and T1 Drive for Thinness can be seen in Table 8.2. This regression found that the final model was significant, accounting for 42% of T2 CET Total variance (R^2). The addition of the socio-cultural risk factors had accounted for 3% of the variance and this change was non-significant (R^2 change = .03, F change $_{(5, 132)}$ = 1.36, p >.05). In the final model, T1 CET Total was a significant unique positive predictor, whilst PSPS Peers was a significant unique predictor in a negative direction. No other variables significantly predicted T2 CET Total.

Table 8.2 Significant predictors of T2 CET Total score (outcome) for boys using a hierarchical multiple regression

Model	F (df)	R^2	Adj R^2	Beta	t
1.	98.48** (1, 138)	.42	.41		
T1 CET Total				.65	9.92**
2.	49.57** (2, 137)	.42	.41		
T1 CET Total				.67	9.31**
3.	15.32** (7, 132)	.45	.42		
T1 CET Total				.68	8.67**
PSPS Peers				-.23	-1.95*

Note: ** p <.001, * p <.05; Only significant unique predictors are reported here; Adj = Adjusted; T1 / T2 = Time 1 / Time 2; CET = Compulsive Exercise Test; PSPS = Perceived Socio-Cultural Pressure Scale

To investigate the risk factors for the specific elements of compulsive exercise, hierarchical regressions were performed with the CET subscales as the outcome variable in each separate regression. After controlling for baseline levels of the outcome variable and T1 Drive for Thinness, the socio-cultural risk factors only provided a significant R^2 change for Avoidance and Rule-Driven Behaviour (R^2 change = .05, F $change_{(5, 132)}$ = 2.19, p <.05) and Lack of Exercise Enjoyment (R^2 change = .05, F $change_{(5, 132)}$ = 2.11, p <.05). Avoidance and Rule-Driven Behaviour was uniquely predicted by PSPS Peers in a negative direction (beta = -.27, t = -2.28, p <.05). Lack of Exercise Enjoyment was uniquely predicted in a positive direction by SCIQ Lose Weight (beta = .18, t = 1.81, p <.05) and SCIQ More Muscular (beta = .14, t = 1.78, p <.05), and uniquely predicted in a negative direction by T1 Drive for Thinness (beta = -.19, t = -1.97, p <.05). There were no other significant findings between the hypothesised socio-cultural risk factors and the T2 CET subscales. In summary, the associations between socio-cultural risk factors and specific elements of the CET centre around the compulsive drive around rules and avoidance of negative feelings, which could also be associated with a lack of enjoyment of exercise.

Girls

The hierarchical regression predicting T2 CET Total in girls can be seen in Table 8.3. The final model for this regression was significant and accounted for 37% of T2 CET Total (R^2). The addition of the socio-cultural risk factors to the model accounted for an additional 2% of the variance and this addition was non-significant (R^2 change = .02, F change $_{(5,\ 173)}$ = 1.16, p >.05). In the final model, only T1 CET Total and PSPS Media were significant unique predictors of T2 CET Total. No other predictors were significantly related to T2 CET Total.

In keeping with the procedure for the boys, the risk factors for the specific CET subscales were examined. After controlling for initial levels of the outcome variable and T1 Drive for Thinness, socio-cultural risk factors accounted for significant additional variance of Avoidance and Rule-Driven Behaviour (R^2 change = .06, F change $_{(5,\ 173)}$ = 3.42, p <.01) and lack of Exercise Enjoyment (R^2 change = .04, F change $_{(5,\ 173)}$ = 2.38, p <.05). Avoidance and Rule-Driven Behaviour was uniquely predicted by PSPS Media (beta = .25, t = 3.62, p <.001). Lack of Exercise Enjoyment was uniquely predicted in a positive direction by SCIQ Lose Weight (beta = .17, t = 1.96, p <.05) and T1 Drive for Thinness (beta = .17, t = 2.27, p <.05), and was uniquely predicted in a negative direction by PSPS Media (beta = -.13, t = -1.79, p <.05). Finally, although the model was non-significant, PSPS Media was a significant unique predictor of Mood Improvement (beta = .13, t = 1.70, p <.05). There were no other significant findings between the hypothesised socio-cultural risk factors and the T2 CET subscales. In summary, as was similar to the associations found among the boys, the socio-cultural risk factors' association with compulsive exercise is specific to avoidance and rule-driven behaviour, as well as a lack of exercise enjoyment.

Table 8.3 Significant predictors of T2 CET Total score (outcome) for girls using a hierarchical multiple regression

Model	F (df)	R^2	Adj R^2	Beta	t
1.	96.37** (1, 179)	.35	.35		
T1 CET Total				.59	9.82**
2.	48.43** (2, 178)	.35	.35		
T1 CET Total				.56	7.88**
3.	14.73** (7, 173)	.37	.35		
T1 CET Total				.54	7.00**
PSPS Media				.15	2.01*

Note: ** p <.001, * p <.05; Only significant unique predictors are reported here; Adj = Adjusted; T1 / T2 = Time 1 / Time 2; CET = Compulsive Exercise Test; PSPS = Perceived Socio-Cultural Pressure Scale

Specificity of the findings: Socio-cultural risk factors for disordered eating attitudes

Boys

In order to assess the specificity of risk factors for compulsive exercise, the same hierarchical regressions were run with T2 EDEQ Global as the outcome variable. After controlling for T1 EDI Total, the final model predicted 39% of the T2 EDEQ Global variance (R^2) and was significant ($F_{(6,\ 117)} = 12.25$, $p < .001$). The addition of the socio-cultural risk factors accounted for an additional 10% of the T2 EDEQ Global variance and was significant (R^2 change = .10, F change $_{(5,\ 117)}$ = 3.92, $p < .01$). Significant unique positive predictors in the second step were T1 EDI Total (beta = .29, t = 2.88, p <.01) and PSPS Peers (beta = .49, t = 3.73, p <.001), whilst PSPS Family was a significant unique predictor in a negative direction (beta = -.25, t = -2.33, p <.05). No other predictors were significant in the final model.

Girls

Using the same procedure as for the boys, the hierarchical regression found that, after controlling for T1 EDI Total, the final model was significant and predicted 44% of the T2 EDEQ Global variance (R^2; $F_{(6,\ 167)} = 21.48$, $p < .001$). The addition of socio-cultural risk factors to the model did not account for any noticeable nor significant additional variance of T2 EDEQ Global (R^2 change = .01,

F change $_{(5,\ 167)}$ = 0.50, $p > .05$). Only T1 EDI Total was a significant unique predictor in the final model (beta = .62, $t = 8.39$, $p < .001$). No other predictors were significant in the final model, including T1 BMI z score.

DISCUSSION

The current study aimed to examine the socio-cultural risk factors for compulsive exercise among adolescents, using a prospective longitudinal design. Overall, the results suggested that a peer pressure to be thin in boys and a media pressure to be thin in girls were both significantly related to compulsive exercise. Interestingly, among boys, peer pressure to be thin predicted compulsive exercise in the negative direction. In other words, it suggests that the greater the peer pressure to be thin perceived by boys, the lower their compulsive exercise will be one year later. Although unexpected, this finding could be explained by the fact that a greater pressure to be thin is probably perceived by individuals who perceive themselves to be overweight, through greater body dissatisfaction (Presnell et al., 2004). However, individuals who are exercising compulsively will not likely be overweight. Therefore, it this could explain the anomalous finding in the current study. Alternatively, the association with compulsive exercise could be due to peer pressure to be thin being a more general risk factor for disordered eating (albeit in the positive direction). Indeed, it was found that peer pressure to be thin was a significant risk factor for later disordered eating attitudes.

The results for girls also demonstrated weak potency of socio-cultural risk factors for compulsive exercise. Regardless of the potency, it was found that a media pressure to be thin predicted subsequent compulsive exercise. This is in agreement with the general literature, which has found that media influences on adolescent girls can increase the internalisation of the ‘thin ideal’ of Western culture (Field et al., 2001), which here, could have led to an increase in the compulsivity to exercise. This supports the cross-sectional findings in this thesis, which found that a media pressure to be thin was associated with compulsive exercise at 13-15 years old (see Chapter 6).

The lack of strength of the predictions between socio-cultural factors and compulsive exercise may have been due to the age of the sample. For example, the onset of eating disorders is regarded as being at its greatest during adolescence (Striegel-Moore & Bulik, 2007). Therefore, it might be that this age group of 13-15 year olds at baseline had already had sufficient years of media messages about weight and shape to influence their exercise and eating attitudes to any great amount. This suggestion is supported by the fact that no socio-cultural risk factors predicted more general disordered eating attitudes in the current sample of girls after baseline levels of disordered eating attitudes had been included. Therefore, despite the literature widely implicating socio-cultural risk factors in the development of the eating disorders (e.g., Polivy & Herman, 2002; 2004), the absence of significant findings in the current study among girls, for disordered eating attitudes, and the weak associations with compulsive exercise, perhaps suggests that examination of potential longitudinal risk factors of these behaviours may need to occur prior to age 13 years. Further research is recommended to examine the socio-cultural risk factors for compulsive exercise in girls at an earlier age than was sampled in the current investigation.

The practical implications of these findings are to be suggested with due caution, given that any risk factors found in the study were of limited potency in both boys and girls. Nevertheless, the findings suggest that professionals working with adolescents need to be cognisant of the weight and shape pressures that boys perceive from their peers. Indeed, eating disorder prevention and early intervention work among boys should perhaps target the peer group, identifying and attempting to reduce any excessive pressures (or bullying) to lose weight that is apparent in the peer groups. Among girls, it would appear that prevention work needs to target those at a younger age, but certainly early intervention work could help by attempting to target the susceptibility of girls to adhere to media messages around weight and shape. Additionally, early intervention work in this age group would benefit from directly targeting girls' existing compulsive exercise attitudes, as well as any existing disordered eating attitudes.

There were several limitations of this study. A key problem was the sample size. Although the overall sample was large, the study aim of analysing boys and girls separately significantly reduced the numbers in each regression analysis. Indeed, given the number of predictor variables entered in the regressions, the number of participants used was marginally above the minimum level recommended for multiple regressions (Tabachnik & Fidell, 2007). This could have meant that there was insufficient power in the analyses to generate findings. Additionally, the lack of completed BMI data also prevented this potentially confounding variable being included in the disordered eating analyses. Therefore, future research should aim to replicate these findings with larger samples and with a measure of actual body weight.

An additional limitation was that the length of follow-up was only one year. Although the 12-month follow-up used in the current study was greater than other longitudinal investigations of adolescent eating and exercise attitudes (e.g., Presnell et al., 2004), it could have been that the length of time was still not long enough to identify noticeable changes in compulsive exercising. Indeed, the baseline CET and follow-up CET were significantly correlated, suggesting a good degree of temporal stability over the 12-month period. Therefore, a longer follow-up period is suggested for future studies to identify whether socio-cultural risk factors can predict more distal compulsive exercise.

In summary, this was the first study to longitudinally examine socio-cultural risk factors of compulsive exercise. The findings suggest that a media pressure to be thin is a specific risk factor for compulsive exercise in girls. Further research replicating the current findings is required, preferably with younger samples and with the use of a greater time period between baseline assessment and follow-up.

PART 4: General Discussion

Chapter 9

Chapter 9

General Discussion

9 Chapter 9 – General Discussion

The research reported on in this thesis has investigated the risk factors for compulsive exercise. Specifically, the thesis adopted a risk factor research design as proposed by Kraemer et al. (1997) and Kazdin et al. (1997), which had been previously applied to the eating disorders by Jacobi et al. (2004). The review by Jacobi and colleagues stated that the progressive research design outlined by Kraemer et al., (1997) and Kazdin et al., (1997) espoused the need to identify first putative risk factors for the outcome of interest and before attempting to examine the interactions of factors. Therefore, this thesis applied the design specifically to compulsive exercise and has identified putative risk factors, without examining the interactive nature of these factors. The empirical studies reported on in this thesis represent the first work examining the risk factors for compulsive exercise. The aims of the thesis are summarised below:

9.1 Aims of the Present Thesis

The broad aim of this thesis was to examine the risk factors for compulsive exercise among adolescents, using the risk factor research process outlined by Kraemer et al. (1997) and Kazdin et al. (1997). The first aim of the thesis was to identify correlates of compulsive exercise in adolescents. Second, the thesis aimed to identify risk factors for compulsive exercise over time. Importantly, the specificity of these risk factors for compulsive exercise was also identified by examining the risk factor status of the studied risk factors for more general eating disorder psychopathology. In order to achieve these aims, the empirical studies reported on in this thesis examined the links highlighted in Figure 1.4 (Chapter 1). As can be seen in this risk factor model of compulsive exercise, potential risk factors were categorised into psychological, socio-cultural and behavioural risk factors. Therefore, in keeping with the first two stages of the risk factor research process (cross-sectional and longitudinal), and using the categories stipulated in the model in Figure 1.4, the aims for the studies in the thesis were to test the links on the hypothesised risk factor model for compulsive exercise:

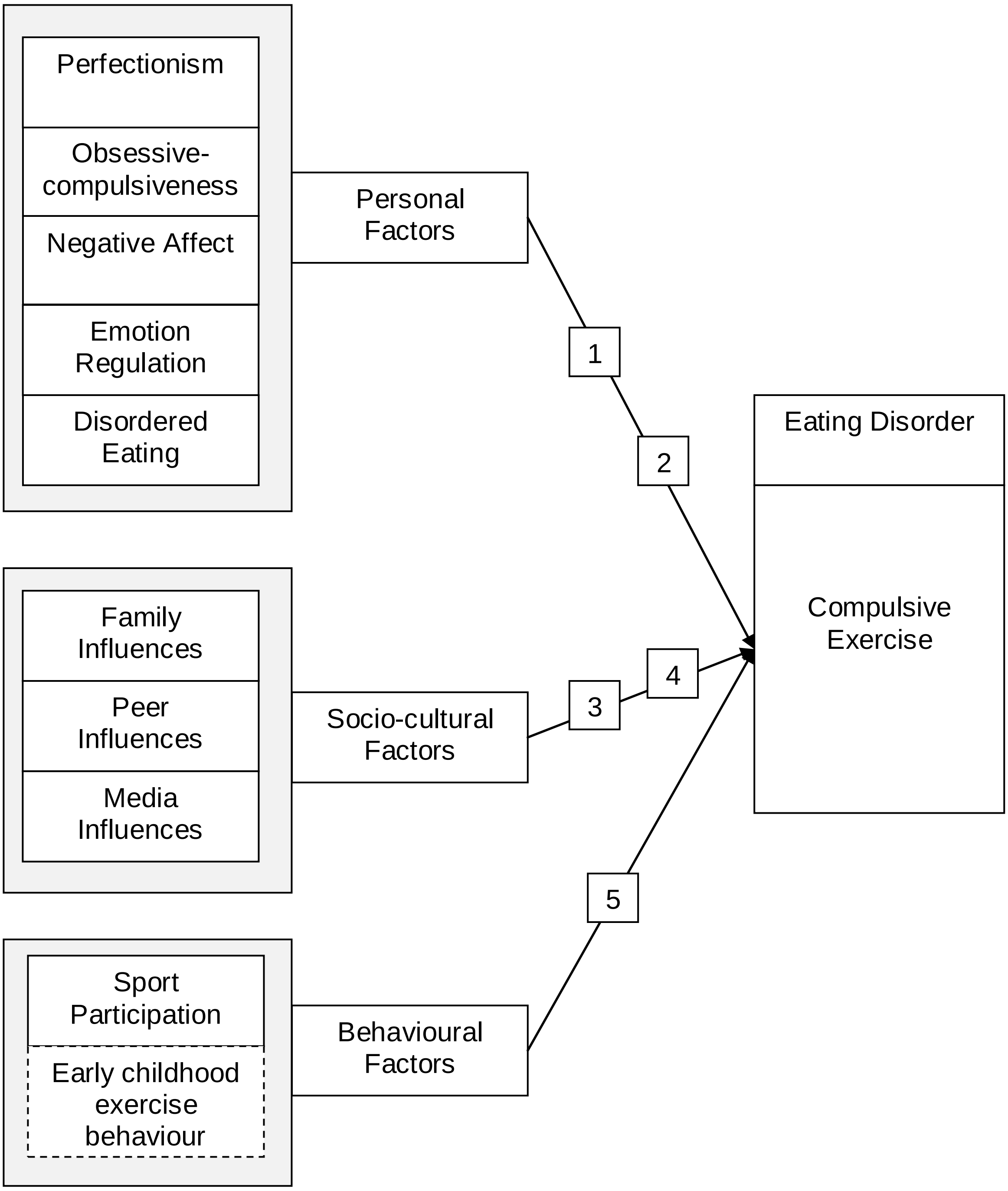


Figure 1.4 Hypothesised risk factor model for compulsive exercise in adolescents

Aims:

1. Identify the psychological correlates of compulsive exercise in adolescent boys and girls (Study 2, Study 3)

2. Identify the socio-cultural correlates of compulsive exercise in adolescent boys and girls (Study 4, Study 5)

3. Identify the association between sport participation, exercise behaviour and compulsive exercise attitudes in adolescent boys and girls (Study 6)

4. Identify the prospective psychological risk factors for compulsive exercise in adolescent boys and girls (Study 7, Study 8)

5. Identify the prospective socio-cultural risk factors for compulsive exercise in adolescent boys and girls (Study 9)

These aims were tested in a series of studies, which have been reported on in the thesis. The results of the studies are summarised below.

9.2 Summary of Results

9.2.1 Chapter 3: Validation of the thesis outcome measure

The first study of the thesis validated the Compulsive Exercise Test (CET; Taranis et al., in press) for use in an adolescent sample (Chapter 3, Study 1; Goodwin et al., in press). This study used factor analytic procedures and confirmed the original five-factor structure of the CET in a sample of adolescent boys and girls. Specifically, compulsive exercise was shown to comprise avoidance and rule-driven behaviour, weight control exercise, exercise for mood improvement, a lack of enjoyment derived from the exercise behaviour, as well as an apparent rigidity around performing exercise through extensive routines and repetitions. Additional analyses also demonstrated that the CET was closely related to a measure of exercise commitment, the Commitment to Exercise Scale (CES; Davis et al., 1993), as well as being associated with the Eating Disorder Inventory-2 (EDI-2; Garner, 1991), a key measure of disordered eating attitudes. Importantly, the results of Study 1 found that compulsive exercise cognitions were not strongly related to exercise frequency in adolescents, highlighting that exercise behaviour is not a good marker of compulsive exercise cognitions in this age group. Overall, the findings from Study 1 suggested that the CET is valid and reliable for use with adolescents, although replication with a clinical sample of adolescents with eating disorders is now required.

9.2.2 Chapters 4 and 7: Psychological correlates and risk factors for compulsive exercise

Chapter 4 investigated the psychological correlates of compulsive exercise, whilst Chapter 7 advanced these cross-sectional findings by replicating the studies using a longitudinal design. These chapters comprised Studies 2, 3, 7 and 8.

9.2.2.1Personality, psychological morbidity and disordered eating

Study 2 tested the cross-sectional associations of compulsive exercise with personality, psychological morbidity, and disordered eating attitudes. In this study, the CET was significantly associated cross-sectionally with a drive for thinness, self-perfectionism, socially-prescribed perfectionism, and obsessive-compulsiveness in boys. In girls, cross-sectional correlates of compulsive exercise were a drive for thinness, self-orientated perfectionism, and obsessive-compulsiveness.

The hypothesised correlates of psychological characteristics tested in Study 2 were replicated in Study 7, using a longitudinal design. Study 7 found that among boys, self-orientated perfectionism and obsessive-compulsiveness were both significant longitudinal predictors of compulsive exercise. Importantly, these significant findings were found even after controlling for the initial levels of compulsive exercise. In girls, psychological risk factors were not significant predictors collectively, although a significant unique association was found with depression, in a negative direction. This suggests that reduced levels of depression could technically be regarded as a risk factor for compulsive exercise. However, it was deemed that this association was more likely a result of individuals with higher levels of depression choosing alternative activities requiring less energy and intensity than exercising, and therefore explaining the negative association with compulsive exercise. Importantly, in both boys and girls, these stated risk factors were specific to compulsive exercise, as they were not found to be risk factors for more general disordered eating attitudes and cognitions.

These potential risk factors were subsequently examined for their relationship with the specific CET subscales in the same study. In boys, it was found that self-orientated perfectionism significantly predicted avoidance and rule-driven behaviour, mood improvement, and exercise rigidity, whilst obsessive-compulsiveness only predicted exercise rigidity. In girls, depression only significantly and negatively predicted exercise rigidity. This suggests that, although overall levels of compulsive exercise may report a set of risk factors, the interaction of these risk factors with the multi-dimensional elements of compulsive exercise varies and requires further investigation.

9.2.2.2Compulsive exercise and emotion regulation

The second study in Chapter 4 investigated the cross-sectional association between compulsive exercise and emotion regulation styles (Study 3). This study found that emotion regulation was significantly associated with compulsive exercise in boys and girls. Specifically, among boys, an external functional emotion regulation (e.g., talking through your feelings with friends, going for a walk) significantly predicted compulsive exercise, whilst among girls, internal functional (e.g., goal setting, putting things into perspective) as well as internal dysfunctional (e.g., rumination, avoidance) emotion regulation styles were significant unique predictors of compulsive exercise. Importantly, these significant associations with compulsive exercise were found even after controlling for disordered eating attitudes. Specifically, it was found that a drive for thinness significantly predicted emotion regulation (in boys and girls).

The second study in Chapter 7 (Study 8) looked at the emotion regulation risk factors for compulsive exercise. This study found that emotion regulation styles did not significantly predict compulsive exercise in boys. However, in girls, emotion regulation did significantly predict compulsive exercise, after controlling for drive for thinness and initial levels of compulsive exercise. Specifically, it was an internal dysfunctional emotion regulation style that was a unique significant predictor of compulsive exercise in girls. Importantly, internal dysfunctional emotion regulation did not predict more general disordered eating attitudes in girls and therefore this emotion regulation style could be regarded as a specific risk factor for the development of compulsive exercise in girls and not simply a general risk factor for wider eating disorder psychopathology.

In the same study, the influence of these emotion regulation styles on the specific elements of the CET was examined. The results found that emotion regulation styles collectively predicted Lack of Exercise Enjoyment in boys. There were several unique significant predictors of these CET subscales, but the amount of variance accounted for by the collective models suggests that further work is required in other potentially more influential risk factors. For girls, there were significant collective predictions of avoidance and rule-driven behaviour, weight control exercise, and lack of exercise enjoyment. Once again, the size of the variance explained suggests that there are other more influential risk factors for the development of compulsive exercise than emotion regulation styles.

9.2.2.3 Summary of psychological correlates and risk factors for compulsive exercise

Overall, the psychological correlates for compulsive exercise in boys and girls can be seen in Figure 9.1. This model represents the cross-sectional associations between psychological characteristics and compulsive exercise found in this thesis. The risk factors for compulsive exercise (longitudinal findings) are included as part of the overall risk factor model generated from the findings in this thesis, and can be seen in Figures 9.4 (for boys) and 9.5 (for girls).

In summary, the psychological correlates of compulsive exercise differed slightly between boys and girls. Additionally, the difference between the psychological correlates for compulsive exercise (see Figure 9.1) and the psychological risk factors for compulsive exercise (see Figures 9.4 and 9.5) demonstrates that not all cross-sectional associations with compulsive exercise are replicated longitudinally. This is important, as the majority of the research into compulsive exercise has only adopted cross-sectional designs (see 1.4.2) and therefore is reporting on possible risk factors which may not have an influence in the development of subsequent compulsive exercise.

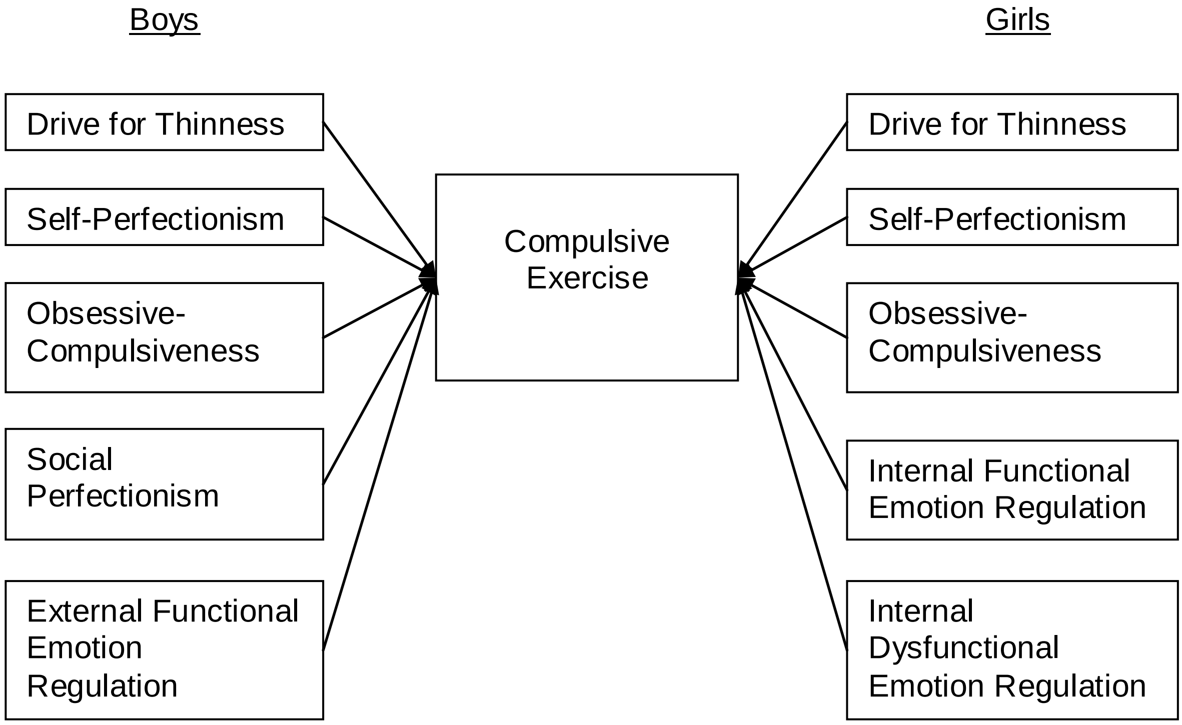


Figure 9.1 Psychological correlates of compulsive exercise in boys and girls found in this thesis

Ultimately, the findings from Chapters 4 and 7 demonstrate that personality, particularly self-perfectionism and obsessive-compulsiveness, is important in the development of compulsive exercise. This is particularly true of boys, as self-perfectionism and obsessive-compulsiveness were found to longitudinally predict compulsive exercise. Replication studies, using longitudinal designs, would have to be conducted to strengthen the risk factor status of these two personality variables for compulsive exercise in both boys and girls. Finally, the findings that emotion regulation styles were also associated with compulsive exercise suggests that compulsive exercise may be regarded as a method for regulating emotions, which concurs with previous compulsive exercise research in adult eating disorder patients (e.g., Bratland-Sanda et al., 2010a).

9.2.3 Chapters 5 and 8: Socio-cultural correlates and risk factors for compulsive exercise

Chapter 5 investigated the socio-cultural correlates of compulsive exercise, whilst Chapter 8 advanced these cross-sectional findings by replicating the studies using a longitudinal design. These chapters comprised Studies 4, 5, and 9.

9.2.3.1 Socio-cultural messages around weight and shape and compulsive exercise

The socio-cultural correlates of compulsive exercise were first examined in Study 4, and this study found that messages (from parents and friends) to be more muscular and a media pressure to be thin were both significantly associated with compulsive exercise in boys. Further correlations identified that the messages from mother, father, and friends about becoming more muscular were all positively linked to compulsive exercise, but the strongest correlate was messages from the boy’s father. In girls, a media pressure to be thin was the only significant socio-cultural correlate of compulsive exercise. These findings were found after controlling for disordered eating attitudes.

The cross-sectional associations tested in Study 4 were extended in Study 9, with a study that examined the longitudinal socio-cultural predictors of compulsive exercise. Study 9 found that the socio-cultural risk factors collectively did not predict compulsive exercise above initial levels of compulsive exercise or drive for thinness in either boys or girls. However, for boys, peer pressure to be thin was significantly related to compulsive exercise in a negative direction, which was an unexpected finding. This negative association could be explained by the fact that boys who are overweight are likely to feel greater peer pressure to be thin, and those that are overweight are not likely to be those currently engaging in compulsive exercise.

Examination of the risk factors for the specific CET subscales found that socio-cultural risk factors were significantly associated with avoidance and rule-driven behaviour and a lack of exercise enjoyment in boys and girls. Greater levels of avoidance and rule-driven behaviour was predicted by less perceived peer pressure to be thin in boys and by greater perceived media pressure to be thin in girls. A lack of exercise enjoyment was greater in those boys who also reported stronger perceived messages to be more muscular as well as by messages to lose weight. In girls, those who were aware of greater messages to lose weight were likely to report a greater lack of exercise enjoyment. Rather contrary to this was that girls’ lack of exercise enjoyment was greater when they perceived less media pressure to be thin.

The lack of significant collective associations of socio-cultural risk factors with compulsive exercise were not replicated with disordered eating attitudes in boys, as socio-cultural risk factors were found to be collective risk factors for disordered eating attitudes. Specifically, peer pressure to be thin significantly and positively predicted disordered eating attitudes, whilst surprisingly family pressure to be thin negatively predicted disordered eating attitudes. For girls, the socio-cultural risk factors were not significant predictors of disordered eating attitudes.

9.2.3.2Physical activity support and compulsive exercise

In addition to the socio-cultural correlates examined in Study 4, Study 5 examined the possible association between one specific element of social support - physical activity support and compulsive exercise. This study reported that peer support and paternal logistic support were significant predictors of compulsive exercise in boys, whilst in girls it was only peer support that was significantly associated with compulsive exercise.

Study 5 also examined the association of physical activity support with the CET subscales. The findings from these analyses showed that for boys, peer support was a significant, positive predictor for all of the CET subscales, with the exception of lack of exercise enjoyment; and that paternal logistic support predicted three of the five CET subscales (Avoidance and Rule-Driven Behaviour, Mood Improvement, Exercise Rigidity). Paternal modelling was the only other significant individual predictor, which was negatively associated with lack of exercise enjoyment.

For girls, peer support was also positively associated with all of the CET subscales, with the exception of the lack of exercise enjoyment, where the significant relationship was in the negative direction. In other words, the less physical activity support girls received from their friends, the more likely that they would not derive any enjoyment from exercise. In addition to peer support paternal logistic support significantly predicted three of the CET subscales, positively predicting mood improvement and exercise rigidity and negatively predicting lack of exercise enjoyment. Finally, avoidance and rule-driven behaviour was significantly and positively predicted by maternal logistic support.

9.2.3.3 Summary of socio-cultural correlates and risk factors for compulsive exercise

Overall, the socio-cultural correlates for compulsive exercise in boys and girls can be seen in Figure 9.2. This model represents the cross-sectional associations between socio-cultural factors and compulsive exercise found in this thesis. The risk factors for compulsive exercise (longitudinal findings) are included as part of the overall risk factor model generated from the findings in this thesis, and can be seen in Figures 9.4 (for boys) and 9.5 (for girls).

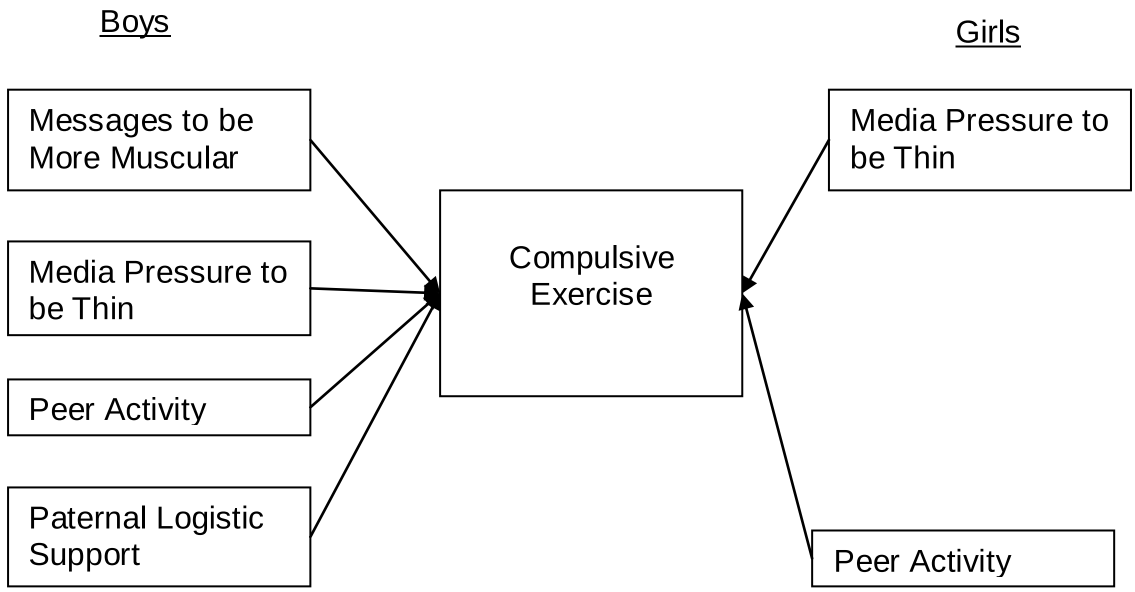


Figure 9.2 Socio-cultural correlates of compulsive exercise in boys and girls found in the current thesis

As was found in the model displaying psychological correlates of compulsive exercise, the socio-cultural correlates model also displayed slight differences between boys and girls. Among boys, messages to be more muscular, as well as paternal logistic support, were both correlated with compulsive exercise, compared to girls, who's perceived pressure to be thin from the media and the activity support from their peers were the two significant correlates of compulsive exercise. The socio-cultural findings of Study 4 were not generally replicated in the longitudinal study of socio-cultural risk factors (Study 9). Study 5 was not replicated longitudinally as it has its grounding in the exercise literature, whereas there was a greater focus in the thesis of risk factors in the context of the eating disorders. The results of Study 9 can be seen as part of the final risk factor model presented in Figure 9.4 for boys, as there were no significant unique socio-cultural risk factors found for girls.

In summary, the socio-cultural correlates appeared to be more strongly linked with compulsive exercise than were the prospective socio-cultural risk factors for compulsive exercise. This could suggest that socio-cultural risk factors are either not important in the development of compulsive exercise, or it could perhaps mean that they may have already affected the development of compulsive exercise at an earlier age, and therefore explain their cross-sectional association with compulsive exercise in Study 4, which used a sample as young as 13 years old. These socio-cultural studies represent some of the first work into socio-cultural correlates and risk factors for compulsive exercise, and so ultimately, these findings need to be replicated in different samples and using different methodological designs, as well as with the use of longer follow-up periods of study.

9.2.4 Chapter 6: Behavioural correlates of compulsive exercise

9.2.4.1 Sport participation, exercise behaviour and compulsive exercise

Chapter 6 investigated the behavioural correlates of compulsive exercise attitudes and cognitions, as measured by the CET. Specifically, the empirical study in Chapter 6 (Study 6; Goodwin et al. unpublished) examined the association between different intensities of exercise behaviour and compulsive exercise, as well as associations between compulsive exercise and sport participation. Study 6 found that among boys, compulsive exercise was significantly associated with greater strenuous exercise behaviour and not any other milder intensities of exercise behaviour. Among girls, strenuous, moderate and mild exercise behaviours were all associated with compulsive exercise, although the association was weaker for mild exercise behaviour. For boys and girls, competitive sport participants reported significantly greater compulsive exercise attitudes and cognitions than those not involved in competitive sports. The study also considered whether lean sports (e.g., aesthetic sports, such as gymnastics; or weight category sports, such as judo) reported significantly greater compulsive exercise than those involved in non-lean sports (e.g., football, netball, golf), given that eating disordered attitudes have been reportedly greater in sports that emphasise leanness (Sundgot-Borgen & Torstveit, 2004). However, Study 6 found no differences in compulsive exercise scores between those involved in lean sports and those involved in non-lean sports for both boys and girls, suggesting that this symptom of eating disorders does not differentiate between the type of sport in this adolescent sample. The summary findings for Chapter 6 can be seen in Figure 9.3.

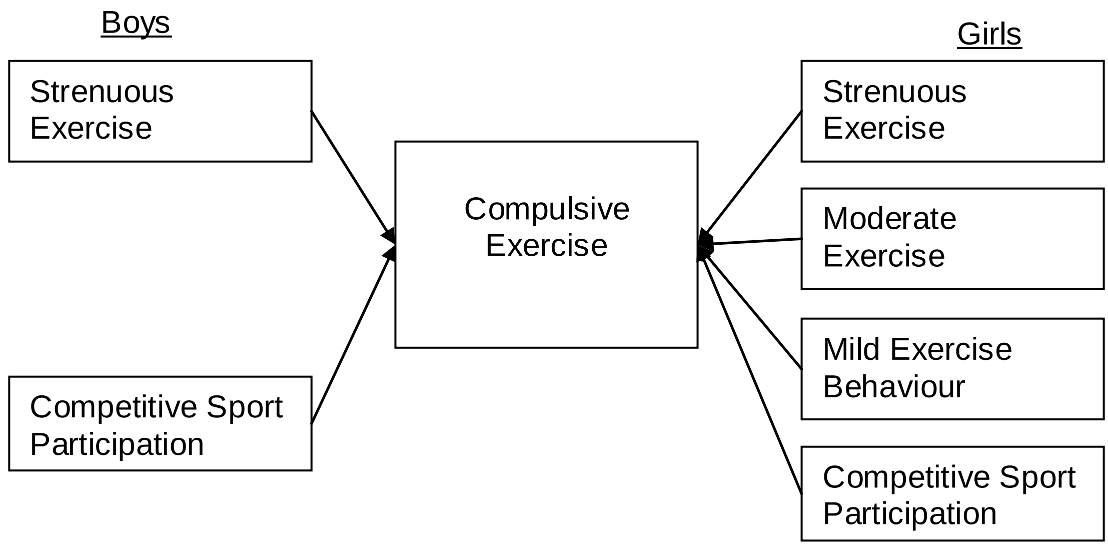


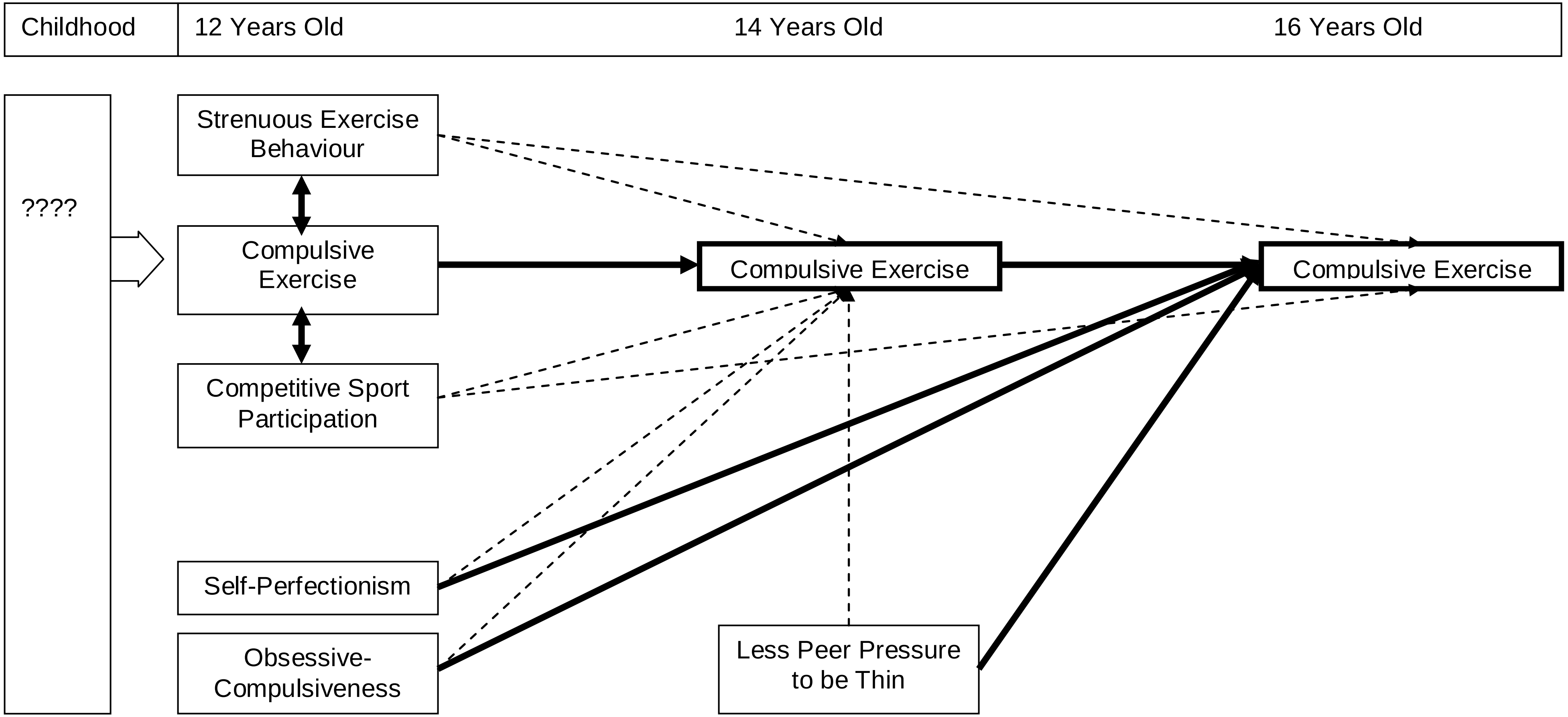
Figure 9.3 Behavioural correlates of compulsive exercise in boys and girls found in the current thesis

9.3 Risk Factor Model for Compulsive Exercise

The risk factor models presented in the following section represent the significant longitudinal predictors of compulsive exercise found in this thesis. In other words, the models represent a psychological and socio-cultural risk factor model of compulsive exercise in adolescent boys and girls. Indeed, although Figures 9.1-9.3 represent correlates of compulsive exercise, they cannot be translated as being true risk factors for the development of compulsive exercise (Jacobi et al., 2004). This was supported by the different findings seen in the longitudinal risk factor studies (Studies 7, 8 and 9) compared to the corresponding cross-sectional studies (Studies 2, 3, and 4). Therefore, a more accurate and final risk factor model created from the findings of this thesis is presented in Figure 9.4 for boys and in Figure 9.5 for girls. For completeness, although it was not tested longitudinally in this thesis, the cross-sectional findings of Chapter 6 have been included in the model, to demonstrate the potential role of behavioural factors on the development of compulsive exercise.

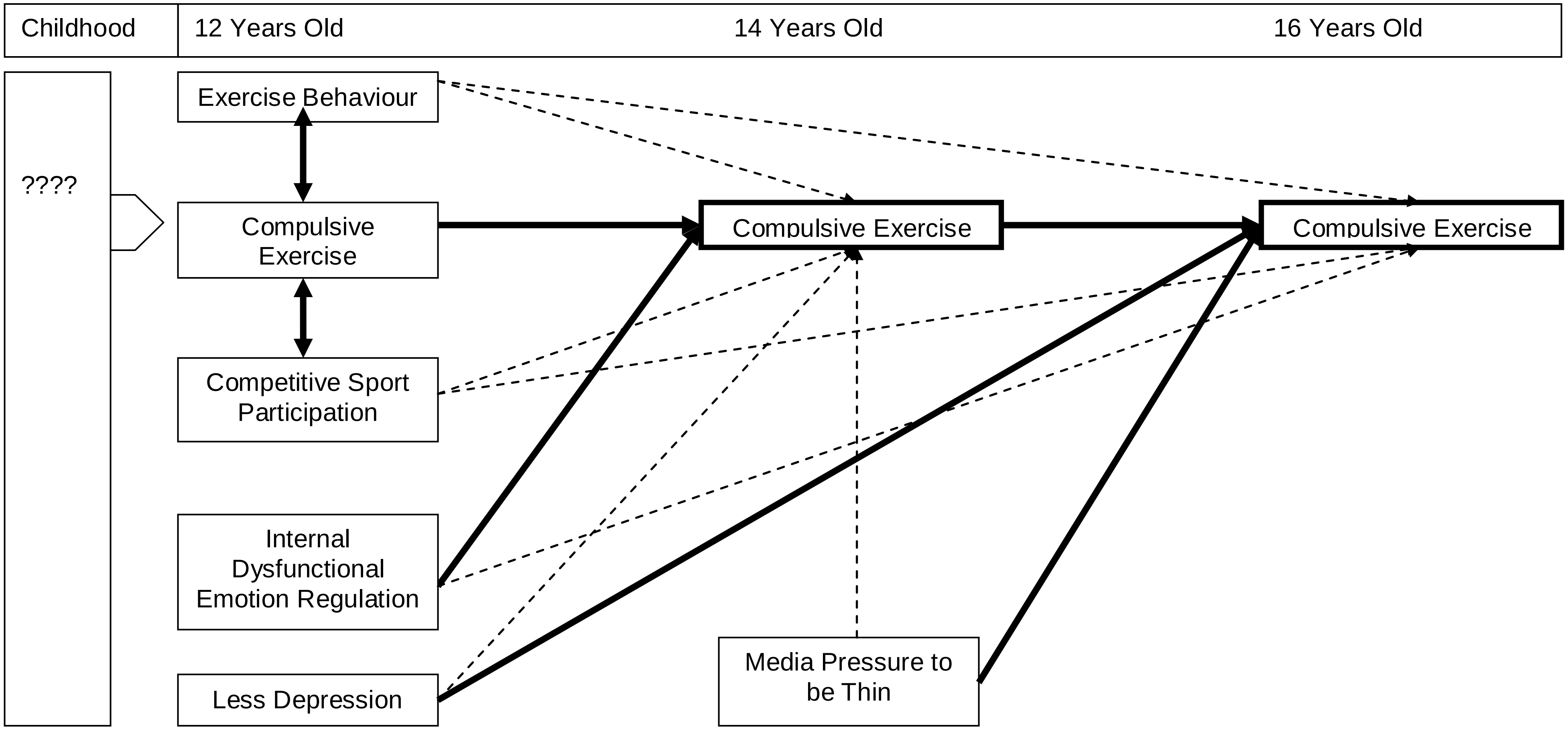
For boys, it appears that a personality style that manifests in being self-driven towards perfection and is obsessive-compulsive could place a boy at an increased risk of developing compulsive exercise cognitions and attitudes. In addition, although beyond the scope of this thesis, it is likely that this increased risk could be further heightened if the boy engages in strenuous exercise behaviour and is involved in competitive sports. The model for boys also includes a reduced peer pressure to be thin. This finding is included in the model, although is counter-intuitive and harder to explain, therefore further work to replicate this finding is required before it can be regarded as a serious risk factor for compulsive exercise.

For girls, different risk emerged. The key risk factor for compulsive exercise in girls appears to be an internal dysfunctional emotion regulation style, which involves the individual dealing with emotions on their own and in a maladaptive way, using strategies such as rumination, avoidance, or even self-harm. The model also demonstrates that a perceived pressure to be thin from the media could also represent an important risk factor for the development of compulsive exercise. Interestingly, the model also suggests that less depression could be considered a risk factor for compulsive exercise. However, like the reduced peer pressure to be thin finding in the boys' model, this finding was unexpected, and it requires replication in further research for it to be considered a serious risk factor for compulsive exercise.



Note: Thick lines are significant findings found in thesis studies; Dotted lines are hypothesised links not tested in the thesis studies; Ages are given as approximate ages based on the sample age range used in each longitudinal study; Strenuous Exercise Behaviour and Competitive Sport Participation were not tested longitudinally but have been included in this model for completeness; Interaction between risk factors and additional risk factors have also not been included in the model

Figure 9.4 Final risk factor model for compulsive exercise in boys



Note: Thick lines are significant findings found in thesis studies; Dotted lines are hypothesised links not tested in the thesis studies; Ages are given as approximate ages based on the sample age range used in each longitudinal study; Exercise Behaviour and Competitive Sport Participation were not tested longitudinally but have been included in this model for completeness; Interaction between risk factors and additional risk factors have also not been included in the model

Figure 9.5 Final risk factor model for compulsive exercise in girls

9.4 Contribution of Results to the Understanding of Compulsive Exercise

9.4.1 The measurement of compulsive exercise in adolescents

The validation of the CET for use in an adolescent population is vital to the understanding of the new conceptualisation of exercise in the eating disorders (see Meyer et al., in press). Indeed, the onset of eating disorders is invariably reported as occurring during adolescence (Striegel-Moore & Bulik, 2007), and many patients receiving treatment for eating disorders are under 18 years old (e.g., Gowers, Weetman, Shore, Hossain, & Elvins, 2000). Therefore, the findings from Study 2 (see Chapter 3) demonstrate that the multidimensional model of compulsive exercise, as defined by Taranis and colleagues (in press), is relevant to an age group that is of crucial importance to the eating disorders (Striegel-Moore & Bulik, 2007). Further, although previous research has found that greater exercise behaviour might be influential in the development of eating disorder psychopathology (e.g., Davis et al., 1994), other studies have demonstrated that it is the cognitions around exercise and not the exercise behaviour itself that are more closely associated with the eating disorders (Mond et al., 2006; Siegel & Hetta, 2001). Therefore, the validation of the CET to measure compulsive cognitions and attitudes around exercise in an adolescent population enables its use in further risk factor research. Namely, research into the role of compulsive exercise in the development of the eating disorders in an age group at heightened risk (Striegel-Moore & Bulik, 2007).

The literature review had previously highlighted the variety of measures that are used to assess exercise in the eating disorders, with clinicians being unsure of the best measure to assess the problematic exercise element to the eating disorders (Hechler et al., 2006). Several researchers used exercise volume (e.g., Brewerton et al., 1995; Penas-Lledo et al., 2002), but the use of behaviour as a marker of compulsive exercise attitudes has been criticised (e.g., Boyd et al., 2007; Lipsey et al., 2007). Indeed, the findings of Study 1 in this thesis supported these criticisms, as it was found that the CET, a multidimensional measure of compulsive exercise cognitions and attitudes, was only weakly correlated with reports of actual exercise behaviour. Therefore, a key implication of the findings of the first study in this thesis (Study 1) is that it confirms that researchers and clinicians using exercise behaviour as a marker of compulsive exercise are potentially ignoring more dangerous cognitions and attitudes that are of greater importance in the eating disorders. Exercise behaviour alone has been shown to be less associated with eating disorder symptomatology than assessing exercise cognitions and attitudes (Siegel & Hetta, 2001), and it is the combination of compulsive exercise attitudes with underlying disordered eating attitudes that has the greatest physical and psychological health risk, rather than excessive exercising per se (e.g., Mond et al., 2006).

Study 1 also added to the existing literature by confirming the multidimensional factor structure of the CET among adolescents. The use of a multidimensional measure of compulsive exercise is important, as each element has been seen to be differentially related to various eating disorder cognitions and behaviours (Taranis & Meyer, 2010). The validation of the CET for use in adolescents is crucial to eating disorder prevention work, as this is the age group of greatest risk for eating disorders (Striegel-Moore & Bulik, 2007). Importantly, exercise has been implicated in the development of the eating disorders (Davis et al., 1997). However, as previously mentioned, it is the exercise cognitions and attitudes, rather just the exercise behaviour that are more closely linked to eating disorder pathology (Siegel & Hetta, 2001). Therefore, in order to assess individuals who are at increased risk of developing an eating disorder through their exercise attitudes, providing evidence that the CET is a viable measure in adolescents, makes it a potential tool to screen for adolescents who could be at risk for developing eating disorders. Certainly, the use of an exercise-related measure to detect eating disorders has been previously advocated (Yates et al., 2001). Finally, the CET can also now be used in outcome studies in adolescents.

A further point requiring explanation was the absence of a link between the compulsive exercise subscale of weight control exercise and disordered eating attitudes demonstrated in Study 1. The traditional eating disorder literature suggests that exercising in the context of the eating disorders is performed excessively in order to control weight and shape (e.g., APA, 1994; Fairburn & Beglin, 1994). However, if this was true, then individuals with greater body dissatisfaction would be more likely to be driven to exercise, in order to alter their weight and shape. However, this was not found in Study 1, suggesting that compulsive exercise is more than simply a weight and shape control strategy for these adolescents. Although this finding needs to be replicated in a clinical sample, this finding could be important for clinicians, as it suggests that compulsive exercise in the eating disorders may be more than a method to control weight and shape. This suggestion is supported by recent research, which found that eating disorder patients excessively exercise predominantly to control negative affect (Bratland-Sanda et al., 2010a). Therefore, given the multidimensional conceptualisation of compulsive exercise, as confirmed in Study 1, it would be vital for professionals working with adolescents to identify which elements of their compulsive exercise are most salient to their behaviour, as well as which elements are potentially linked to underlying disordered eating attitudes.

In summary, the validation of the CET among an adolescent sample will enable future research to determine clear risk factor models, will allow for teachers, clinicians and health professionals to screen for potentially problematic exercise cognitions in adolescents, and also enable researchers to use the CET in outcome studies of adolescent compulsive exercise.

9.4.2 Psychological characteristics and the development of compulsive exercise

9.4.2.1 Compulsive exercise as a function of personality and anorexia nervosa cognitions

Study 2 reported that among boys and girls, a high drive for thinness was the strongest cross-sectional predictor of increased compulsive exercise, followed by self-orientated perfectionism and then obsessive-compulsiveness. In addition, in boys only, socially-prescribed perfectionism was also found to be a significant predictor of compulsive exercise, although its association with compulsive exercise was weaker than the association between compulsive exercise and the other aforementioned significant predictors. These results confirm the existing literature, which has previously demonstrated a link between compulsive exercise and eating disorder psychopathology (e.g., Shroff et al., 2006; Taranis & Meyer, 2010), perfectionism (e.g., Shroff et al., 2006; Taranis & Meyer, 2010) and obsessive-compulsiveness (e.g., Davis et al., 1997). These findings are important, though, as they extend these previous associations to an adolescent sample, as the majority of the prevailing literature has used adult-only samples. This has important practical implications, given that the age of onset for the eating disorders is invariably during adolescence (e.g., Striegel-Moore & Bulik, 2007), and therefore, identifying potential risk factors in this age group can help inform future prevention and early intervention work. Certainly, adults working with adolescents, such as teachers, sports coaches, clinicians, and health professionals, should perhaps target boys and girls who display compulsive exercising attitudes, and screen them for their disordered eating attitudes as well, given the identified link with drive for thinness reported in this thesis.

It is important to note as well that, although drive for thinness was significantly associated with compulsive exercise in both boys and girls, compulsive exercise was associated with neither bulimic attitudes nor body dissatisfaction. This is important as it demonstrates that compulsive exercise could be more closely linked with AN than with BN. This finding was also found in other studies reported in this thesis, when the three EDI subscales were entered as control variables for socio-cultural and emotion regulation associations with compulsive exercise (Studies 3 and 4). This close association between compulsive exercise and a drive for thinness concurs with the existing literature, which has found compulsive exercise to be more prevalent among AN patients than among patients with other eating disorder diagnoses (e.g., Brewerton et al., 1995; Dalle Grave et al., 2008; Shroff et al., 2006). The findings in this thesis of links between compulsive exercise and a drive for thinness in a non-clinical adolescent sample could imply that the compulsive exercise element to AN exists premorbidly, rather than simply as a function of starvation and low weight (e.g., Exner et al., 2000; Hebebrand et al., 2003). Therefore, this could place compulsive exercise as a potential risk factor for the development of AN. Certainly, it has been found that exercise predicts dietary restraint (McLaren et al., 2001) as well as having a role in the development of eating, weight and shape concerns (Davis et al., 1990).

Although there was a cross-sectional association with drive for thinness, demonstrating compulsive exercise's close relationship with eating disorder psychopathology, it could be argued that compulsive exercise is more influenced by personality dimensions of perfectionism and obsessive-compulsiveness. This argument has its basis in the cross-sectional associations between compulsive exercise and these two personality variables (Study 2), as well as in the longitudinal prediction of compulsive exercise by self-perfectionism and obsessive-compulsiveness which was found in boys in this thesis. This link between perfectionism and obsessive-compulsiveness with compulsive exercise concurs with previous research highlighting a link between compulsive exercise and obsessive-compulsive personality disorder cognitions (e.g., Davis & Kaptein, 2006). The association with self-perfectionism is particularly worrying, given that it is self-perfectionism in its more extreme form that has been regarded as the problematic 'clinical perfectionism' (Shafran, Cooper, & Fairburn, 2002). Clinical perfectionism refers to the setting of unrealistically high standards combined with relentless self-criticism, the latter of which has been shown to be the better predictor of psychiatric disorder (Dunkley, Blankstein, Masheb, & Grilo, 2006). Importantly, this clinical perfectionism has been labelled a key maintenance factor for the eating disorders (Fairburn et al., 2003), as well as being related to other psychological morbidity such as depression, anxiety, and suicidality (Flett & Hewitt, 2002). Treatment of perfectionism is often resistant to change, but some research has found that targeting perfectionism directly has resulted in an alleviation of the specific symptoms of comorbid disorders (Bieling et al., 2004). Therefore, given the association of compulsive exercise with self-perfectionism in the current thesis, and the apparent problem of self-perfectionism, then the practical implications from the thesis findings suggest that treatment options and/or early intervention attempts for compulsive exercise should look to tackle the personality cognitions of perfectionism as well as the compulsive exercise attitudes.

In summary, although the findings warrant replication and further examination longitudinally, they do imply that professionals (e.g., teachers, sports coaches, clinicians) working with adolescents need to be cognisant of not just adolescents' potentially detrimental eating attitudes, but also their compulsive exercise attitudes as well, in order to attempt to reduce the adolescent's risk for the development of eating disorder psychopathology, particularly, AN. Further, the treatment of compulsive exercise cognitions may benefit from targeting the individual's setting of unrealistic high standards and their continued self-criticism.

9.4.2.2 Compulsive exercise as an emotion regulator

The results of Study 3 demonstrated that compulsive exercise was associated with emotion regulation. Previous research has suggested that the excessive exercise behaviour seen in the context of the eating disorders may indeed be performed to manage emotions (Penas-Lledo et al., 2002). Study 3 supported this suggestion and extended it by providing a link between emotion regulation and compulsive exercise cognitions and attitudes, and not just with exercise behaviour. This finding with emotion regulation demonstrates that adolescents are exercising compulsively to manage their emotions. However, this use of exercise may not simply be to make the individual feel better. Indeed, it was found in Study 8 that there was no association between emotion regulation and the mood improvement subscale of the CET. However, there were positive associations between the emotion regulation styles and the avoidance and rule-driven behaviour subscale of the CET. This suggests that perhaps an individual who compulsively exercises is performing this driven behaviour to regulate their emotions, specifically to avoid negative emotions that may occur if they do not continue to exercise. This is in line with previous research that has found the CET to be related to an avoidance of affect (Meyer & Taranis, 2007), as well as recent research in eating disorder patients, which found that excessively exercising patients were exercising to reduce negative affect (Bratland-Sanda et al., 2010a).

Therefore, practically, the findings on compulsive exercise and emotion regulation from this thesis would suggest that parents and adults working with adolescents, such as teachers, support workers, and clinicians, should look to address the adolescents' emotion regulation strategies. Importantly, their styles of emotion regulation do not necessarily have to be dysfunctional, as both functional and dysfunctional styles of emotion regulation were found to be related to compulsive exercise in the thesis. Instead, professionals should look to help adolescents' develop alternative strategies to deal with emotions, as well as helping them to address potentially difficult negative emotions, rather than using avoidant strategies such as exercise, which could develop into a compulsion, as reported in Study 8's longitudinal findings.

9.4.3 Socio-cultural factors in the development of compulsive exercise

The first study looking at the relationship between socio-cultural factors with compulsive exercise in this thesis (Study 4) found that for boys and girls the perceived pressures to be thin from media sources were significantly associated with compulsive exercise. The effects of the media on adolescents' weight and shape concerns have been previously noted (e.g., Field et al., 1999). However, the association found in Study 4 was identified after controlling for disordered eating attitudes, as well as BMI. Therefore, this suggests that the media could play a direct role in the compulsive exercising of adolescents, and that this may not simply be via more general disordered eating attitudes. This is important as it could represent a key area to target in the prevention of compulsive exercise.

In addition to media pressure to be thin, in boys there was an association between compulsive exercise and messages to be more muscular (Study 4). Certainly, it has previously been reported that boys display desires to be thinner as well as to be more muscular (McCabe & Ricciardelli, 2004a). Furthermore, endorsing messages to be more muscular have been linked to boys' extreme weight control behaviours (White & Halliwell, 2010). However, White and Halliwell (2010) reported that socio-cultural messages only had an indirect effect on compulsive exercise via body image concerns. Therefore, the findings in Study 4 in this thesis support the existing literature, and extend the knowledge by demonstrating a direct link between socio-cultural messages to be more muscular and compulsive exercise attitudes in boys. These messages were from boys' parents and friends, although it was found that the strongest association came from messages from fathers. This too is in agreement with previous empirical work, which found that messages from fathers around exercise led to increased exercise behaviour to alter body weight and shape of adolescent boys (Ricciardelli et al., 2000). Therefore, the influence of fathers on boys' exercising warrants further investigation, but certainly represents a possible area for prevention of compulsive exercise attitudes, by perhaps targeting the father-son relationship around building muscles, and the appropriate use of exercise to achieve this aim.

This influence of fathers on compulsive exercise was further supported by the results from Study 5 in this thesis. Study 5 found that paternal logistic support for physical activity was significantly associated with compulsive exercise for boys.

This finding may be a product of a social-cultural role taken on by fathers in transporting their sons to sporting endeavours, and therefore, the paternal logistic support could feasibly be a consequence of the boys' compulsive exercise rather than the cause. Nonetheless, the association between fathers and sons around exercise does demonstrate that boys' exercising cognitions are likely to either be a product of paternal influences, or are to be reinforced by paternal influences. Therefore, as mentioned above, fathers' behaviours concerning their sons' exercising needs to be further examined, to establish whether they can be influential in reducing adolescent boys' compulsivity towards exercise when this becomes problematic. Noticeably, this area of possible prevention for compulsive exercise is rather gender-specific. This is because there were few associations between paternal variables and girls' compulsive exercise attitudes in both socio-cultural messages around weight and shape, as well as in terms of logistic support or modelling of exercise behaviour.

Despite the lack of association between fathers and compulsive exercise attitudes in girls, fathers were influential in girls' actual exercise behaviour, as it was found that paternal logistic support significantly predicted girls' total exercise behaviour (Study 5). This supported previous work of physical activity support and exercise behaviour in girls (e.g., Davison, 2004). However, once again, this association with fathers may be more a result of cultural norms, with fathers more likely to take their children to exercise-related extra-curricular activities, regardless of whether it is their son or daughter (e.g., Raudsepp, 2006).

In summary, socio-cultural factors may play a role in the development of compulsive exercise. Specifically, the media appears to be an important area to target for prevention and intervention work, with the aim of reducing the media's focus on the cultural thin ideal. Additionally, boys may be susceptible to receiving messages to be more muscular, particularly from their father, and this could influence their attitudes towards exercise. Finally, fathers appear to be important in the exercise attitudes and behaviours of boys and girls, and therefore could play an important role in the reduction of adolescent compulsive exercising.

9.4.4 Compulsive exercise attitudes, exercise behaviour and sport participation

Within this thesis, the use of the CET as an outcome measure of compulsive exercise means a focus on the cognitions and attitudes around compulsive exercise, rather than on the actual exercise behaviours. Therefore, the purpose of Study 6 was to examine the link between these compulsive exercise cognitions and attitudes, as measured by the CET, and the behavioural concomitants, namely sport and exercise behaviour. Study 6 found that among boys, compulsive exercise was associated with greater strenuous exercise only. This could have beneficial implications for teachers and coaches working with adolescent boys, as it could be easier to identify boys that may be at risk of developing compulsive exercise attitudes, as they will be engaging in more obvious exercise behaviour.

However, the picture was less clear for girls. Compulsive exercise attitudes were positively associated to some degree with all three exercise intensities of strenuous, moderate and mild exercise behaviour. Therefore, this could make it harder to identify girls at risk of having compulsive exercise attitudes, as their compulsive exercise behaviours could be performed by low intensity behaviour, such as walking. This is confirmed by the reports of predominantly female eating disorder patients surreptitiously trying to satisfy their drive to exercise by using such mild physical activity behaviour as getting off public transport several stops before their required destination, or carrying items up a set of stairs one at a time, when a single trip would have sufficed (Beumont et al., 1994). Therefore, these findings would suggest that among girls, screening methods for compulsive exercise other than simply observation of exercise behaviour would be warranted, such as the use of the CET, which would tap exercise cognitions that have been linked with eating disorder psychopathology (Taranis & Meyer, 2010).

An interesting finding of Study 6 was that among both boys and girls, there was only a weak association between weight control exercise attitudes and actual exercise behaviour. This lack of a meaningful association may have been due to the fact that perhaps in this age group there are other reasons why boys and girls are engaging in physical activity, such as through play and enjoyment, rather than for weight and shape reasons. However, more importantly, it reinforces the notion that the traditional view of excessive exercise behaviour in the eating disorders, i.e. for weight control reasons (e.g., APA, 1994), may be incomplete. Indeed, the finding in Study 6 of the thesis implies that compulsive exercise attitudes around weight control may be particularly strong in an individual, but that this may not necessarily translate into greater exercise behaviour. Therefore, previous research that has only used behavioural markers of compulsive exercise (e.g., Penas-Lledo et al., 2004) may not correctly identify all compulsively exercising individuals in their samples. Further, individuals working with adolescents, such as physical education teachers and sports coaches must be cognisant that compulsive exercise behaviour could be performed strenuously and excessively but may not be performed for weight and shape reasons. Therefore, adults working with adolescents require a greater understanding of the motivation of exercise behaviour among adolescents and the reasons behind their compulsive drive to exercise, than simply assuming that it is being performed to burn off extra calories.

Another behavioural association found with compulsive exercise in this thesis was that of competitive sport participation. Study 6 reported that those who engaged in competitive sport had significantly greater compulsive exercise attitudes than those adolescents who did not engage in competitive sport. This finding was the same for both boys and girls. This is important practically, as it could be that adolescents who engage in sport represent a group at increased risk of developing compulsive exercise. Certainly, the existing literature has suggested that athletes are exposed to additional sport-specific risks for the development of general eating disorder pathology (Sundgot-Borgen & Torstveit, 2004), beyond those risks experienced by the general population. Therefore, it would appear that teachers, and in particular sports coaches, should be aware of the exercise-related attitudes of their adolescent male and female athletes and not just their eating attitudes, as these adolescents could be particularly susceptible to the development of compulsive exercise cognitions, which could have adverse health consequences.

However, the association with sport participation was only studied using a cross-sectional design. Therefore, it could equally be feasible that boys and girls who already have compulsive exercise attitudes are attempting to maximise (or hide) their exercising through participation in the socially-acceptable behaviour of sport participation. Nonetheless, for adults working with adolescent sport participants, regardless of whether the sport played a role in developing compulsive exercise or whether the sport participation was an outcome of the compulsive exercise, the end result would mean that adolescents engaged in sport are more likely to have compulsive exercise attitudes than those adolescents who are not involved in sports. Therefore, such places as after-school sports clubs, or extra-curricular community sporting clubs could represent key venues to target in the early identification of compulsive exercise attitudes of adolescents.

9.5 Strengths and Limitations of the Present Thesis

This thesis represented the first work of compulsive exercise, as measured by the CET, in an adolescent sample. A key strength of the thesis was the size of the samples used in the research. Indeed, approximately 2000 adolescents were involved at some stage of the research for this thesis, recruited from a variety of schools within the United Kingdom. This represents a powerful sample that has contributed to the understanding of compulsive exercise in this age group and is an undoubted strength of the thesis as it allows for the findings to be generalised further than if a smaller number of participants had been recruited.

Further to the size of the sample was the fact that both girls and boys were studied. This is important as, although the eating disorders are more prevalent in girls (Reijonen et al., 2003), the number of cases of eating disorders in boys and men is rising (Braun, Sunday, Huang, & Halmi, 1999). Furthermore, the use of certain eating disorder behaviours has been demonstrated to be similar in prevalence in both male and female participants (Anderson & Bulik, 2004). Therefore, it was deemed important to study both boys as well as girls to establish risk factors for compulsive exercise. This certainly demonstrates a strength of the thesis research, as the majority of the existing compulsive exercise literature specifically comprises female-only samples.

An additional strength of this thesis is the methodological design used in several of the studies. Specifically, the use of longitudinal research to identify risk factors was an advantage over the majority of existing risk factor studies in the eating disorders literature, which have only reported cross-sectional findings (Jacobi et al., 2004). Importantly, this longitudinal design was prospective in nature, which is recommended (e.g., Kazdin et al., 1997) over retrospective designs, which are subject to memory inaccuracy issues (Striegel-Moore & Bulik, 2007). Finally, examining the specificity of the risk factors for compulsive exercise was also a clear strength of the thesis, as many risk factor studies have not assessed whether or not their hypothesised risk factors are simply generic risk factors for multiple outcomes (Jacobi et al., 2004). Assessing the specificity of risk for compulsive exercise will help to design targeted prevention and early intervention programmes that are specific to compulsive exercise.

Despite the numerous strengths of the thesis, there were also some limitations which should be acknowledged. For example, the findings of this thesis were predominantly focused on independent predictors. However, eating disorders, and their array of disordered behaviours such as compulsive exercise, are invariably shown to have multi-factorial aetiological models (see Polivy & Herman, 2002). Therefore, although this thesis has provided specific risk factors for compulsive exercise attitudes and behaviour, it is unknown whether these risk factors interact with each other in specific ways to strengthen (or perhaps weaken) their role in the development of compulsive exercise. Therefore, multivariate aetiological models need to be examined, identifying mediating, moderating and protective factors (Lacey & Price, 2004). The multitude of mediating and moderating effects that will likely occur between the suggested risk factors were not assessed in the current research due to the already broad scope and because of the requirement to first establish possible risk factors for compulsive exercise, which had not been previously studied. Despite the possible interaction between the identified risk factors, as well as potential interaction with further unidentified risk factors, the thesis still represents a strong first step in the understanding of the risk factors for compulsive exercise in adolescents.

A second limitation of the thesis was that the data were collected solely from self-report measures. Participants may have misreported their own perceptions, leading to under or over-reporting of actual behaviours (Sallis & Saelens, 2000). For example, it has been found that self-report measures of eating disorder psychopathology yield greater levels of eating disorder psychopathology than when interviews are used (Keel, Crow, Davies, & Mitchell, 2002). However, others have argued that the anonymity of self-report data may actually result in more accurate data than through the use of interviews (Lavender & Anderson, 2009). Nonetheless, self-report data is certainly subject to inherent limitations, such as misunderstanding of wording, as well as the use of ill-defined or complex questions (Fairburn & Beglin, 1994), and therefore, the fact that alternative methods were not used to verify the findings in this thesis does suggest a limitation to the methodological design. However, the size of the sample used throughout the thesis precluded the use of more objective and researcher-intensive methods, such as interviews. Further, only self-report measures that had previously been used in adolescent samples and/or validated for use in this age group were chosen in the studies in this thesis. Therefore, it was deemed appropriate to identify risk factors in this first instance using self-report data, but with the suggestion that future research should use other forms of data collection, e.g. experimental designs that use objective behaviour (see 9.6.1).

The current research focused on the psychological, socio-cultural and behavioural risk factors for compulsive exercise, defining the research from an eating disorder framework. However, over the past decade, there has been an increase in the number of studies examining the genetic and biological risk factors for the development of the eating disorders (Striegel-Moore & Bulik, 2007). This research has implicated certain genetic and biological risk factors in the aetiology of eating disordered attitudes as well as behaviours (see Bulik et al., 2000). Therefore, a limitation of this thesis is that it was not able to consider the potential genetic and biological risk factors that could be equally (if not more) influential in the development of compulsive exercise. Additionally, the current thesis looked at specific psychological, socio-cultural and behavioural risk factors in isolation, and so potentially missed out the importance of these risk factors in their interaction with the aforementioned genetic and biological factors. However, genetic research requires complex methodology and a different skill set to that which was within the scope of this thesis. Therefore, given that no systematic research into the risk factors of compulsive exercise has been previously conducted, then it was deemed sufficient to focus on psychological, socio-cultural and behavioural factors as a positive starting point in the risk factor research for compulsive exercise.

9.6 Future Directions for Risk Factor Research into Compulsive Exercise

9.6.1 Replication of the longitudinal design and use of experimental studies of compulsive exercise

The risk factor research process reported on in this thesis adheres to the suggestion that cross-sectional designs followed by longitudinal designs represent the first stages of identifying risk factors (Kazdin et al., 1997; Kraemer et al., 1997). Importantly, for a risk factor to be established, a longitudinal design must be used in order to establish temporal precedence between the risk factor and the outcome of interest (Kazdin et al., 1997). The status of a hypothesised risk factor can vary with the advancement of additional studies (e.g., move from being a correlate to a risk factor). However, it requires more than a single longitudinal study for a correlate to be considered a strong risk factor for a particular outcome of interest (Jacobi et al., 2004). Therefore, the significant results found in the current thesis must be replicated in future longitudinal research. These replications, aside from being good scientific practice would, for instance strengthen the risk factor status of self-perfectionism and obsessive-compulsiveness among boys.

The final step in the risk factor process of Kazdin et al. (1997) and Kraemer et al. (1997) is that of experimental designs, where the risk factor in question can be manipulated and the resulting effect on the outcome of interest can be assessed (Kazdin et al., 1997). The use of this experimental design would enable true causal risk factors to be established. This would represent the pinnacle of the risk factor identification process for compulsive exercise by establishing the causes of it. This would inform prevention and early intervention work and hopefully help reduce the symptoms of compulsive exercise in the population. However, it is accepted that ultimately the causes of eating disorders, and symptoms thereof (such as compulsive exercise), are inherently multi-factorial (Striegel-Moore & Cachelin, 2001). In other words, several factors are likely to combine together to create an additive effect on the outcome, and/or risk factors can interact with each other (e.g., genes and the environment; Striegel-Moore & Bulik, 2007). Therefore, the identification of individual causal risk factors for compulsive exercise in experimental conditions would be almost impossible.

Nonetheless, the use of experimental studies to examine potential causal risk factors for compulsive exercise would represent an advancement of the knowledge into the causes of compulsive exercise.

Finally, the use of experimental designs would lend itself to the collection of data beyond self-report measures. Indeed, future research should also look to examine the risk factors for compulsive exercise using objective measures of the study variables, as well as perhaps using interview-based assessment. The use of different methods for collecting data would generate greater reliability of the hypothesised risk factor links with compulsive exercise.

9.6.2 Investigate the links between the development of compulsive exercise and the corresponding development of the eating disorders

The findings from this thesis have identified several potential risk factors in the development of compulsive exercise. However, although disordered eating attitudes were included in the studies, the relationship between eating disorder pathology and compulsive exercise in adolescents warrants further investigation. Specifically, it is still unclear whether compulsive exercise plays a causal role in the development of the eating disorders (e.g., Davis et al., 1997), or whether the eating disorders play a causal role in the development of compulsive exercise (e.g., Exner et al., 2000). Thirdly, it is unknown whether there is a third underlying variable that is causal in the development of both compulsive exercise and eating disorder psychopathology as a whole (e.g., Eisler & Le Grange, 1990). The answer to these questions requires a plethora of additional studies, and was beyond the scope of this thesis. Nonetheless, it is an important avenue for future research in order to help prevent the development of both problematic exercise and eating behaviours in adolescents, which could ultimately be detrimental to their psychological and physical health.

9.7 Practical Implications of the Present Thesis

The practical implications of the thesis findings were incorporated into the discussion in section 9.4. However, to summarise, the thesis findings do provide several key practical implications:

- The CET can be used to screen for compulsive exercise attitudes in the age group of greatest risk in the development of eating disorders; and therefore the CET can be used to detect adolescents at risk of developing clinical eating disorder pathology;
- The CET can be used in adolescent outcome studies measuring compulsive exercise;
- Prevention and early-intervention work into compulsive exercise can use the findings to target specific psychological and socio-cultural factors that place an adolescent at increased risk of developing compulsive exercise;
- Specificity of risk factors means that compulsive exercise should not be subjected to generic eating disorder prevention programmes, but instead have tailored programmes focused on the identified risk factors found in this thesis;
- After-school sports clubs, as well as extra-curricular activity clubs may represent fruitful places to screen for compulsive exercise attitudes, to maximise the likelihood of identifying an adolescent at increased risk of developing compulsive exercise;

9.8 Conclusions

This thesis represented the first investigation of risk factors for compulsive exercise in adolescent boys and girls. The studies benefitted from the use of longitudinal designs, as well as the recruitment of relatively large numbers of participants. The results from the empirical studies reported on in this thesis found several correlates and risk factors for compulsive exercise. In boys, a drive for thinness, perfectionism, obsessive-compulsiveness, emotion regulation, messages to be more muscular, media pressure to be thin, paternal logistic support, peer activity support, strenuous exercise behaviour and sport participation were positively associated with compulsive exercise attitudes. However, in the longitudinal studies, it is suggested that only self-orientated perfectionism and obsessive-compulsiveness should be regarded as risk factors for compulsive exercise in boys. For girls, a drive for thinness, self-perfectionism, obsessive-compulsiveness, emotion regulation, media pressure to be thin, peer activity support, exercise behaviour, and sport participation were all positively linked to compulsive exercise attitudes. However, as was found in boys, fewer predictors of compulsive exercise were found longitudinally. Indeed, only internal dysfunctional emotion regulation and a media pressure to be thin should be regarded as potential risk factors for compulsive exercise in girls. These findings provide invaluable information to professionals working with adolescents. Further work to replicate these thesis findings in different samples and using different methodological designs are now required to support these suggested risk factors for compulsive exercise.

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List of Appendices

Appendix A

Institutional ethical review board approval

Ref No: R08-P45

LOUGHBOROUGH UNIVERSITY
ETHICAL ADVISORY SUB-COMMITTEE

RESEARCH PROPOSAL
INVOLVING HUMAN PARTICIPANTS

Title: Predictors of exercise attitudes

Applicant: Dr C Meyer, H Goodwin, Dr E Haycraft

Department: Human Science

Date of clearance: 18 April 2008

Comments of the Sub-Committee:

The Sub-Committee agreed to issue clearance to proceed subject to the following conditions:

- That the investigators provided confirmation that completing the questionnaires, and the types of issues raised, would not have a long term effect on the participants.
- That confirmation was provided on whether the language of the questionnaires was suitable for the age and literacy levels of the participants and whether they would be combined and formatted as one coherent document.
- That the telephone numbers for the investigators were included on all information sheets
- That a protocol was in place should any of the questionnaires indicate that a participant had a serious eating disorder.
- That all investigators were appropriately trained so that they were able to assist participants who needed clarification of the questions without biasing their responses.

Appendix B

Compulsive Exercise Test

Instructions: Listed below are a series of statements regarding exercise. Please read each statement carefully and circle the number that best indicates how true each statement is of you. Please answer all the questions as honestly as you can.

Never true	Rarely true	Sometimes true	Often true	Usually true	Always true
0	**1**	**2**	**3**	**4**	**5**

1)	I feel happier and/or more positive after I exercise.	0	1	2	3	4	5
2)	I exercise to improve my appearance.	0	1	2	3	4	5
3)	I like my days to be organised and structured of which exercise is just one part.	0	1	2	3	4	5
4)	I feel less anxious after I exercise.	0	1	2	3	4	5
5)	I find exercise a chore.	0	1	2	3	4	5
6)	If I feel I have eaten too much, I will do more exercise.	0	1	2	3	4	5
7)	My weekly pattern of exercise is repetitive.	0	1	2	3	4	5
8)	I do not exercise to be slim.	0	1	2	3	4	5
9)	If I cannot exercise I feel low or depressed.	0	1	2	3	4	5
10)	I feel extremely guilty if I miss an exercise session.	0	1	2	3	4	5
11)	I usually continue to exercise despite injury or illness, unless I am very ill or too injured.	0	1	2	3	4	5
12)	I enjoy exercising.	0	1	2	3	4	5
13)	I exercise to burn calories and lose weight.	0	1	2	3	4	5
14)	I feel less stressed and/or tense after I exercise.	0	1	2	3	4	5
15)	If I miss an exercise session, I will try and make up for it when I next exercise.	0	1	2	3	4	5
16)	If I cannot exercise I feel agitated and/or irritable.	0	1	2	3	4	5
17)	Exercise improves my mood.	0	1	2	3	4	5
18)	If I cannot exercise, I worry that I will gain weight.	0	1	2	3	4	5
19)	I follow a set routine for my exercise sessions e.g. walk or run the same route, particular exercises, same amount of time, and so on.	0	1	2	3	4	5
20)	If I cannot exercise I feel angry and/or frustrated.	0	1	2	3	4	5
21)	I do not enjoy exercising.	0	1	2	3	4	5
22)	I feel like I’ve let myself down if I miss an exercise session.	0	1	2	3	4	5
23)	If I cannot exercise I feel anxious.	0	1	2	3	4	5
24)	I feel less depressed or low after I exercise.	0	1	2	3	4	5

Appendix C

Commitment to Exercise Scale

Appendix D

Godin Leisure Time Exercise Questionnaire

Appendix E

Eating Disorder Inventory (Drive for Thinness, Bulimia, Body Dissatisfaction)

Appendix F

Spence Child Anxiety Scale – Obsessive-Compulsiveness Subscale

Appendix G

Child and Adolescent Perfectionism Scale

Appendix H

Hospital Anxiety and Depression Scale

Appendix I

Social Physique Anxiety Scale

Appendix J

Regulation of Emotions Questionnaire

Appendix K

Perceived Socio-Cultural Pressure Scale

Appendix L

Modified Perceived Sociocultural Influences on Body Image and Body Change Questionnaire

Appendix M

Eating Disorder Examination Questionnaire