
Exercise Addiction and Compulsive Exercising: Relationship to Eating Disorders, Substance Use Disorders, and Addictive Disorders

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Abstract

The recent addition of a behavioral addictions category in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) has provided a framework to examine when behaviors progress from normal to pathologically excessive. Several behaviors that are either typically harmless (e.g., gambling, shopping) or even healthy (e.g., alcohol consumption, sex) when performed in moderation have been identified as having addictive potential. Exercise is one such behavior that may be viewed as an addiction. However, the literature is confused by several terms such as compulsion, addiction, and dependence that all may refer to similar, if not the same, pathological patterns of problematic exercise. This chapter will first review the various terms that are widely used and provide a clear distinction among exercise addiction, dependence, and compulsion. Next, we will review assessment measures that are commonly used in research and in clinical practice to screen for problematic exercise patterns. Finally, we will discuss the emerging literature that examines the co-occurrence of problematic exercise and eating pathology, substance use disorders, and other behavioral addictions.

Keywords

Behavioral addiction • Eating disorders • Exercise addiction • Exercise compulsion • Exercise dependence • Substance use disorders

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Behavioral addictions have recently become a topic of increasing interest in light of the addition of gambling disorder as the sole condition in a new category on behavioral addictions in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychological Association [APA], 2013). While the DSM-5 identifies only gambling as a behavioral addiction, other behaviors such as sex, shopping, and Internet gaming may have addictive potential. Exercise is another behavior that has been described as an addiction (Freimuth, Moniz, & Kim, 2011), compulsion (Meyer & Taranis, 2011), and dependency (Hausenblas & Symons Downs, 2002). The varied terms used to describe excessive exercise collectively indicate the pathological potential of physical activity. Although a great deal of recent research on pathological patterns of exercise exists, our understanding of problematic exercise is limited by the use of several terms that may be describing one singular phenomenon (Cook et al., 2013; Freimuth, 2009; Mónok et al., 2012).

Because exercise can serve as an effective method of weight control, and it is a common feature of eating disorders (ED) (Shroff et al., 2006), much of the excessive exercise literature has been conducted within the context of ED. The association among exercise and ED is so strong that some argue that problematic exercise does not exist independent of an ED (Mond, Hay, Rodgers, Owen, & Beumont, 2004). Nevertheless, problematic exercise has been observed clinically in the absence of ED (de Coverley Veale, 1987; Veale, 1995) and diagnostic guidelines for problematic exercise exclusive of ED have been proposed (Bamber, Cockerill, & Carroll, 2000, 2003). To come to such a conclusion requires clear operational definitions that describe and define pathological exercise and guide assessments. Therefore, this chapter will first review the large body of research examining all major nomenclatures of problematic exercise. Second, we will examine current tools available to quantify problematic exercise. We will conclude the chapter with a brief review of problematic exercise in conjunction with ED, substance use disorders (SUD), and other addictions. (For further information on the use of exercise in treatment, see Chap. 28.)

7.1 Distinguishing Exercise Addiction and Compulsion

Definitions for addiction and compulsion share much in common. Specifically, both addictions and compulsions are associated with adverse consequences across many domains (e.g., interpersonal, work), describe urge-driven repetitive behaviors that are difficult to control, and may also serve to manage affect. Thus, considerable overlap in features associated with exercise addiction and compulsion has contributed, in part, to the inconsistent use of terms describing pathological exercise. However, there is evidence that the scope of affect regulation, the developmental sequence, and presence of tolerance and withdrawal symptoms has the potential to distinguish exercise addiction from compulsion.

7.2 Addiction

The American Society of Addiction Medicine (ASAM, 2011; Smith, 2012) has recently updated their definition of addiction to reflect a more accurate description of both substance use *and* behaviors (Karim & Chaudhri, 2012) that have been conceptualized as addictions. Addiction is characterized by an inability to consistently Abstain, impaired Behavioral control, Craving or increased hunger for drugs or rewarding experiences (i.e., behavioral addictions), Diminished recognition of significant problems with one's behaviors and interpersonal relationships, and a dysfunctional Emotional response. Moreover, addictions have a genetic basis that leads to a primary, chronic disease of brain reward, motivation, memory, and related circuitry that manifests as a bio-psycho-social-spiritual dysfunction (ASAM, 2011). Simply stated, individuals with an addiction have a genetic predisposition that results in either substance use or behaviors producing hypersecretion of dopamine in the mesolimbic reward pathway (Smith, 2012). Consequently, repeated engagement in a behavior (e.g., drug use, exercise) becomes compulsive and without regard for the bio-psycho-social-spiritual consequences.

Exercise addiction research has begun to examine most aspects included in the ASAM definition of addiction. Much of this work has focused on examining addictive behaviors ability to manage affect. For example, exercise either reduces or alleviates a variety of negative affective states such as anger, depression, stress, and boredom (USDHHS, 2008). Where compulsive behavior is primarily a means to either escape or reduce a specific negative affect, anxiety, a distinctive feature of addiction is a dual potential to reduce negative affect while also creating positive feelings (Goodman, 2008). Therefore, addictive behaviors are intrinsically motivated through a substance or behavior's ability to increase positive affect and/or good feelings sometimes described as a high or buzz (e.g., runner's high, β -endorphin release; see Hamer & Karageorghis, 2007, for a review). A recent ecological momentary assessment study examined the relationship between daily activities and mood (i.e., valence, energetic arousal, and calmness) over a 10-week period and found that participants felt more content (valence), awake (energetic arousal), and calm (calmness) after being physically active compared to when they were inactive (Kanning & Schlicht, 2010). This study also found that the positive mood-exercise relationship was affected by the individual's baseline mood level, with the greatest effect seen when mood was depressed. This dual capacity of a behavior to escape negative affect while bringing relief, pleasure, or a high characterizes a potential addiction in its early stage of development. When a person discovers that a behavior provides a significant benefit (e.g., the behavior is a means to cope, improve self-esteem) that is not readily obtainable through other means, the behavior begins to increase in frequency.

With time, the addictive behavior can begin to have a compulsive urge-driven quality (not to be confused with a compulsive disorder). That is, as the behavior increases in frequency, the individual continues to engage in the behavior despite it creating havoc in the person's life. For example, the addicted runner may put this activity above work and family. Ceasing or cutting back on this routinized

repetitive behavior is not an option because to do so is associated with cravings and dysphoria. The addictive behavior is then “compulsive” in the sense that it is difficult to control, and the primary motivation is escape from distress (Freimuth et al., 2011). At this point, the addicted exerciser may miss out on family events or work deadlines because taking a break from the gym means experiencing the discomfort of withdrawal.

Tolerance and withdrawal are also often included in definitions that are unique to addiction. The presence of each may offer another way to distinguish addiction from compulsion. Specifically, tolerance refers to the need to do more of a behavior to get the desired effect. A person who once needed four beers to get “high” now consumes six beers or what began as a 1 h workout three times a week has extended into daily workouts of no less than 2 h to achieve the desired sense of accomplishment. Ceasing any addictive behavior is also associated with withdrawal syndrome. In the case of exercise, withdrawal is associated with a sense of being uneasy, irritability, sluggishness, sleep disturbances, decreased sexual drive, and increased negative affect (Aidman & Woollard, 2003; Berczik et al., 2012).

Finally, exercise addiction has also been presented as a form of dependence. In general, dependence occurs in response to taking a substance that affects the central nervous system and represents a normal physiological adaptation to repeating a dose of a substance. Functionally, dependence and addiction refer to the same pattern of behavior. Moreover, some types of substance use (e.g., prescription drug use, nonproblematic alcohol use) may show tolerance and/or mild withdrawal symptoms but would not reflect the compulsion nor the severity of a disorder necessary to satisfy a diagnosis of addiction. Therefore, the use of dependence as the preferred nomenclature over addiction as a diagnostic term originated in the DSM-III-R with the intention of avoiding a potentially stigmatizing and pejorative term such as addiction and to better describe a wide range of problematic substance use (O’Brien, Volkow, & Li, 2006). Because patterns of exercise display many similarities with SUD (i.e., tolerance, withdrawal symptoms, ability to be performed by most individuals without progressing to addiction), a compelling argument has been made that exercise dependence is the preferred term. The basis for this nomenclature, in large part, was to more closely reflect the diagnostic criteria in the DSM-IV (Hausenblas & Symons Downs, 2002). The DSM-5 criteria are similar, although the term “dependence” has been dropped in favor of “use disorders,” and “craving” has been added to the list of potential symptoms of SUD (American Psychiatric Association, 2013).

7.3 Compulsion

Compulsive has also been used as a descriptive term to indicate problematic exercise. Compulsivity is defined as an urge to perform a behavior to relieve anxiety arising from the perception of a negative consequence if the behavior is not performed (American Psychiatric Association, 2000; Meyer, Taranis, Goodwin, & Haycraft, 2011). Examples of compulsive disorders include ritualized and

stereotyped behaviors such as frequent checking or hand washing (de Coverley Veale, 1987). For example, an individual with obsessive–compulsive disorder who, after leaving home, worries that the stove was left on will be consumed by thoughts that there will be an explosion until he returns home to check. Thus, compulsions are a response to an urge to take action with the intent of escaping unpleasant affect, usually anxiety. This anxiety arises from imagined negative consequences (i.e., obsessions) if the action is not taken. As we have previously described, patterns of exercise in an addicted individual may begin to exhibit compulsive tendencies. However, one key distinction of compulsion from addiction is that compulsions do not show tolerance. That is, a given behavior, be it hand washing or checking, alleviates anxiety until the next time the urge arises, but the individual does not need to wash more or check more often to quell a given urge.

Compulsive behavior is also associated with obsessive thinking. For example, the compulsive exerciser is consumed with thoughts of adverse events if exercise does not occur. While both the addicted and compulsive exercisers obsess about the adverse effects of forgoing the behavior, the addicted person's obsessions are focused more on realistic negative consequences of doing the behavior, while those of the compulsive are based on unrealistic consequences arising from not doing the behavior (Yates, 1991).

Review of both the exercise addiction and compulsion literatures reveals major overlap among each nomenclature as the preferred term to describe problematic exercise patterns. This may be simplistically summarized as a pattern of exercise that is deeply engrained in the individual's daily rituals, increased time spent in exercise behavior and/or exercise-related activities (e.g., planning for future episodes, recovering from previous episodes, shopping for equipment), and continuing to exercise despite serious consequences such as injury and/or weight-related health detriments (e.g., ED). Moreover, this pattern of exercise is performed with a zeal that is beyond the scope of a "normal" exerciser and is resistant to change. Notable differences in these literatures are that the addiction literature provides a more dynamic and inclusive framework for defining exercise as a behavioral addiction and has presented various theories on the etiology and biopsychosocial implications of exercise as an addiction. Alternatively, descriptions of exercise as a compulsion offer better evidence of exercise's role in affect regulation and in ED. A further key distinction among addiction and compulsion terminology is that compulsive behaviors do not show the same tolerance or withdrawal symptoms that are hallmarks of addiction.

Case studies (de Coverley Veale, 1987) and correlational research (Cook et al., 2013) support the importance of distinguishing forms of problematic exercise. Primary exercise addiction is defined as continually exercising solely for the psychological gratification resulting from the exercise behavior (de Coverley Veale, 1987). Secondary exercise addiction occurs when an individual uses exercise to accomplish some other end in conjunction with other pathologies, specifically ED (Hausenblas & Symons Downs, 2002). While compulsion may exist in primary exercise addiction (Freimuth et al., 2011), there is clear evidence that compulsion is the key factor of secondary addiction that may distinguish beneficial

from detrimental exercise in ED (Cook & Hausenblas, 2011; Cook, Hausenblas, Tuccitto, & Giacobbi, 2011; Hausenblas, Cook, & Chittester, 2008; Meyer & Taranis, 2011). Thus, addiction terminology represents all forms of problematic exercise, while compulsive terminology is a preferable term for secondary exercise addiction (Meyer & Taranis, 2011). Simply stated, all problematic patterns of exercise may be described as an addiction. However, addictions include compulsive urge-driven qualities, and compulsions are the key facet that may explain the relationship among exercise and ED. Therefore, compulsive exercise is the preferred terminology for what has been referred to as secondary exercise addiction.

Given the current state of the literature where exercise addiction and compulsion are often not distinguished and to avoid further confusion, we will use the term *problematic exercise* throughout the remainder of this chapter unless we are referring to a study that clearly makes the distinction or measurement tool.

7.4 Measuring Exercise Addiction and Compulsion

The various conceptualizations and definitions previously described have generated several measurement tools that quantify the various forms of problematic exercise. Each tool has its own advantages and disadvantages in measuring facets of addiction or compulsion that are pertinent to either general or specific populations (e.g., eating-disordered individuals, body builders, runners). Additionally, it is important to note that most measures contain items that continue to confuse conceptualizations of problematic exercise (e.g., compulsion scales that contain items assessing tolerance or withdrawal). We have focused our review to reflect the tools that are most commonly used, demonstrate superior psychometrics, and present an approach to quantifying problematic exercise that may be broadly applicable to multiple fields of research. Therefore, we have included the *Exercise Addiction Inventory* (EAI) and *Exercise Dependence Scale* (EDS) because they are the two most widely used measures of exercise addiction (Mónok et al., 2012). Similarly, we have included the *Compulsive Exercise Test* (CET) and *Obligatory Exercise Questionnaire* (OEQ) because they are two popular scales of exercise compulsion that have been used extensively in research examining exercise in ED. Examples of specific items for each facet of all measurements are provided in parenthesis.

7.5 Exercise Addiction Inventory

The EAI (Terry, Szabo, & Griffiths, 2004) is a quick and simple screening tool measure that is based on theoretical constructs of behavioral addiction (Griffiths, 1996). The EAI includes one item for each of the following six components of behavioral addiction:

- Salience (“Exercise is the most important thing in my life”)

- Mood modification (“I use exercise as a way of changing my mood (e.g., to get a buzz, to escape, etc.)”)
- Tolerance (“Over time I have increased the amount of exercise I do in a day”)
- Withdrawal (“If I have to miss an exercise session, I feel moody and irritable”)
- Conflict (“Conflicts have arisen between me and my family and or my partner about the amount of exercise I do”)
- Relapse (“If I cut down on the amount of exercise I do, and then start again, I always end up exercising as often as I did before”)

Responses to the items are on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Item scores are summed, and higher total scores reflect problematic exercise. The EAI can also be used categorically. Total scores of 0–12 are indicative of an “asymptomatic individual,” 13–23 are indicative of a “symptomatic individual,” and scores above 24 are indicative of an “at risk of exercise addiction individual.” A cutoff score of 24 reflects the top 15 % of responses (Terry et al., 2004).

7.6 Exercise Dependence Scale

The EDS (Hausenblas & Symons Downs, 2002) is a 21-item measure of exercise dependence symptoms that was developed to reflect the criteria for substance dependence listed in the DSM-IV (American Psychiatric Association, 2000). The EDS includes seven subscales consisting of three items each that assess:

- Tolerance (“I continually increase my exercise frequency to achieve the desired effects/benefits”)
- Withdrawal effects (“I exercise to avoid feeling tense”)
- Continuance (“I exercise despite persistent physical problems”)
- Lack of control (“I am unable to reduce how intense I exercise”)
- Reductions in other activities (“I think about exercise when I should be concentrating on school/work”)
- Time (“I spend a lot of time exercising”)
- Intention (“I exercise longer than I expect”)

Responses to the items are on a 6-point Likert scale ranging from 1 (never) to 6 (always). A lower score reveals less exercise dependence symptoms. Responses can be summed for a total continuous score of exercise dependence symptoms. Additionally, the scale can be used categorically. Individuals endorsing scores of five to six on items for at least three subscales are categorized as “at risk for exercise dependence,” scores of three to four on at least three subscales are categorized as “nondependent symptomatic,” and scores of one to two are categorized as “nondependent asymptomatic.” The psychometric properties of this scale are good (Symons Downs, Hausenblas, & Nigg, 2004). This scale has not yet been updated to reflect the recent addition of cravings in the SUD criteria in DSM-5.

7.7 Compulsive Exercise Test

The CET (Taranis, Touyz, & Meyer, 2011) is a 24-item measure that assesses compulsive features of exercise that are implicated in the maintenance of excessive exercise in ED. The CET includes the following five subscales:

- Avoidance and rule-driven behavior (“I usually continue to exercise despite injury”)
- Weight control exercise (“I exercise to burn calories and lose weight”)
- Mood improvement (“I feel less anxious after I exercise”)
- Lack of exercise enjoyment (“I find exercise a chore”)
- Exercise rigidity (“My weekly pattern of exercise is repetitive”)

Responses to the items are on a 6-point Likert scale ranging from 0 (never true) to 5 (always true). An item on the “weight control exercise” subscale is reverse scored (e.g., “I do not exercise to be slim”) as is an item on the “lack of exercise enjoyment” subscale (e.g., “I enjoy exercising”). All items may then be summed to provide a total score. Items included in each subscale may also be summed. The CET has demonstrated good psychometric properties (Taranis et al., 2011).

7.8 Obligatory Exercise Questionnaire

The OEQ (Thompson & Pasman, 1991) is a 20-item scale that assesses how often individuals experience various emotions, attitudes, and behaviors related to exercise and compulsion to continue exercising. The OEQ has three distinct dimensions (Ackard, Brehm, & Steffen, 2002) that assess:

- Exercise fixation (“When I miss a scheduled exercise session, I may feel tense, irritable, or depressed”)
- Exercise frequency (“I engage in physical exercise on a daily basis”)
- Exercise commitment (“When I miss an exercise session, I feel concerned about my body possibly getting out of shape”)

Responses are indicated on a 4-point Likert scale ranging from “never” to “always.” The psychometric properties of this scale are good (Thompson & Pasman, 1991). The OEQ has been used extensively in research examining the association among exercise compulsion and ED.

7.9 Prevalence of Problematic Exercise

Prevalence estimates for problematic exercise are limited by the following three reasons. First, measures that have been developed to quantify problematic exercise are largely driven by continuous assessments of symptom severity rather than a theoretical approach (Terry et al., 2004). Second, most problematic exercise research has reported symptom severity scores rather than prevalence rates of a fully developed condition (Sussman, Lisha, & Griffiths, 2011). Third, because problematic exercise prevalence is higher in eating-disordered individuals (Shroff

Table 7.1 Prevalence of exercise pathology

Scale type	Authors	Year	Exercise measure	Prevalence (%)	Sample	<i>N</i>
Addiction	Griffiths et al.	2005	Exercise Addiction Inventory	3.0	College students	279
Addiction	Mónok et al.	2012	Exercise Addiction Inventory	3.2	Hungarian nationwide—regular exercisers	474
Addiction	Mónok et al.	2012	Exercise Addiction Inventory	0.5	Hungarian nationwide—point prevalence	2,710
Addiction	Szabo and Griffiths	2007	Exercise Addiction Inventory	6.9	College students	355
Addiction	Villella et al.	2011	Exercise Addiction Inventory	8.5	Italian high school students	2,853
Addiction	Modolo et al.	2011	Negative Addictions Scale	33.2	Amateur athletes	300
Compulsion	Garman et al.	2004	Commitment to Exercise Scale	21.8	College students	268
Compulsion	Mond et al.	2006	Commitment to Exercise Scale	16.5	Australian sample of female exercisers	3,472
Compulsion	Mond et al.	2008	Commitment to Exercise Scale	22.6	Adult women primary care patients	257
Compulsion	Guidi et al.	2009	Consumptive Habits Questionnaire	18.1	College students	589
Compulsion	Dalle Grave et al.	2008	Eating Disorder Examination	45.5	Eating disorder patients	165
Compulsion	Ackard et al.	2002	Obligatory Exercise Questionnaire	8.9	College students—female only	586
Compulsion	Slay et al.	1998	Obligatory Exercise Questionnaire	25.9	Runners in a 4-mile recreational road race	324
Compulsion	Schroff et al.	2006	Structured Interview for Anorexic and Bulimic Disorders	38.8	Eating disorder patients	1,857
Dependence	Lejoyeux et al.	2008	Author-developed questionnaire	42.0	French gym users	300
Dependence	Lejoyeux et al.	2012	Author-developed questionnaire	30.0	French gym users	500

(continued)

Table 7.1 (continued)

Scale type	Authors	Year	Exercise measure	Prevalence (%)	Sample	<i>N</i>
Dependence	Bamber et al.	2000	Exercise Dependence Questionnaire	22.8	College students, fitness classes, runners, and eating disorder patients	291
Dependence	Blaydon and Lindner	2002	Exercise Dependence Questionnaire	52.0	Triathletes	171
Dependence	Grandi et al.	2011	Exercise Dependence Questionnaire	36.4	Fitness club users and regular exercisers	79
Dependence	Weik and Hale	2009	Exercise Dependence Questionnaire	24.9	Adult exercisers	204
Dependence	Zmijewski and Howard	2003	Exercise Dependence Questionnaire	45.9	College students	237
Dependence	Allegre et al.	2007	Exercise Dependence Scale	3.2	Ultramarathoners	95
Dependence	Cook and Hausenblas	2011	Exercise Dependence Scale	1.9	College students—females only	387
Dependence	Cook et al.	2013	Exercise Dependence Scale	1.4	Community sample of runners	2,660
Dependence	Cook et al.	2011	Exercise Dependence Scale	2.7	College students	539
Dependence	Hausenblas and Symons Downs	2002 (Study 1)	Exercise Dependence Scale	3.4	College students	266
		(Study 2)	Exercise Dependence Scale	13.4	College students	553
		(Study 3)	Exercise Dependence Scale	3.1	College students	862
		(Study 4)	Exercise Dependence Scale	9.6	College students	366
		(Study 5)	Exercise Dependence Scale	9.8	College students	419
Dependence	Mónok et al.	2012	Exercise Dependence Scale	1.9	Hungarian nationwide—regular exercisers	474

(continued)

Table 7.1 (continued)

Scale type	Authors	Year	Exercise measure	Prevalence (%)	Sample	<i>N</i>
Dependence	Mónok et al.	2012	Exercise Dependence Scale	0.3	Hungarian nationwide—point prevalence	2,710
Dependence	Symons Downs et al.	2004	Exercise Dependence Scale	5.0	College students	1,263
Dependence	Weik and Hale	2009	Exercise Dependence Scale	11.9	Adult exercisers	204

et al., 2006) and athletes (Allegre, Therme, & Griffiths, 2007; Blaydon & Lindner, 2002; Modolo et al., 2011), prevalence estimates have been biased by sample characteristics (Cook et al., 2013; Mónok et al., 2012). We have summarized the major studies that reported exercise addiction, compulsion, and dependence prevalence in Table 7.1.

7.10 Problematic Exercise and Eating Disorders, Substance Use Disorders, and Other Addictive Disorders

Individuals who display some form of problematic exercise typically exhibit personality characteristics and psychological distress such as perfectionism, inhibition of anger, high self-expectations, tolerance of physical discomfort, denial of severity, depression, and anxiety that are similar to features of anorexia nervosa. These similarities initially suggested that increased exercise amount is associated with ED and may explain the increased prevalence of ED in athletes (Sundgot-Borgen & Klungland Torstveit, 2004).

Animal research has provided some support for the ED and problematic exercise association. That is, the activity-based anorexia model is based on the observation that when rats are restricted from feeding, but have unhindered access to a running wheel, they engage in increased amounts of physical activity (Epling & Pierce, 1996). These rats subsequently voluntarily restrict feeding when food is available and continue to increase physical activity amount that, if not intervened upon, results in death. Similar to humans, athletic-based anorexic rats self-restricted food intake and increased physical activity more rapidly and to a more severe extent than rats of the same litter without athletic-based anorexia (Boakes, Mills, & Single, 1999). Animal research has the advantage of being able to more closely examine possible mechanistic pathways in the brain that may be responsible for this effect. Specifically, the association between hypothalamic–pituitary–adrenal (HPA) axis activity and food restriction increased in physical activity, and this relationship is mediated through body fat levels (Adan et al., 2011; Duclos, Bouchet, Vettier, & Richard, 2005; Hamer & Karageorghis, 2007). However,

research examining athletic-based anorexia is difficult to replicate in humans, and explanations of this effect typically include some recognition of culture (Epling & Pierce, 1996).

Current research on exercise and eating behaviors suggests that within ED populations exercise is more like a compulsion than an addiction (Meyer & Taranis, 2011). That is, an individual with an ED may be consumed by an unrealistic worry that an immediate unpleasant change in appearance will occur if an exercise session is missed and that exercise behavior may serve as a means to escape the unpleasant affect associated with an ED. This aspect of affect regulation has supported the role of exercise as a compensatory behavior as part of an ED (American Psychiatric Association, 2013; Meyer et al., 2011).

Affect regulation is a key aspect of understanding ED and has been implicated as a central construct in the development and maintenance of these disorders (Haynos & Fruzzetti, 2011). With regard to exercise in ED, compulsive exercise in ED patients has been associated with elevated levels of negative affect (Brewerton, Stelfson, Hibbs, Hodges, & Cochrane, 1995; Vansteelandt, Rijmen, Pieters, Probst, & Vanderlinden, 2007), anxiety (Brewerton et al., 1995; Klein, Mayer, Schebendach, & Walsh, 2007), and depression (Peñas-Lledó, Leal, & Waller, 2002). This research points to problematic exercise in ED populations to be more like a compulsion than an addiction (Meyer & Taranis, 2011) and that exercise may be used to cope with these kinds of adverse emotional states (Fairburn, Cooper, & Shafran, 2003). Also like a compulsion, a person with an ED is consumed by the unrealistic worry that an immediate unpleasant change in appearance will occur if an exercise session is missed. As such, exercise behavior may serve as a means to escape unpleasant affect. This aspect of affect regulation has supported the role of exercise as a compensatory behavior as part of an ED (American Psychiatric Association, 2013; Meyer et al., 2011).

In two recent ecological momentary analysis studies, LePage, Price, O'Neil, and Crowther (2012) found that compulsive exercise is related to lower positive affect on nonexercise days than exercise days and negative affect was stronger on exercise days. Furthermore, increased compulsive exercise was associated with more thoughts about eating on nonexercise days in individuals with scores above 13 on the Eating Attitudes Test-26. Thus, the ability for exercise to provide an escape from unpleasant internal cues such as negative affect supports the social-cognitive/cognitive-behavioral view of compulsive exercise as a symptom, but not an antecedent, of an ED (Fairburn et al., 2003).

The association of exercise with ED fails to account for the well-established physiological and psychological benefits of exercise. That is, several narrative reviews and meta-analyses have shown that in the absence of an ED, exercise imparts positive improvements in factors associated with ED such as anxiety, depression, stress reactivity, and self-esteem (USDHHS, 2008). Similarly, the physiological benefits conveyed by exercise may also help to counteract the negative consequences of ED. For example, cardiovascular benefits such as increased cardiac mass, increased stroke volume and cardiac output at rest and during exercise, lower resting heart rate and blood pressure, and a decreased

tendency for blood clotting are pertinent to ED (Pearson, Goldklang, & Streigel-Moore, 2002). Exercise also has the ability to reduce adiposity, thus, contributing to a leaner and fit body type (Thompson, Heinberg, Altabe, & Tantleff-Dunn, 1999). The metabolic benefits of exercise, beyond contributing to decreased adiposity, include decreased triglycerides and increased high-density cholesterol, increased insulin-mediated glucose uptake, and possible increase in resting metabolism (Haskell, 1994). Finally, exercise increases skeletal muscle mass and bone density in youth and is related to the retention of bone mineral density in older adults. This has implications in the development of osteoporosis, a common consequence of prolonged ED behaviors (Klump, Bulik, Kaye, & Treasure, 2009). Thus, examining pathological motivations for exercise (e.g., compulsions) is a key factor in understanding the relationship among exercise amount and ED (Adkins & Keel, 2005).

Hausenblas et al. (2008) presented a model that may reconcile why problematic exercise is associated with ED, while nonproblematic exercise is associated with several factors that may protect against ED. This model posits that exercise may impart mental health benefits (e.g., reduced anxiety and depression) which serve as protective factors in the development of eating pathology. However, when cognitions and motivations for exercise become pathological (i.e., exercise dependence), exercise may exacerbate eating pathology, thus supporting clinical observations and animal model research.

Recent research has begun to support this model. In a series of studies, Cook and colleagues found that regular exercise positively affects psychological well-being, which in turn reduces ED risk. In each study, problematic exercise, defined as exercise dependence, negated this relationship and mediated the exercise and ED relationship (Cook & Hausenblas, 2008, 2011; Cook et al., 2011). Moreover, exercise dependence may exacerbate the detrimental impact of an ED on health-related quality of life (Mond, Myers, Crosby, Hay, & Mitchell, 2008). Further research is needed to prospectively examine these associations that have received initial support and continue to examine physiological effects specified in the original model (Hausenblas et al., 2008).

While most of the research investigating problematic exercise and co-occurring disorders has focused on ED, researchers have recently begun to examine the association with other addictions. Initial studies suggest that other addictions, particularly behavioral addictions, are quite common in individuals with problematic exercise. This may superficially suggest common neurological pathways in addictive disorders (Lynch, Peterson, Sanchez, Abel, & Smith, 2013). Sussman and colleagues' (2011) review of the literature revealed that 15 % of exercise-addicted individuals are also addicted to smoking, alcohol, or illicit drugs and that an additional 25 % of exercise addicts exhibit behavioral addictions such as gambling, Internet, love, sex, work, and/or shopping addictions. Other studies have reported higher prevalence rates of co-occurring disorders. For example, in a study of patrons of a Parisian gym, prevalence of compulsive buying (63 % vs. 38 %), bulimia nervosa (70 % vs. 47 %), and hypochondria (28 % vs. 20 %) was higher in the exercise dependence group than the nonexercise dependence group (Lejoyeux, Avril, Richoux, Embouazza, & Nivoli, 2008). However, these elevated rates may

have been due to poor measurement and overly broad operational definitions. Finally, in a study of individuals described as having a sexual addiction (Carnes, Murray, & Charpentier, 2005), 11.4 % of the men and 13.2 % of the women were identified as also having “addictive athleticism” (presumably problematic exercise).

Further research is needed to examine the etiology and relationships among exercise and other addictions. For example, several recent reviews have concluded that moderate amounts of exercise may be an effective therapy or adjunct to therapy for both ED (Hausenblas et al., 2008; Ng, Ng, & Wong, 2013; Wolff et al., 2011; Zschuckle, Gaudlitz, & Ströhle, 2013; Zunker, Mitchell, & Wonderlich, 2011) and other addictions (Fontes-Ribeiro, Marques, Pereira, Siva, & Macedo, 2011; Lynch et al., 2013). Moreover, exercise is also a widely recommended and accepted behavior that may foster a norm of inclusion to the larger healthy community as opposed to the stigmatization of being labeled with an addiction. Thus, it is not yet clear whether problematic exercise occurs with other forms of addiction or if the individual is compulsively exercising to self-treat the original addiction.

7.11 Summary

For over 40 years researchers have described problematic patterns of exercise (Baekland, 1970). A major goal of our chapter was to provide definitional clarity of exercise dependence, addiction, and compulsion that can be used to guide the next generation of research in this area. Addiction terminology represents all forms of problematic exercise, while compulsive terminology is a preferable term for problematic exercise that is secondary to an ED. Definitional clarity, both in nomenclature and in measurement tools that attempt to quantify aspects of addiction or compulsion, is needed as we move forward examining the antecedents and consequences of excessive exercise.

References

- Ackard, D. M., Brehm, B. J., & Steffen, J. J. (2002). Exercise and eating disorders in college-aged women: Profiling excessive exercisers. *Eating Disorders, 10*, 31–47.
- Adan, R. A., Hillebrand, J. J., Danner, U. N., Cardona Cano, S., Kas, M. J., & Verhagen, L. A. (2011). Neurobiology driving hyperactivity in activity-based anorexia. *Current Topics in Behavioral Neurosciences, 6*, 229–250.
- Adkins, C. E., & Keel, P. K. (2005). Does “excessive” or “compulsive” best describe exercise as a symptom of bulimia nervosa? *International Journal of Eating Disorders, 38*, 24–29.
- Aidman, E. V., & Woollard, S. (2003). The influence of self-reported exercise addiction on acute emotional and physiological responses to brief exercise deprivation. *Psychology of Sport and Exercise, 4*, 225–236.
- Allegre, B., Therme, P., & Griffiths, M. D. (2007). Individual factors and the context of physical activity in exercise dependence: A prospective study of ‘ultra-marathoners’. *International Journal of Mental Health and Addiction, 5*, 233–243.

- American Psychological Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed. Text revision). Washington, DC: Author.
- American Psychological Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.
- American Society of Addiction Medicine (ASAM). (2011, August 26). Public policy statement: Definition of addiction. Retrieved from <http://www.asam.org/research-treatment/definition-of-addiction>
- Baekland, F. (1970). Exercise deprivation: Sleep and psychological reactions. *Archives of General Psychiatry*, 22, 365–369.
- Bamber, D., Cockerill, I. M., & Carroll, D. (2000). The pathological status of exercise dependence. *British Journal of Sports Medicine*, 34, 125–132.
- Bamber, D., Cockerill, I. M., & Carroll, D. (2003). Diagnostic criteria for exercise dependence in women. *British Journal of Sports Medicine*, 37, 393–400.
- Berczik, K., Szabó, A., Griffiths, M. D., Kurimay, T., Kun, B., Urbán, R., & Demetrovics, Z. (2012). Exercise addiction: Symptoms, diagnosis, epidemiology, and etiology. *Substance Use & Misuse*, 47, 403–417.
- Blaydon, M. J., & Lindner, K. J. (2002). Eating disorders and exercise dependence in triathletes. *Eating Disorders*, 10, 49–60.
- Boakes, R. A., Mills, K. J., & Single, J. P. (1999). Sex differences in the relationship between activity and weight loss in the rat. *Behavioral Neuroscience*, 113, 1080–1089.
- Brewerton, T. D., Stelfox, E. J., Hibbs, N., Hodges, E. L., & Cochrane, C. E. (1995). Comparison of eating disorder patients with and without compulsive exercising. *International Journal of Eating Disorders*, 17, 413–416.
- Carnes, P. J., Murray, R. E., & Charpentier, L. (2005). Bargains with chaos: Sex addicts and addiction interaction disorder. *Sexual Addiction & Compulsivity*, 12, 79–120.
- Cook, B., & Hausenblas, H. (2008). The role of exercise dependence for the relationship between exercise behavior and eating pathology: Mediator or moderator? *Journal of Health Psychology*, 13(4), 495–502.
- Cook, B. J., & Hausenblas, H. A. (2011). Eating disorder specific health-related quality of life and exercise in college females. *Quality of Life Research*, 20(9), 1385–1390.
- Cook, B. J., Hausenblas, H. A., Tuccitto, D., & Giacobbi, P. (2011). Eating disorders and exercise: A structural equation modeling analysis of a conceptual model. *European Eating Disorders Review*, 19(3), 216–225.
- Cook, B., Karr, T., Zunker, C, Mitchell, J., Thompson, R., Sherman, R., . . . Wonderlich, S. (2013). Primary and secondary exercise dependence in recreational road race runners. *Journal of Sport and Exercise Psychology*, 35, 464–469.
- Dalle Grave, R., Calugi, S., & Marchesini, G. (2008). Compulsive exercise to control shape or weight in eating disorders: Prevalence, associated features, and treatment outcome. *Comprehensive Psychiatry*, 49, 346–352.
- De Coverley Veale, D. (1987). Exercise dependence. *British Journal of addiction*, 82, 735–740.
- Duclos, M., Bouchet, M., Vettier, A., & Richard, D. (2005). Genetic differences in hypothalamic-pituitary-adrenal axis activity and food restriction-induced hyperactivity in three inbred strains of rats. *Journal of Neuroendocrinology*, 17, 740–752.
- Epling, W. F., & Pierce, W. D. (1996). *Activity anorexia: Theory, research, and treatment*. Mahwah, NJ: Erlbaum.
- Fairburn, C. G., Cooper, Z., & Shafran, R. (2003). Cognitive behavior therapy for eating disorders: A transdiagnostic theory and treatment. *Behavior Research and Treatment*, 41, 509–528.
- Fontes-Ribeiro, C. A., Marques, E., Pereira, F. C., Siva, A. P., & Macedo, T. R. A. (2011). May exercise prevent addiction? *Current Neuropharmacology*, 9, 45–48.
- Freimuth, M. (2009). *Hidden addictions: Assessment practices for psychotherapists, counselors, and health care providers*. New York, NY: Jason Aronson.

- Freimuth, M., Moniz, S., & Kim, S. R. (2011). Clarifying exercise addiction: Differential diagnosis, co-occurring disorders, and phases of addiction. *International Journal of Environmental Research and Public Health*, 8, 4069–4081.
- Garman, J. F., Hayduk, D. M., Crider, D. A., & Hodel, M. M. (2004). Occurrence of exercise dependence in a college-aged population. *Journal of American College Health*, 52, 221–228.
- Goodman, A. (2008). Neurobiology of addiction: An integrative review. *Biochemical Pharmacology*, 75, 266–322.
- Grandi, S., Clementi, C., Guidi, J., Benassi, M., & Tossani, E. (2011). Personality characteristics and psychological distress associated with primary exercise dependence: An exploratory study. *Psychiatric Research*, 189, 270–275.
- Griffiths, M. D. (1996). Behavioural addiction: An issue for everybody? *Journal of Workplace Learning*, 8(3), 19–25.
- Griffiths, M. D., Szabo, A., & Terry, A. (2005). The exercise addiction inventory: A quick and easy screening tool for health practitioners. *British Journal of Sports Medicine*, 39, e30.
- Guidi, J., Pender, M., Hollon, S., Zisook, S., Schwartz, F., Pedrelli, P., . . . Petersen, T. J. (2009). The prevalence of compulsive eating and exercise among college students: An exploratory study. *Psychiatry Research*, 165, 154–162.
- Hamer, M., & Karageorghis, C. I. (2007). Psychobiological mechanisms of exercise dependence. *Sports Medicine*, 37(6), 477–484.
- Haskell, W. L. (1994). Physical/physiological/biological outcomes of physical activity. In H. A. Quinney, L. Gauvin, & A. E. T. Wall (Eds.), *Toward Active Living: Proceedings of the International Conference on Physical activity, Fitness, and Health* (pp. 17–24). Champaign, IL: Human Kinetics.
- Hausenblas, H. A., Cook, B. J., & Chittester, N. I. (2008). Can exercise treat eating disorders? *Exercise and Sport Sciences Reviews*, 36, 43–47.
- Hausenblas, H. A., & Symons Downs, D. (2002). How much is too much? The development and validation of the exercise dependence scale. *Psychology & Health*, 17, 387–404.
- Haynos, A. F., & Fruzzetti, A. E. (2011). Anorexia nervosa as a disorder of emotion dysregulation: Evidence and treatment implications. *Clinical Psychology Science and Practice*, 18, 183–202.
- Kanning, M., & Schlicht, W. (2010). Be active and become happy: An ecological momentary assessment of physical activity and mood. *Journal of Sport & Exercise Psychology*, 32, 253–261.
- Karim, R., & Chaudhri, P. (2012). Behavioral addictions: An overview. *Journal of Psychoactive Drugs*, 44(1), 5–17.
- Klein, D. A., Mayer, L. E., Schebendach, J. E., & Walsh, B. T. (2007). Physical activity and cortisol in anorexia nervosa. *Psychoneuroendocrinology*, 32, 539–547.
- Klump, K. L., Bulik, C. M., Kaye, W. H., & Treasure, J. (2009). Academy for eating disorders position paper: Eating disorders are serious mental illnesses. *International Journal of Eating Disorders*, 42, 97–103.
- Lejoyeux, M., Avril, M., Richoux, C., Embouazza, H., & Nivoli, F. (2008). Prevalence of exercise dependence and other behavioral addictions among clients of a Parisian fitness room. *Comprehensive Psychiatry*, 49, 353–358.
- Lejoyeux, M., Guillot, C., Chalvin, F., Petit, A., & Lequen, V. (2012). Exercise dependence among customers from a Parisian sport shop. *Journal of Behavioral Addictions*, 1, 28–34.
- LePage, M. L., Price, M., O’Neil, P., & Crowther, J. H. (2012). The effect of exercise absence on affect and body dissatisfaction as moderated by obligatory exercise beliefs and eating disordered beliefs and behaviors. *Psychology of Sport and Exercise*, 13(4), 500–508.
- Lynch, W. J., Peterson, A. B., Sanchez, V., Abel, J., & Smith, M. A. (2013). Exercise as a novel treatment for drug addiction: A neurobiological and stage-dependent hypothesis. *Neuroscience and Biobehavioral Reviews*, 37, 1622–1644.
- Meyer, C., & Taranis, L. (2011). Exercise in the eating disorders: Terms and definitions. *European Eating Disorders Review*, 19, 169–173.

- Meyer, C., Taranis, L., Goodwin, H., & Haycraft, E. (2011). Compulsive exercise and eating disorders. *European Eating Disorders Review, 19*, 174–189.
- Modolo, V. B., Antunes, H. K. A., Borba de Gimenez, P. R., De Mello Santiago, M. L., Tufik, S., & Túlio de Mello, M. (2011). Negative addiction to exercise: Are there differences between genders? *Clinics, 66*, 255–260.
- Mond, J. M., Hay, P. J., Rodgers, B., & Owen, C. (2006). An update on the definition of excessive exercise in eating disorders research. *International Journal of Eating Disorders, 39*, 147–153.
- Mond, J. M., Hay, P. J., Rodgers, B., Owen, C., & Beumont, P. J. (2004). Relationships between exercise behaviour, eating disordered behaviour and quality of life in a community sample of women: When is exercise excessive? *European Eating Disorders Review, 12*, 265–272.
- Mond, J., Myers, T. C., Crosby, R., Hay, P., & Mitchell, J. (2008). “Excessive exercise” and eating-disordered behavior in young adult women: Further evidence from a primary care sample. *European Eating Disorders Review, 16*, 215–221.
- Mónok, K., Berczik, K., Urbán, R., Szabó, A., Griffiths, M., Farkas, J., . . . Demetrovics, Z. (2012). Psychometric properties and concurrent validity of two exercise addiction measures: A population wide study. *Psychology of Sport and Exercise, 13*, 739–746.
- Ng, L. W. C., Ng, D. P., & Wong, W. P. (2013). Is supervised exercise training safe in patients with anorexia nervosa?: A meta-analysis. *Physiotherapy, 99*, 1–11.
- O’Brien, C. P., Volkow, N., & Li, T. (2006). What’s in a Word? Addiction versus dependence in DSM-V. *American Journal of Psychiatry, 163*(5), 764–765.
- Pearson, J., Goldklang, D., & Streigel-Moore, R. (2002). Prevention of eating disorders: Challenges and opportunities. *International Journal of Eating Disorders, 31*, 233–239.
- Peñas-Lledó, E. F., Leal, V., & Waller, G. (2002). Excessive exercise in anorexia nervosa and bulimia nervosa: Relation to eating characteristics and general psychopathology. *International Journal of Eating Disorders, 31*, 370–375.
- Shroff, H., Reba, L., Thornton, L. M., Tozzi, F., Klump, K., Berrettini, W. H., . . . Bulik, C. M. (2006). Features associated with excessive exercise in women with eating disorders. *International Journal of Eating Disorders, 39*, 454–461.
- Slay, H. A., Hayaki, J., Napolitano, M. A., & Brownell, K. D. (1998). Motivations for running and eating attitudes in obligatory versus nonobligatory runners. *International Journal of Eating Disorders, 23*, 267–275.
- Smith, D. E. (2012). Editor’s note: The process addictions and the new ASAM definition of addiction. *Journal of Psychoactive Drugs, 44*, 1–4.
- Sundgot-Borgen, J., & Klungland Torstveit, M. K. (2004). Prevalence of eating disorders in elite athletes is higher than in the general population. *Clinical Journal of Sports Medicine, 14*, 125–132.
- Sussman, S., Lisha, N., & Griffiths, M. (2011). Prevalence of the addictions: A problem of the majority or the minority? *Evaluations and the Health Professionals, 34*, 3–56.
- Symons Downs, D., Hausenblas, H., & Nigg, C. (2004). Factorial validity and psychometric examination of the exercise dependence scale-revised. *Measurement in Physical Education and Exercise Science, 84*, 183–201.
- Szabo, A., & Griffiths, M. D. (2007). Exercise addiction in British sports science students. *International Journal of Mental Health and Addictions, 5*, 25–28.
- Taranis, L., Touyz, S., & Meyer, C. (2011). Disordered eating and exercise: Development and preliminary validation of the compulsive exercise test (CET). *European Eating Disorders Review, 19*, 256–268.
- Terry, A., Szabo, A., & Griffiths, M. D. (2004). The exercise addiction inventory: A new brief screening tool. *Addiction Research and Theory, 12*, 489–499.
- Thompson, J. K., Heinberg, L. J., Altabe, M., & Tantleff-Dunn, S. (1999). *Exacting beauty. Theory, assessment, and treatment of body image disturbance*. Washington, DC: American Psychological Association.
- Thompson, J. K., & Pasman, L. (1991). The Obligatory Exercise Questionnaire. *Behavior Therapist, 14*, 137.

- USDHHS. (2008). Physical activity guidelines for Americans. <http://www.health.gov/paguidelines/guidelines/default.aspx>
- Vansteelandt, K., Rijmen, F., Pieters, G., Probst, M., & Vanderlinden, J. (2007). Drive for thinness, affect regulation and physical activity in eating disorders: A daily life study. *Behaviour, Research and Therapy*, *45*, 1717–1734.
- Veale, D. (1995). Does primary exercise dependence really exist? In J. Annett, B. Cripps, & H. Steinberg (Eds.), *Exercise addiction: Motivation for participation in sport and exercise* (pp. 1–5). Leicester: British Psychological Society.
- Villella, C., Martinotti, G., Di Nicola, M., Cassano, M., La Torre, G., Gliubizzi, M. D., . . . Conte, G. (2011). Behavioral addictions in adolescents and young adults: Results from a prevalence study. *Journal of Gambling Studies*, *27*, 203–214.
- Weik, M., & Hale, B. D. (2009). Contrasting gender differences on two measures of exercise dependence. *British Journal of Sports Medicine*, *43*, 204–207.
- Wolff, E., Gaudlitz, K., von Lindenberger, B., Plag, J., Heinz, A., & Ströhle, A. (2011). Exercise and physical activity in mental disorders. *European Archives of Psychiatry and Clinical Neuroscience*, *261*(S), S186–S191.
- Yates, A. (1991). *Compulsive exercise and the eating disorders: Toward an integrated theory of activity*. New York, NY: Brunner/Mazel.
- Zmijewski, C. F., & Howard, M. O. (2003). Exercise dependence and attitudes toward eating among young adults. *Eating Behaviors*, *4*, 181–195.
- Zschuckle, E., Gaudlitz, K., & Ströhle, A. (2013). Exercise and physical activity in mental disorders: Clinical and experimental evidence. *Journal of Preventive Medicine and Public Health*, *46*, S12–S21.
- Zunker, C., Mitchell, J. E., & Wonderlich, S. A. (2011). Exercise interventions for women with anorexia nervosa: A review of the literature. *International Journal of Eating Disorders*, *44*, 579–584.