STRESS AND DIETARY RESTRAINT: AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN RESTRAINED EATING AND CORTISOL

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Abstract

The purpose of this study was to elucidate the nature of the relationship between dietary restraint and physiological stress, by investigating which eating and body-related constructs are related to cortisol excretion and to perceived stress. Female undergraduates (N=170) completed self-report measures on dietary restraint, appearance beliefs, body satisfaction variables, perceived stress, and eating self-efficacy. Participants also provided two saliva samples. The first sample was collected in the participants' home, a half-hour after wakening, and the second was collected 6-8 hours later. A factor analysis was performed in order to reduce redundancy in the set of measures surrounding eating and body attitudes, which yielded three factors. The findings indicated that women with stronger beliefs about the importance of their appearance, as well as negative emotions and cognitions surrounding their body image, had higher levels of cortisol in the afternoon. These appearance and body-related constructs were also associated with higher levels of perceived stress. However, perceived stress was not associated with cortisol excretion. There were no significant relationships between any of the eating or psychological variables and morning cortisol levels. These results suggest that dysfunctional cognitions surrounding appearance and body image may contribute to the relationship between dietary restraint and elevations in cortisol excretion. Implications for interventions and women's health are discussed.

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Background

Despite a burgeoning weight-loss industry, Western societies are battling an escalating prevalence of obesity and obesity-related illness (Flegal, Carroll, Kuczmarski, & Johnson, 1998). In addition, there is rising awareness that diet plays an important role in the etiology and prevention of illness, as a proliferation of diet and food-related research documents. As a society, we are thus highly attuned to our diets. Preoccupation with weight loss and dieting has become so widespread that periodic dieting may now even be considered 'normal' behaviour (Polivy & Herman, 1987). French and Jeffery (1994) found that 20% of adults had reported that they were currently dieting to lose weight, and approximately 61% of adults reported having ever dieted. Recent estimates of the prevalence of dieting suggest an upward trend, and among some populations, such as female college students, prevalence rates are often as high as 50-60% (French & Jeffery, 1994).

Perhaps the increasingly pertinent and sensitive associations we have with food in North American culture is evidenced by the fact that food is seen less and less as a source of pleasure, and more of a source of concern or stress, compared with other countries (Rozin, Fischler, Imada, Sarubin, & Wrzesniewski, 1999). For instance, Americans are the least likely to make culinary and pleasure-related associations with food, and most likely to associate food with worry and concern for one's health. This phenomenon is even more pronounced for American women (Rozin et al., 1999). Eating (and not eating) is therefore increasingly seen as a pathway to alter our health and appearance.

At the same time that obesity rates are soaring, there is a parallel trend in the media that depicts the ideal physiques as slimmer than ever. As a consequence, many of those who are dieting, or report that they consistently 'diet', are not even overweight (e.g., Putterman &

Linden, 2004). This is especially true of women, who are more concerned, and dissatisfied with their appearance, weight, and body shape (Rozin & Fallon, 1988). As food and diet is increasingly a source of concern and frustration, this heightened consciousness is bound to have deleterious consequences, both on a psychological and physiological level. Because dieting, appearance, and weight concerns are so ubiquitous among women, an examination of their implications, both from a mental health and physiological perspective, merits attention. The purpose of the current study is to clarify the nature of the relationship between stress and dietary restraint.

Dietary Restraint

A fundamental concept in the examination of dieting behaviour is that of dietary restraint. Dietary restraint refers to the desire to consciously restrict food intake in an effort to maintain one's weight or produce weight loss. The theory of restrained eating evolved from the realization that the observed eating behaviours of overweight persons were not necessarily the cause of their obesity, but possibly a consequence of their history of repeated weight loss attempts and chronic dieting (Herman & Mack, 1975). A vast literature now describes restrained eaters, many of whom are of normal weight, but who behave like the dieting obese in their approach to eating. Herman and Polivy (1980) noted that a number of behavioural, emotional, and cognitive features characterize restrained eaters (as classified by the Restraint Scale (RS), Herman & Polivy, 1975), above and beyond their concern with dieting and monitoring of food intake. For instance, it has been well documented that in some conditions, restrained eaters' eating behaviour is actually opposite to that of unrestrained ones: restrained eaters overeat when anxious, whereas for normal, unrestrained eaters, anxiety leads to a reduction in food intake (Herman & Polivy, 1975). The same is true for individuals under stress (Rutledge & Linden, 1998). Since then, a variety of

factors and conditions in which those high in dietary restraint respond by overeating have been described, such as: dysphoric mood, alcohol consumption, and leading them to believe that they have broken their diets by having them consume a preload of food (Ruderman, 1986). This phenomenon of overeating, which has been termed *disinhibition* or *counterregulation*, has been described as a characteristic of the restrained eater that is as notable as the restraint per se (Ogden, 1993). Reasons for this counterregulatory effect range from physiological explanations and disassociation from conditioned satiety signals, to distraction from distress and learned helplessness (Polivy & Herman, 1999).

Other psychological features associated with restrained eating include exaggerated responsiveness to nutritional or food-related cues (Tuschl, 1990), increased distractibility and emotionality, (Herman & Polivy, 1975; Polivy, Herman, & Warsh, 1978), depression, and anxiety (French & Jeffery, 1994). Physiological ramifications of dieting, such as elevated triglyceride levels have also been noted (Laessle, Tuschl, Kotthaus, & Pirke, 1989). Repeated weight cycling, which is associated with dieting, has been associated with higher risks of morbidity (Lissner et al., 1991). Additionally, restrained eating has been critically implicated in the development of eating disorders such as binge eating, bulimia, and anorexia nervosa (Polivy & Herman, 1985; Tuschl, 1990). At the very least, restrained eating is thought of as representing a midpoint on a continuum, with "normal" eating on one end and disordered eating on the other (Polivy & Herman, 1985; Polivy & Herman, 1987).

What Leads us to Believe that Restraint is Associated with Stress?

Endocrinological features. Given that advances in the field of health psychology and psychoneuroimmunology have begun to shed light on how psychological states influence our physiology, it should come as little surprise that the impact of restrained eating can also be felt

on the endocrine system. It is posited that preoccupation with diet and food choice can act as a subtle, but perhaps chronic psychological stressor that activates the stress response, given that we, as a society, are constantly exposed to food cues. Three studies have recently found that women scoring higher on the Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985) restraint scale have elevated levels of basal cortisol (Anderson, Shapiro, Lundgren, Spataro, & Frye, 2002; McLean, Barr, & Prior, 2001a; Rideout, Barr, & Linden, in press). Salivary cortisol is positively correlated with restraint levels, such that women scoring higher in restraint have higher cortisol levels when assessed in the morning (Anderson et al., 2002). Young women scoring in the upper range of the TFEQ restraint scale have been found to have significantly higher 24-hour urinary levels of cortisol than those scoring lower on the scale (McLean et al., 2001a). In this study, urinary cortisol was not found to be correlated with exercise, nutrient intake, or weight fluctuation (McLean et al., 2001a).

Recently, this relationship between 24-hour urinary cortisol and restraint was also replicated with postmenopausal women (Rideout et al., in press). The only variable significantly related to urinary cortisol in this study was cognitive restraint. Highly restrained women did not differ from low-restraint women with respect to energy intake, and had similar body weights and composition. This study also found that among highly restrained women, those who indicated that they were trying to lose weight had higher levels of cortisol, whereas low-restraint women displayed the opposite pattern. The authors of these studies collectively surmised that the constant struggle to alter one's body weight or shape acts as a chronic stressor. It also appears that women with eating disorder tendencies (those scoring higher on a bulimia symptomatology scale), but who have never been diagnosed with an eating disorder display increased urinary

cortisol secretion, elevated cardiovascular reactivity to a lab stressor, and depressed urinary epinephrine levels (Koo-Loeb, Costello, Light, & Girdler, 2000).

Taking these observations one step further, a perhaps more worrisome effect of restraint-related hypothalamic-pituitary-adrenal axis activation is that dietary restraint has been found to be associated with self-reported menstrual irregularity in women (McLean & Barr, 2003). TFEQ-Restraint scores differentiated women with regular and irregular cycles, despite being of similar body weights. Studies have also indicated that women with higher cognitive dietary restraint levels display objective signs of subtle menstrual disturbances (Barr, Prior, & Vigna, 1994; Schweiger et al., 1992). In one study, among low restraint women (as measured by both the TFEQ and the Dutch Eating Behavior Questionnaire, or DEBQ), 11 of 13 had cycles that fulfilled standard criteria for normal menstrual cycles (as measured by blood sampling) while only two of the nine restrained eaters satisfied these criteria (Schweiger et al., 1992). The criteria included peak serum estradiol values of > 440 pmol/L, peak serum progesterone levels of > 19 nmol/L, and luteal phase lengths of > 9 days. In particular, highly restrained women exhibited decreased and shortened progesterone production in the luteal phase. Barr, Prior, & Vigna had similar findings: using measures of basal temperature over at least three menstrual cycles, women in the upper tercile of restraint had shorter luteal phase lengths.

Dietary restraint is also an independent negative predictor of lumbar spine mineral density in young women, and appears to attenuate the positive effects of exercise on bone density (McLean, Barr, & Prior, 2001b). One study found that bone mineral content was significantly lower in women with high TFEQ cognitive restraint scores, particularly if they weighed less than 71 kg, suggesting that these women may be at a higher risk of osteoporosis (Van Loan & Keim, 2000). Elevated cortisol secretion may be the culprit for both menstrual

irregularity and bone density: Corticotropin releasing hormone interrupts the release of gonadotropin secretion, leading to lower concentrations of luteinizing hormone and follicle-stimulating hormone, both of which are associated with disturbances in ovulation (Barbarino et al., 1989). Elevated cortisol levels have been associated with lower bone mineral density by affecting calcium homeostasis, and inhibiting bone formation. In addition, menstrual dysfunction and irregularity affects circulating sex steroids and thus can lead to bone loss (Prior, Vigna, Schecter, & Burgess, 1990). Thus, it would seem that restraint-induced elevations in cortisol levels may have many far-reaching, health-compromising implications.

Cognitive features. In addition to the aforementioned physiological markers of stress, several studies have demonstrated that dieters and restrained eaters manifest cognitive deficits compared to non-dieters (Green, Rogers, Elliman, & Gatenby, 1994; Jones & Rogers, 2003; Vreugdenburg, Bryan, & Kemps, 2003). Concentration difficulties, distractibility, and poorer performances on cognitive tasks are considered some of the cognitive effects of stress (Cohen, 1980). Given that restrained eaters display some cognitive performance impairments, restrained eating appears to involve cognitive, as well as physiological markers of stress. Moreover, dieters display impairments in cognitive performance in the absence of significant weight loss. Because of this finding, in addition to other explorations into macronutrient intake, it appears that these deficits are not related to differences in physiological states, such as low glucose levels (Green & Rogers, 1995). Furthermore, one experiment demonstrated that dieters' performance on a memory task was even further impaired, rather than improved, after actual food consumption (Jones & Rogers, 2003). Dieters' poorer performance was attributed to food and dieting-related preoccupation. In this study, participants completed a variety of cognitive tasks before and after having consumed a chocolate bar. Dieters performed slightly worse than nondieters before the

food consumption, and their performance deteriorated significantly after eating. Surprisingly, the study did not find differences in mood and anxiety ratings of dieters before or after eating the chocolate bar, despite interview responses indicating they had experienced thoughts involving guilt and anxiety. However, the measures used did not specifically assess diet or body-related distress. Another study involved an investigation into the nature of cognitive changes associated more specifically with preloading of high versus low calorie foods (Ogden & Greville, 1993). This revealed that restrained eaters (measured with the DEBQ) show more retardation on a Stroop task involving the naming of body size and food words after consuming a high-calorie food than after consuming a lower calorie food. Apparently, restrained eaters were more preoccupied with food after having eaten a more 'forbidden' or higher calorie food. These participants also displayed increased feelings of rebelliousness, defiance, and a desire to challenge the limitations of their diets. Of further interest, the results from this study also suggested that restrained eaters responded to the preloading of food with an increase in anxiety (Ogden & Greville, 1993). Thus, thoughts surrounding, and elicited by, food consumption clearly interfere with certain cognitive processes among dieters and restrained eaters.

It seems that current dieting status is closely related to cognitive functioning. One study contrasted restrained eaters' cognitive performance on several tasks when they were either spontaneously dieting at the time of the session or not actively trying to diet (Green & Rogers, 1995). The results indicated that restrained eaters' (classified with the DEBQ) performance on more attentionally demanding tasks was poorer when they were actively dieting, while tasks that assessed motor ability and motivation were not affected. The authors noted that the affected performance generally involved tasks that are susceptible to distraction. Restrained eaters, who may or may not be currently dieting, appear to fall somewhere in between current dieters and

unrestrained non-dieters with respect to cognitive performance (Green et al., 1994). Thus, taken together, it appears that there is something onerous about restrained eating, and perhaps it becomes more burdensome the more closely attention is paid to diet.

What do we Mean by Restraint?

While caloric restriction and weight loss lead to decreases in cortisol (e.g. Buffenstein, Karklins, & Driver, 2000), dietary restraint is associated with higher levels of both urinary and salivary cortisol (Anderson et al., 2002; McLean, et al., 2001b; Rideout et al., in press). It is therefore important to more closely examine what is meant by restraint or dieting. Many studies on dietary restraint actually use participants who have high scores on measures of dietary restraint, but do not report that they are currently dieting (for example, see Green & Rogers, 1995; McLean et al., 2001b), and also compare them to restrained eaters who are currently dieting (Lowe & Timko, 2004). In a related vein, while elevated scores on measures of dietary restraint predict the onset of binge eating and eating pathology, participants placed on low-calorie diets in randomly controlled treatment trials show decreases in binge eating (Stice, Fisher, & Lowe, 2004). Thus, dieting per se is not necessarily implicated in disturbances in eating. There are many factors involved with dietary restraint—which may or may not result in disordered eating, and some of which may or may not be associated with elevated stress levels. Surprisingly, those scoring higher on various measures of dietary restraint do not engage in caloric restriction to a sufficient extent to induce weight loss (Laessle, Tuschl, Kotthaus, & Pirke, 1989). When restraint is measured by the TFEQ, highly restrained eaters do not report consuming fewer calories based on food diaries (Beiseigel & Nichols-Richardson, 2004). In fact, in a recent paper by Stice et al. (2004), restraint scales were largely uncorrelated with caloric intake measured surreptitiously. This study calls into question, as have others, who it is that we

are studying when we classify certain individuals as restrained eaters. If they do not appear to be eating less, is dietary restraint solely an attitude, or cognitive construct, that is based upon the *desire* to restrict intake? Therefore, the label of restrained eater does not necessarily imply that one is actively dieting or losing weight, but instead appears to refer to the cognitive component, or *intention* to restrict food and lose weight. It may be that restraint scales capture a variety of people, many of whom do not actively engage in caloric restriction, but are nonetheless preoccupied with their intake and wanting to control their eating in order to effect some change to their bodies. Thus, the reader must bear in mind that the term 'dietary restraint' or 'restrained eater' may not actually describe the way a person, in practice, may be eating, but may instead refer to the attitude or intention the person holds toward eating and food.

Since restraint appears to capture a whole host of eating attitudes and behaviours, it is difficult to surmise, based on the available literature, why restraint per se has a positive relationship with cortisol excretion. To date, the only established relationship is that between restraint and cortisol, while other eating attitudes or body image factors have not been examined with regard to their relationship with cortisol. Thus, the association between cortisol and restraint is clearly in need of some elaboration.

Because those scoring higher on in restraint may actually be heavier (e.g., Putterman & Linden, 2004), or, at least not any thinner, depending on the measure used (e.g., Beiseigel & Nichols-Richardson, 2004), some restrained eaters are presumably people who face disparity between the extent to which they monitor their intake (and are preoccupied with eating less) and the amount that they eat in actuality. In fact, some have argued that the Restraint Scale, upon which theories of restrained eating have been built, is actually a measure that captures unsuccessful dieting (Heatherton, Herman, Polivy, King, & McGree, 1988). In other words,

these people face the worst of both worlds: they are aware of what they should be eating and want to lose weight, but are not successful at exerting restraint. However, there is very little discussion in the literature surrounding this phenomenon. Moreover, a needed distinction between *cognitive* dietary restraint and *behavioural* restraint has received little attention, and would seem to be an instrumental distinction, particularly with respect to stress and restraint. In fact, the TFEQ, which has a subscale labelled 'cognitive dietary restraint' contains items that are clearly behavioural, such as "I deliberately take small helpings as a means of controlling my weight". Of course, taking small helpings requires a conscious effort, is a deliberate and 'cognitive' process, but also a concrete behaviour aimed at reducing one's weight. Allison, Kalinsky, & Gorman (1992), in their comparison of the psychometric properties of various restraint measures, found that indeed, the TFEQ restraint subscale contains two subfactors: cognitive and behavioural restraint. However, no efforts to further explore this division have been made since then by any research group. Presumably, if one continually planned to exert control by counting calories at every meal (cognitive restraint), yet routinely failed to do so, more stress and distress would ensue than if one were successful at following through with one's intentions.

In their research using cortisol data, Anderson et al. (2002) found that there was a stronger relationship between cortisol and restraint as measured by the TFEQ than as measured by the Restraint Scale. This is interesting, given that many have suggested that the TFEQ is a more accurate measure of 'successful' restraint, whereas the Restraint scale seems to capture unsuccessful dieters (Heatherton et al., 1988). Perhaps, then, the continual exertion involved in maintaining more successful control over one's eating is stressful. Or it may be that the cognitive effort or intent to eat a certain way followed by failed attempts is more strongly associated with

distress. It remains to be seen what aspect of restraint contributes to this heightened activation. This study will attempt to shed light on some of these unanswered, and largely unaddressed, questions.

What is Stress?

Stress can be conceived of as a negative emotional experience that is associated with threat, harm, or demands, and which requires some form of adjustment (Baum, 1990). This emotional state is accompanied by specific biochemical, physiological, cognitive and behavioural events that act as coping responses to alter the event/stressor or render the organism more prepared to manage it. The physiological response to stress can be described as follows: When events or situations are appraised as stressful by the cerebral cortex, this information is transmitted to the hypothalamus. The hypothalamus, in turn, initiates arousal in the sympathetic nervous system. Sympathetic arousal is associated with the activation of the whole system, mediated primarily by catecholamines. This arousal helps to mobilize glucose and redistribute blood supply to support this coping response (Baum & Grunberg, 1997). The hypothalamus is also responsible for activating the hypothalamic-pituitary-adrenocortical (HPA) axis. The hypothalamus releases corticotrophin-releasing factor (CRF), which then stimulates the pituitary to secrete adrenocorticotropic hormone (ACTH). ACTH affects the adrenal cortex, resulting in the release of corticosteroids. Cortisol is the primary glucocorticoid for humans, and its primary function is the maintenance of glucose production from protein as well as the facilitation of fat mobilization (Baum & Grunberg, 1997). It has anti-inflammatory effects, and also serves to regulate immune and muscle function. Cortisol is a reliable indicator of HPA axis activity (Kirschbaum & Hellhammer, 1989) because during stress, larger quantities of cortisol are released in a burst-like, or pulsatile fashion (Baum & Grunberg, 1997).

What Could be Stressful about Restraint?

While both the cognitive and endocrine findings in restrained eaters are demonstrative of some stressful element inherent in this attitude towards eating, no research to date has thoroughly explored why restrained eaters are stressed. When stress, anxiety, and depressive symptoms have been directly assessed among restrained eaters, few clear findings have emerged. For instance, Green & Rogers (1995) found that dieters showed relative cognitive deficits, but dieters did not score higher on state measures of anxiety and depression. However, anxiety and depression were not assessed after any diet-related stressful or distressing events or circumstances. The measures used were also not specifically assessing restraint or body-related distress or cognitions. Similarly, scores on a perceived stress scale were not independently associated with cognitive restraint in a regression analysis, nor did they differ between women with regular and irregular menstrual cycles (presumed to be related to elevations in cortisol) (McLean & Barr, 2003). However, highly restrained women did report more perceived stress in their lives than did low-restraint women. The authors surmised that women who are more stressed may direct this anxiety toward their bodies, and, subsequently to their attitude regarding food. Moreover, it is equally likely that the stress associated with maintaining this outlook towards eating permeates other aspects of their lives. This study did not find any evidence that perceived stress explains the relationship between restraint and menstrual irregularity.

One study that examined the cardiovascular, neuroendocrine, and psychosocial profiles of women with bulimic tendencies, but who did not meet criteria for Bulimia Nervosa (Koo-Loeb et al., 2000) indicated that in addition to exhibiting greater cardiovascular reactivity during an interpersonal scenario laboratory task, these women reported greater trait anxiety, and more significant emotional impact of daily stressors. In this study, they did not report differences in

their overall perceived stress or number of stressors. It may be that restraint/weight preoccupation is a stress process that is rather circumscribed, and thus more difficult to detect apart from issues surrounding food and body weight. It may also be the case that this form of stress is not typically revealed through self-report, but is manifested primarily by subtle physiological changes.

Thus, the purpose of this study was to shed light on the relationship between biological stress and dietary restraint. Although there is an established relationship between cortisol and cognitive dietary restraint (Anderson et al., 2002; McLean, Barr, & Prior, 2001b; Rideout et al., in press), no attempt has yet been made to elaborate on the association between various eating and body-image related constructs and stress. It was anticipated that this study would help, in an applied manner, to provide a knowledge base to aid psychotherapists helping women who experience eating, body image, and food-related distress. Understanding the restraint factors associated with physiological stress can serve to target and modify, more specifically, distorted cognitions in therapy. These new insights could also be of value to those dealing with public health policy and campaigns by illuminating which attitudes and approaches to food and dieting are most distressing. Given that high levels of cognitive dietary restraint are associated with health implications for young women, it is clear that certain eating and body attitudes are in dire need of modification. To investigate this relationship, several constructs were hypothesized to be involved in restraint related stress—namely: body-image dysphoria, appearance beliefs, rigid restraint, diet-related cognitions, and eating self-efficacy.

Self-discrepancy, body dissatisfaction, and arousal. Self-discrepancy theory concerns the relationship between beliefs about the self and self-evaluative standards (Higgins, 1987). Discrepancies between the self-concept and one's self-imposed standards have different

relationships with affect, depending on the type of discrepancy. For instance, the theory distinguishes between two standards for the self: the ideal self (what one would ideally like to have or be) and the ought self (what one believes one ought to be). According to the theory, an actual/ideal discrepancy evokes dysphoria as a result of feeling that one's hopes are not fulfilled, whereas an actual/ought discrepancy evokes anxiety, due to a sense that one has failed to meet one's obligations, and the sense that a negative consequence will ensue. In fact, Strauman, Lemieux and Coe (1993) elicited these different emotional states after priming vulnerable individuals with various self-discrepancies, replicating earlier findings in this literature (e.g., Strauman, 1992). Carver, Lawrence, & Scheier (1999) broadened the theory by incorporating the concept of the 'feared self'—a self-concept that motivates people to act so as to avoid this unwanted representation of the self. They found that overall, proximity to the feared self was more strongly associated with guilt and anxiety than discrepancy from the ought self.

Body dissatisfaction has been conceptualized as a disparity between a person's perceived current and ideal body size or shape (Williamson, Gleaves, Watkins, & Schlundt, 1993). Presumably then, dieters should be susceptible to anxiety or distress as a result of exposure to situations that may heighten perceived gaps between how they believe they currently look and how they would like to look. Several studies have specifically examined eating and body image disturbances using the theory of self-discrepancy (e.g., Forston & Stanton, 1992; Harrison, 2001; Szymanski & Cash, 1995). Actual-ideal self-discrepancies appear to correlate positively with body-dissatisfaction and bulimic tendencies, whereas actual-ought discrepancies are associated with anorexic-related attitudes and behaviours (Strauman, Vookles, Berenstein, & Chaiken, 1991).

It is likely that women engage in more restrictive eating patterns because they are more susceptible to perceiving a disparity between themselves and their ideals, and thus vulnerable to ensuing negative affect. For instance, the relationship between self-discrepancy and distress appears to be more pronounced in women with abnormal eating (particularly bulimic symptoms) than in women with normal eating patterns (Forston & Stanton, 1992). These authors suggested that for these women, distress-evoking self-discrepancies seem to be activated with greater frequency or intensity.

The relationships among body dissatisfaction, restraint, problematic eating, and general distress were examined longitudinally (over 11 months) in a large sample of British adolescents (Johnson & Wardle, 2005). These authors found that after controlling for body dissatisfaction, restraint was no longer a significant predictor of stress, depression, low self-esteem or bulimic symptoms (both cross-sectionally and longitudinally). Body dissatisfaction, which was measured using a construct that assessed body weight distress, appeared to mediate the relationship between restraint (measured by the DEBQ) and depression, and restraint and low self-esteem. Thus, these data suggest that body dysphoria may be the culprit with respect to the eating pathology and distress associated with restraint. It may be then, that these same emotions are also associated with the physiological stress associated with restraint.

Body dissatisfaction is relatively labile, subject to various situational factors and situations that may heighten this discontent (Baker, Williamson, & Sylve, 1995; Tiggemann, 2001). Moreover, estimation of current body size has been shown to worsen with negative mood induction, yet perception of ideal body size does not appear to shift with different mood states (Baker et al., 1995). This implies that a negative mood would result in a greater perceived discrepancy between one's current and ideal body size. Furthermore, imagining body-focused

situations appears to render women more dissatisfied with their bodies, a finding that is even more pronounced for restrained eaters, who are generally less satisfied with their bodies overall (Tiggemann, 2001). Exposure to media has also been shown to activate body-specific self-discrepancies and evoke feelings of dejection and agitation in the laboratory (Harrison, 2001). The relationship between media exposure and eating disorder variables appears to be mediated through the activation of self-ideal discrepancies. In an interesting lab experiment, exposure to an example of thinness being rewarded elicited more feelings of dejection in those with high ideal self-discrepancies. Presumably, this demonstration highlighted the absence of certain positive outcomes in the lives of these participants. Moreover, during an exposure to an overweight person being punished, individuals with high ought self-discrepancies experienced more agitation than those with high ideal discrepancies (Harrsion, 2001). This scenario was thought to serve as a reminder of negative outcomes to being overweight. It may be that chronic activation of self-discrepancies may be one of the more stressful aspects associated with restrained eating. Because previous studies assessing stress or distress did so with measures that were not specific to distress related to body satisfaction (e.g., Jones & Rogers, 2003; McLean & Barr, 2003), these studies may have failed to capture a significant source of distress for restrained eaters. The current study addressed this issue by assessing body-image related distress.

From the literature on self-discrepancy theory in general, it appears that anxiety elicited from highlighting people's perceived self-discrepancies leads to changes in endocrine and immunological functioning. Anxious and dysphoric states have physiological as well as cognitive implications. For instance, Strauman et al. (1993) demonstrated that priming anxious participants with individually tailored stressors (actual/ought self-discrepancies) resulted in increased sympathetic activation—increased cortisol levels and suppressed natural killer cell

activity. These authors pointed out that the goals or standards a person has, whether he or she feels they have been met, and the consequences for meeting these standards, all have implications for the perception that something is stressful, and hence, result in a cascade of cognitive and physiological processes. It is possible, then, that self discrepancies play a significant part in eliciting stress in those individuals with high dietary restraint scores. This study assessed feelings of body-image dysphoria, with the hope of shedding light on whether these emotions contribute to the stress reactions displayed by restrained eaters.

Appearance beliefs. It would seem that restraint should be more stressful if the importance of maintaining or altering one's weight or shape were deemed to be highly important. In this way, the stakes are higher for maintaining control over one's intake, and failure represents more detrimental ramifications. In the field of stress and coping, researchers have explored the role of life domains and central values in reactions to stressors (Swindle & Moos, 1992). Individuals are more vulnerable to stressors that occur in the domains in which they are most invested, since some of these domains may be more salient or central to the self. The construct of self-complexity is similar: an individual can be susceptible to a stressor by either placing too much emphasis on one of the aspects of the self, or because the different aspects of the self are too closely tied (Swindle & Moos, 1992). Indeed, Spangler (2002) found that dysfunctional beliefs regarding appearance (defined as overvaluation of the implications of physical appearance for one's life) predicted restraint (assessed with the DEBQ), body dissatisfaction and self-esteem within and across time (20 months). Moreover, none of these known eating disorder risk factors predicted beliefs about appearance. This makes sense—the more important one deems appearance and weight, the more likely one is to feel dissatisfied, distressed, and motivated to change one's body.

It is possible that these overvalued beliefs about one's appearance play a central role in fuelling stress in restrained eaters. If a dieter believes that losing weight (or averting weight gain) will have great implications for many aspects of her life, then maintaining tight control over her eating will be highly significant. Furthermore, because one of the key features of the restrained eater is that she frequently (and counter-intentionally) indulges, the consequences of these episodes would be perceived as more detrimental and anxiety-provoking to someone who is more heavily invested in her appearance and physique. In fact, dieting that is motivated primarily by aesthetic, as opposed to health-related reasons, is associated with more disinhibited and problematic eating (Putterman & Linden, 2004). This may be a result of a more stringent approach to dieting, and setting goals that are less attainable, and thus making failure more likely. One of the facets explored in this study with respect to arousal, therefore, was the importance of one's beliefs about appearance.

Rigid versus flexible restraint. Numerous attempts have been made to identify variables that distinguish between two types of restrained eaters: namely, those who have more of a tendency to overeat, and those who are able to exert more restraint. Westenhoefer (1991) found that those who were more prone to disinhibited eating tended to use such dietary practices as counting calories, eating low-calorie foods, and avoiding certain foods. They also felt guiltier after overeating than did those less prone to disinhibition. Those scoring lower on the scale took smaller portions, and ate more slowly. The author concluded that dietary restraint is not a homogeneous construct, and that dietary restraint can be subclassified into two dimensions—flexible versus rigid control. In another study, more rigidly controlled eating behaviour was associated with higher disinhibition scores, higher body mass index, and generally more disturbed eating patterns, whereas flexible control was associated with lower disinhibition scores

and more successful weight reduction (Westenhoefer, Stunkard, & Pudel, 1999). It appears that the relationship between disinhibited or disordered eating patterns and dietary restraint depends on the type of restrained eating. These subscales provide a more specific explanation of the nature of the relationship between restraint and disinhibition. Rigidly controlled eating behaviour is one marked by unsuccessful weight loss attempts and binge eating, whereas a more flexible controlled style is associated with lower body weight and weight reduction attempts that are more successful (Westenhoefer et al., 1999). The finding of higher BMI, disinhibition scores, and negative affect among those higher in rigid control was also replicated by Timko & Perone (2005). One could surmise that the more rigid approach to restraint and eating may be more stressful. Since restrained eaters (and, it seems, especially 'rigid' ones) are susceptible to lapses in restraint over their eating, they would then be routinely exposed to situations in which they unintentionally eat more than they had planned. One can easily see how a more rigid perspective, in which deviations from a self-imposed dietary plan are associated with guilt and distress, would indeed be a more stressful experience. On the other hand, cortisol excretion has been found to have a stronger relationship with restraint as measured by the TFEQ (a measure of more successful restraint, and not related to disinhibition) than with scores on the Restraint Scale (Anderson et al., 2002). Moreover, Rideout et al. (in press) did not find that cortisol excretion was related to disinhibition. One of the goals of this study was to examine whether these two subclassifications of restraint have differing relationships with cortisol secretion.

Self-efficacy and control. Perhaps the stress (measured physiologically, as well as through cognitive interference) associated with dietary restraint involves the sense of control one has over one's eating and appearance. Anxiety has typically been regarded as a reaction to perceived impending harm (or negative consequence), or proximity to an undesirable, feared

'self' (see earlier discussion on self-discrepancy theory) (Carver et al., 1999). Indeed, it may be that the aspect of stress "most responsible for distress is the possibility of failure and attendant consequences" (Baum, 1990, p.661). One way that psychological stress has been conceptualized is as a condition in which perceived demands exceed one's coping abilities or resources (Lazarus & Folkman, 1984). These perceived abilities (or lack thereof) may be critical in the relationship between stress and restraint. Relatedly, the construct of self-efficacy refers to the perception one has of one's capabilities to mobilize motivation or resources to meet these demands (Bandura, 1977). One's sense of control appears to play an essential role in stress reactions. If people believe they have some control over the outcome of aversive circumstances, they experience less distress (Bandura, Cioffi, Taylor, & Brouillard, 1988). Research has shown that lower levels of self-efficacy are associated with higher levels of perceived stress, autonomic arousal, neuroendocrine changes, and even lowered immune function (Bandura et al., 1988).

In the case of restraint, self-efficacy may be derived from following a meal plan, eating as much (or as little) as one intends to, and/or one's sense of ability to cope with situations in which one is prone to overeat. In fact, women who identify themselves as currently attempting to lose weight report lower self-efficacy in their ability to control their overeating (Glynn & Ruderman, 1986). In a similar vein, restrained eaters score lower on the eating self-efficacy scale (Glynn & Ruderman, 1986). This is an interesting finding, and perhaps may represent one of the reasons restraint is stressful: if one continually feels unable to exert as much control as one would like, the dieter may face ongoing feelings of stress and failure. Moreover, women with eating disorder tendencies report a decreased sense of perceived control or sense of mastery over their environment in general (Koo-Loeb et al., 2000). Thus, it is possible that some people use diet as a way of bolstering their sense of control. Alternatively, if a restrained eater sees her

restraint as a successful means of maintaining her desired physique, staying healthy, or takes pride in her ability to exert control, then perhaps it may not be stressful at all. Thus, this study addressed whether or not sympathetic activation is associated with maintaining a sense of control over one's eating (or lack thereof).

Diet-related cognitions. In the literature on the cognitive impairments displayed by restrained eaters, dieters' poorer performance is generally attributed to food and dieting-related preoccupation (Jones & Rogers, 2003). In a study in which participants completed a variety of cognitive tasks before and after having consumed a chocolate bar, dieters performed slightly worse than nondieters before the food consumption, and their performance deteriorated significantly after eating. They reported having had more food and diet-related thoughts (garnered from interview data) than did nondieters even before food consumption. After eating, these preoccupying cognitions became even more prevalent, whereas non-dieters did not experience an increase in such thoughts as a result of eating. Cognitions included plans for later restriction, feelings of guilt, anxiety, and loss of control. Self-reported feelings of fatness were related to poorer performances on a working memory task in another study with women who were dieting (Green et al., 2003). These authors concluded that preoccupying cognitions surrounding body shape, more specifically, mediated the relationship between dieting and cognitive deficits.

The fact that these cognitions caused interference, and were preoccupying in nature, implies that dieting is taxing, if not stressful. Preoccupying thoughts can be conceived of as a form of worry. Individuals who report more frequent work-related worrying show clear signs of chronic physiological arousal: they display higher cortisol levels, and also exhibit larger weekend-workday differences in their cortisol levels than do those who deny worrying as

frequently (Schlotz, Hellhammer, Schulz, & Stone, 2004). It has also been shown that the intensity and frequency of intrusive thoughts after a major stressful life event (such as the nuclear accident at Three Mile Island) is associated with physiological arousal and poorer task performance--markers of chronic stress--for up to six years after the event (Baum, 1990). This suggests that recollections and cognitions of an event can become substitutes for the stressful event itself, and sustain chronic stress. Taken together, these findings highlight the importance of thoughts in creating or maintaining stress. Thus, preoccupying thoughts and cognitions related to body image or food and diet may be viewed as forms of self-generated stressors—manifested with chronic cognitive and physiological sequelae.

Cortisol Responses

A commonly used measure of physiological stress in psychological research is the corticosteroid cortisol. Because the relationship between restrained eating and elevated cortisol has already been established (Anderson et al., 2002; McLean, Barr, & Prior, 2001b; McLean & Barr, 2003; Rideout et al., in press), this study also used cortisol as an index of physiological stress. Recently, evidence has been accumulating that morning wakening is associated with an activation of the HPA axis and a rapid increase in cortisol. This response has been labelled the cortisol awakening response, or CAR. Free cortisol levels have been found to increase by 50-75% within the first 30 minutes after awakening, and then gradually decrease throughout the day (Pruessner et al., 1997). Morning cortisol response appears to be a reliable marker of adrenocortical activity, with high intraindividual stability across days and weeks (Pruessner et al., 1997). Thus, it would seem that the CAR is a useful tool to assess individual differences in chronic stress activation. In fact, the cortisol response to awakening has been found to be heightened in those undergoing chronic stress: the morning surge was found to be greater on

work than on weekend days, particularly among women (Kunz-Ebrecht, Kirschbaum, Marmot, & Steptoe, 2004; Schlotz et al., 2004). In addition, higher job strain has been found to be associated with elevated levels of cortisol in the early morning (between 8:00 and 8:30 AM), but not with cortisol levels at later times of the day or evening (Steptoe, Cropley, Griffith, & Kirschbaum, 2000). Moreover, weekday-weekend differences in mean cortisol are more pronounced in those who score higher on measures of worry (Schlotz et al., 2004). People who indicate that they worry a lot have higher cortisol levels overall, independent of time of day (Schlotz et al., 2004). Lower socio-economic status is also associated with a larger cortisol response to awakening. Several aspects of perceived chronic stress, such as worrying, social stress, and lack of social recognition are associated with an increase in early morning cortisol levels (Wust, Federenko, Hellhammer, & Kirschbaum, 2000). Because those who report more worrying have greater cortisol awakening responses (CAR) on workdays, it is presumed that these stronger CARs signify greater stress responses due to the anticipation of upcoming stressors or worry concerning the ability to manage daily stressors (Schlotz et al., 2004). Thus, it appears as though cortisol levels measured 30 min after awakening are sensitive to cognitive factors, such as stress and worry, particularly where more chronic stress is concerned. This study assessed both chronic stress (peak morning cortisol levels), as well as cortisol levels later on in the day, presumably after potentially stress-inducing cues have been encountered over the course of a normal day.

In the literature on restraint, there are still many unanswered questions. As we have seen, dietary restraint is associated with physiological markers that are presumed to be mediated by cortisol, such as bone loss and menstrual irregularities, as well as with elevations in cortisol itself (Anderson et al., 2002; McLean, Barr, & Prior, 2001b; McLean & Barr, 2003). These findings

suggest that there is some aspect of dietary restraint that activates the stress response, and is indeed stressful over the long run. We also know that dieters perform more poorly on laboratory-based cognitive tasks (Green & Rogers, 1995; Jones & Rogers, 2003; Vreugdenburg et al., 2003), presumably due to interfering cognitions surrounding issues such as food, diet, and body shape, particularly after food consumption (Jones & Rogers, 2003). There has been no research to date examining more precisely what psychological variables are associated with the physiological correlates of restrained eating. It remains to be seen what part of trying to control one's weight through diet (or that may be related to it) contributes to these markers of stress, and importantly, which variables contribute most to this resulting stress. Perhaps these elevations are largely due to chronic distress concerning one's body weight/shape or beliefs about appearance, and have less to do with dietary attitudes. This study sought to answer these, as well as other questions involving the relationship between dietary restraint and physiological stress.

In sum, the current research addressed the central question of which aspects of restrained eating are associated with physiological and psychological markers of stress. It measured a physiological marker of stress via morning peak salivary cortisol levels to obtain a marker of more chronic stress, and a second cortisol sample taken 6-8 hours after awakening. This second sample was taken to a) increase the stability of the cortisol index and b) to capture the potential difference between the peak morning levels, and an afternoon sample that presumably reflects exposure to daily cues of food, weight, and appearance throughout the course of the day. Psychological stress was assessed via self-report on perceived stress in general. Another goal of this study was to clarify and simplify the various eating and body-related scales used in the study in order to see which underlying diet and weight constructs are related to stress. More specifically, the nature of the relationships between rigid versus flexible restraint, appearance

beliefs, eating self-efficacy, food and weight preoccupying cognitions, body-image dysphoria, perceived stress, and cortisol excretion in women was investigated in order to shed light on which eating and body attitudes are associated with variations in cortisol and stress levels.

Method

Participants

Participants were obtained through the volunteer subject pool at the University of British Columbia. Participants were given course credit in exchange for their participation. Posters advertising a study on eating behaviours and hormones targeted females who were fluent in English. Only females were used in this study, as the literature on restraint typically examines these attitudes and behaviours among women only. The only two exclusionary criteria were that participants could not be taking any medications which may affect cortisol levels (such as corticosteroids), and those who worked night shifts.

Measures

Preoccupying cognitions. For a study designed to investigate the role of preoccupying cognitions in memory impairments associated with weight loss dieting, Vreugdenburg, Bryan, & Kemps (2003) constructed a measure to assess the extent to which dieters experience thoughts about food, diet, and body shape. This 20-item measure has high internal consistency (α=.96) as well as good to excellent internal reliability for each subscale (Food, 4 items, Diet, 2 items, and Body, 14 items). Responses are made on a 6-point scale, ranging from *never* to *always*. Sample items include "I spend most of the day thinking about food" and "I think a lot about wanting to be thinner".

Perceived stress. Given that perceived stress has been found to be elevated in highly restrained eaters (McLean & Barr, 2003), but not in others (Rideout et al., in press), this

construct was assessed in the current study in order to ascertain whether any body or eating measures are related to perceived stress. The Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983) is a 14-item measure of the degree to which situations in one's life are appraised as stressful. The items were designed to tap into the extent to which people perceive their lives as unpredictable, uncontrollable, and overloading. Questions such as "have you felt that you were on top of things?" are answered on a scale of 1 (*never*) to 5 (*very often*). The scale has an internal consistency α of between .84 and .86 and has a 2-week test-retest reliability of .85 in a college population. The scale also possesses predictive validity in that it is more highly predictive of measures of health and health-related outcomes than scales that simply assess the number of stressful life events (Cohen et al., 1983).

Eating Self-efficacy. The Eating Self-Efficacy Scale (ESES; Glynn & Ruderman, 1986). The ESES is a 25-item measure designed to assess participants' perceived ability to control their overeating in a variety of situations. The degree of difficulty is rated on a 7-point scale, ranging from 1 (*no difficulty controlling eating*) to 7 (*most difficulty controlling eating*). Thus, higher scores on the scale reflect poorer self-efficacy with respect to controlling one's overeating in various situations. This scale has been found to have two factors: eating when experiencing negative affect, and eating during socially acceptable circumstances. Sample situations include "Overeating when tempting food is in front of you" and "Overeating when nervous". This measure has demonstrated good internal consistency, with an alpha of .92 for the whole scale. The test-re-test reliability was found to be acceptable, (r=.70) over 7 weeks (Glynn & Ruderman, 1986).

Appearance beliefs. The Beliefs about Appearance Scale (BAAS; Spangler & Stice, 2001) is a 20-item instrument designed to assess dysfunctional attitudes regarding the perceived

consequences of appearance for relationships, achievement, self-view, and one's feelings. These beliefs are thought to underlie the desire to restrict eating, criticize the body, and focus on appearance-related stimuli. This measure has been found to have high internal consistency in several samples (αs ranging from .94 to .96), and a 3-week test-retest reliability of r=.83 (Spangler & Stice, 2001). This measure is not correlated with BMI and has been found to predict dietary restraint over and above the effects of BMI, body dissatisfaction, and thin-ideal internalization. Degree of endorsement with such statements as "I would enjoy my life more if I looked the way I wished" are rated on a 5-point scale ranging from 0 (*not at all*) to 4 (*extremely*).

Body-image affect. Body-image related distress was assessed using the short form of the Situational Inventory of Body-Image Dysphoria (SIBID-S; Cash, 2002). This 20-item measure describes situations for which participants indicate the frequency with which they experience negative body-image emotions on a 5-point scale from 0 *never* to 4 *always*. The situations included are both social and non-social, such as eating, exercising and intimacy. The SIBID is both internally consistent, Cronbach's alpha of .96, and stable, with a 1-month test-retest reliability of r=.86. Higher SIBID scores are positively associated with the Beck Depression Inventory, and negatively associated with social desirability, giving evidence for its convergent and discriminant validity. It appears that the SIBID is a predictable function of both body-image evaluation and investment in appearance (Cash, 2002).

Rigid versus flexible restraint. The TFEQ Cognitive Restraint (TFEQ-R) Rigid and Flexible Control subscales were also included so as to be able to examine participants' dieting behaviours along the rigid-control dimensions developed by Westenhoefer (1991). The TFEQ Restraint subscale was chosen because it was constructed in order to separate restraint and disinhibition, whereas the Restraint Scale has been criticized for confounding (Stunkard &

Messick, 1985). Only the Cognitive Restraint items of the TFEQ were administered. The separate Control dimensions to the Cognitive Restraint scale were created based on the extent to which they are correlated with the TFEQ Disinhibition scale (Westenhoefer, 1991). Both subscales have a strong relationship with Cognitive Restraint, but opposite relationships with Disinhibition. These two subscales together consist of 28 questions (Flexible Control contains 12 items and Rigid Control contains 16). The format is a mixture of true/false and multiple-choice items. The fact that the TFEQ has a separate disinhibition scale, and the fact that the TFEQ-R scale has a weak and inconsistent relationship with disinhibited eating can be taken as evidence for its discriminative validity. The Flexible Control subscale has an internal consistency of α= .82, and the Rigid Control subscale has a Cronbach's α of .80 (Westenhoefer et al., 1999). An example of an item in the Rigid Control scale is "I avoid some foods on principle even though I like them", while the Flexible Control scale contains items such as: "I pay attention to my figure, but I still enjoy a variety of foods".

Dieting motivations. Participants were asked the extent to which any dieting that they may have been engaged in was for aesthetic, as opposed to health reasons. This was assessed with one question. This question was designed as part of a series of questions that were constructed for another study on dieting motivations (Putterman & Linden, 2004). That study found that women who more strongly endorsed dieting for appearance reasons experienced more problematic eating patterns. Using the same method, participants were asked to rate, on a 10-point scale, the extent to which dieting is appearance driven, e.g., "Please indicate the extent to which the reason you are dieting is to improve your appearance (such as fit into another size clothing/ change your body shape/ look younger)", where 1 is *not at all*, and 10 is *very much so*.

In the morning, participants were asked how and what they planned to eat on the particular day of cortisol sampling. When they filled in the questionnaire package later on in the day, they were also asked to indicate whether or not they felt that they were successful at (or simply did not care about) following through with these predictions. This questionnaire was included in order to prime participants about their eating behaviour and dieting plans. The idea was that they would be more likely to contemplate their food choices in the morning, and throughout the day.

Demographic information. Participants were asked to indicate their ethnicity via an open-ended question. They were also asked whether or not English was their first language by indicating "yes" or "no". They were asked whether or not they were currently dieting, and, if they were currently dieting to lose weight (both "yes or "no"). Participants were also asked to indicate how many hours of physical activity in which they typically engage in a week. The women in the study were also asked to indicate their weight and height.

Cortisol. Obtaining cortisol through saliva sampling has been gaining in popularity, given that it is considered a valid measure of unbound, or free cortisol. It is an ideal measure since this method is not invasive, and thus, not stress-inducing itself, as blood sampling may be for some participants (Kirschbaum & Hellhammer, 1989). Moreover, morning cortisol levels are not related to sleep duration (Pruessner et al., 1997). In the current study, participants were asked to take the first saliva sample approximately 30 minutes after awakening, presumably at the peak level. They then were asked to give a second sample anywhere from 6 to 8 hours later on that same day, after having completed the questionnaires in the lab. These two samples were taken in order to ascertain whether restraint and body-related measures are related to morning levels (which are presumably more representative of chronic stress) and/or to afternoon levels,

after participants have had the opportunity to be exposed to food and body-related cues over the course of their day. To assess for stress-inducing effects of completing the questionnaire, 48 participants completed the questionnaire after providing a saliva sample, rather than before.

Procedure

Potential participants came to the lab for a first visit in order to receive instructions and materials necessary for the cortisol sampling. Prior to signing a consent form, they were asked about their medication use and whether or not they were doing shift work. Those who worked night shifts or who were currently being treated with corticosteroids were not eligible to participate. Those who were not excluded on these bases were given a consent form to read and sign. Instructions for saliva collection were then explained by a trained research assistant, who asked participants to collect saliva samples by chewing on a cotton dental roll for 1 minute until it was saturated with saliva (Salivette; Sarstedt Corp., Nümbrecht, Germany). The dental roll was then placed in a collection container and brought with them to the laboratory on the day of collection. Participants were instructed to collect the first sample 30 minutes after awakening on the morning of their choice, which was selected in advance with a research assistant. They were asked to refrain from brushing their teeth or eating or drinking prior to the saliva collection, to avoid false high cortisol values due to minor oral bleeding. They were also asked to complete a brief questionnaire on whether or not they had any dietary plans for the day (such as eating more fruits and vegetables, a certain number of calories, low-carbohydrate, low fat).

On the chosen day of sampling, participants returned to the lab with their saliva samples approximately 6 to 8 hours after awakening. At the laboratory, they were asked if they had deviated at all from the cortisol collection instructions, and whether there were any unusual circumstances surrounding the sampling. They then completed the set of questionnaires. They

were then asked to fill out some basic information regarding their oral contraceptive use, weight, height, physical activity level, and marital status. They then provided a second saliva sample in the laboratory. Finally, they were debriefed and thanked for their participation. The Salivettes were centrifuged for 5 minutes at 3000 rpm, yielding a supernatant that was then frozen at -80°C until the samples were shipped to the University of Dresden. Cortisol assays were performed in duplicate using a time-resolved fluorescence immunoassay with a cortisol-biotin conjugate as a tracer. This assay has a sensitivity of 0.43 nmol/l (Kirshbaum & Hellhammer, 1989).

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 11.5 (SPSS Inc, Chicago, Illinois). In contrast to previous research in this field, all restraint and body-image related scales were treated as continuous variables, since some researchers have argued specifically against dichotomizing restraint variables (Gorman & Allison, 1995). Initially, the correlation matrices for all psychological and physiological variables were examined. Variables that were significantly related to cortisol were entered into a regression analysis to see which ones accounted for a significant proportion of variance in cortisol when entered together in the equation. Next, a factor analysis was performed because we suspected that many variables would be intercorrelated and therefore represent an unneccessarily confusing picture. The resulting parsimonious factor scores were then used to predict cortisol. In all analyses, the .05 level of statistical significance was used. Although this may be considered to be a fairly liberal criterion, it was used for two reasons. First, cortisol measures (particularly ones that are not aggregated over several days or samples) are variable. This makes it harder to detect significant patterns of relationships with only one or two cortisol samples, and one can easily be over-exclusive in one's conclusions. Second, the current study was innovative in its use of several

psychological measures to predict cortisol differences, and was thus intended for more descriptive, rather than decision-making purposes.

Results

First, total scores were obtained for all six scales by summing the items after reversing the appropriate items. Omitted answers for dichotomous items were completed by replacing them with prorated responses based on whether their scores on the subscale in question were below or above the midpoint. For Likert-type omitted answers, items were replaced with the participant's mean for the subscale in question. There were never more than two omitted answers in any given subscale.

There were 170 females who participated in the study. In terms of ethnicity, 29.4% of the sample indicated that they were Caucasian, 21.8% Chinese, 10.1% other Asian, 12.9% indicated they were 'North American', 12.4% were 'other', and for 12.9%, ethnicity data were not collected. Sixty-one percent of the sample indicated that English was their first language. The mean age of the sample was 20.43 (range of 18 to 41, sd=3.18). Thirty-five of the women (20.6%) indicated that they were currently dieting, 32 of whom (18.8%) reported that they were dieting to lose weight. The mean self-reported Body Mass Index (BMI) (calculated as kg/m^2) of the sample was 21.15 (range of 16.22 to 35.71, sd =2.96). See Table 1 for means and standard deviations of the constructs of interest.

Preliminary analyses involved examining the correlation matrix for the six scales (see Table 2). Higher body mass indices were significantly related to Rigid Control (r=.28, p<.001), Eating Self-Efficacy (r=.19, p=.01), Body-Image Dysphoria (SIBID) (r=.31, p<.001), and Preoccupying Cognitions Total (r=.40, p<.001). Consistent with the literature, BMI was not

related to Flexible Control (Westenhoefer et al., 1999) or the Beliefs about Appearance Scale (Spangler & Stice, 2001).

Table 1

Means and Standard Deviations of Constructs of Interest (N=170)

Scale	Mean	SD
Flexible Control	19.9	3.9
Rigid Control	25.3	5.7
Eating Self-Efficacy	83.3	23.8
Beliefs About Appearance	36.2	15.9
Body-Image Dysphoria (SIBID)	40.9	16.0
Perceived Stress	41.8	7.8
Preoccupying Cognitions (total)	60.7	20.5

Cortisol Findings

The 170 participants provided 337 usable cortisol results (3 samples did not yield sufficient saliva to perform analyses). It was decided a priori to exclude cortisol readings that were more than 6 standard deviations away from the mean. Two readings met this criterion, and were excluded from analyses, as they were likely artifacts. Thus, 168 readings for AM cortisol, and 167 readings for PM cortisol were used in all the analyses. The correlation between morning cortisol and afternoon cortisol samples was r=.24, p=.002. There were no significant differences among different ethnic groups for either AM or PM cortisol values (all ps>.05). There were also no differences in morning or afternoon cortisol levels between women who were currently taking oral contraceptives (N=62) and those who were not (N=105), p>.05.

Table 2

Intercorrelations Between Scales and BMI (N=170)

	Rigid Control	Eating Self-Efficacy	Beliefs about Appearance	Body-Image Dysphoria	Perceived Stress	Preoccupying Cognitions	BMI
Flexible Control	.82**	.18*	.39**	.47**	.18*	.67**	.11
Rigid Control	—	.23**	.47**	.54**	.16*	.78**	.28**
Eating Self-Efficacy	—	—	.38**	.44**	.30**	.44**	.19*
Beliefs about Appearance	—	—	—	.67**	.41**	.61**	.08
Body-Image Dysphoria	—	—	—	—	.42**	.75**	.31**
Perceived Stress	—	—	—	—	—	.33**	.15
Preoccupying Cognitions	—	—	—	—	—	—	.40**

Note. BMI=Body Mass Index
** $p<.01$, *$p<.05$

Morning cortisol. The mean AM cortisol reading was 23.9 nmol/l (range=0.7 to 69.6, sd=12.1), while the mean of the PM cortisol samples was significantly lower at 7.6 nmol/l (range=1.4 to 61.1, sd=7.0), $t(165)=18.2$, $p<.001$. Morning cortisol levels had a negative relationship with age ($r=-.19$, $p=.011$). There were no significant relationships between any of the body and eating attitude measures and the morning cortisol levels (all $ps>.05$). This was also true of the amalgamated cortisol scores (AM+PM), all $ps>.05$.

Afternoon cortisol. Because the afternoon cortisol levels were highly positively skewed, a logarithmic (log) transformation was performed on these data, yielding a distribution that was closer to normal. After this transformation, the mean was 0.78, sd= .26. For afternoon cortisol levels, there was a significant, positive relationship between scores on the BAAS (Beliefs about

Appearance) and PM cortisol, r=.18, p=.02. There was also a positive relationship between body shape cognitions and cortisol, r=.16, p=.04, but there was no relationship between afternoon cortisol and diet or food-related preoccupying cognitions (ps>.05). Women with higher Flexible Control scores also had higher afternoon cortisol levels, r=15, p<.05. There were no significant associations between afternoon cortisol and scores on the Rigid Control scale, the SIBID, ESES, and PSS, nor was cortisol significantly related to any of the meal plan items (all ps>.05). See Table 3 for correlations between cortisol values and psychological measures. Unexpectedly, the 48 women who provided saliva samples before completing the questionnaires had higher cortisol values than those who provided the samples later, $t(165)$=-2.4, p<.05.

Cortisol change. A residualized change score from morning to afternoon cortisol levels was calculated, in order to control for morning cortisol levels. This was done by regressing morning levels on to afternoon levels and deriving standardized residuals. Using this method, as opposed to a simple change score, the change in cortisol is statistically unrelated to morning levels, which had higher absolute values. Bivariate correlations were then run with the change scores. Cortisol change scores were significantly and positively related to Flexible Control (r=.17, p=.03) and Rigid Control (r=.16, p=.04). In addition, women scoring higher on the BAAS (r=.19, p=.01) had larger residualized change scores for cortisol, as did those endorsing more body shape cognitions (r=.18, p=.02), and preoccupying cognitions in general (total score) (r=.17, p=.03). Figure 1 graphically illustrates the correlation between cortisol change scores and the BAAS.

Table 3

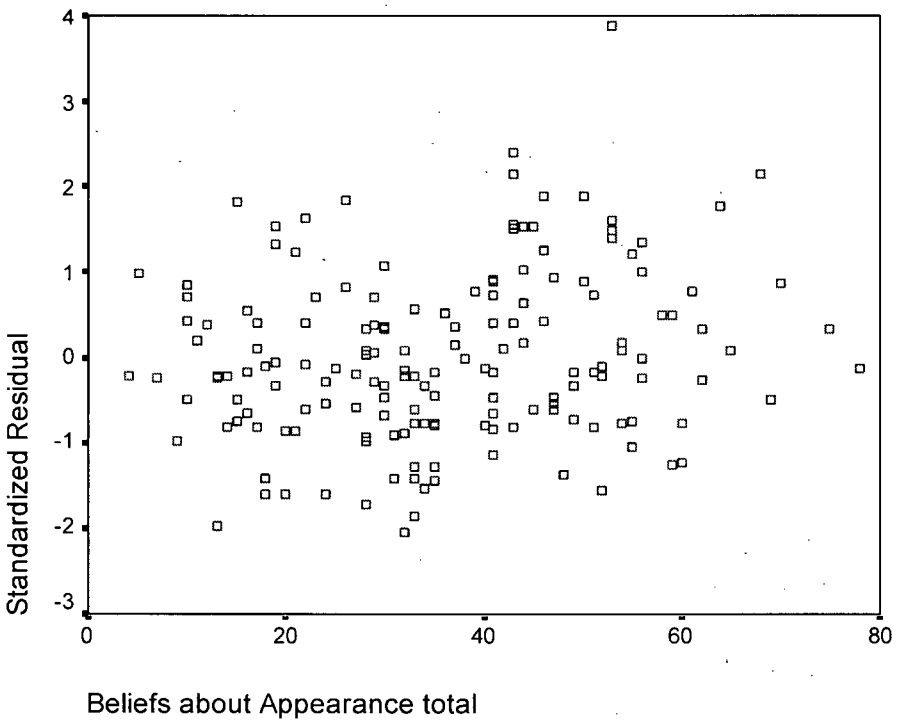
Intercorrelations Between Scales and Cortisol (N=167)

	AM Cortisol	PM Cortisol	Cortisol Change
Flexible Control	-.02	.15*	.17*
Rigid Control	-.04	.14	.16*
Eating Self-Efficacy	.08	.12	.10
Beliefs about Appearance	.09	.18*	.19*
Body-Image Dysphoria	.01	.13	.14
Perceived Stress	.01	.12	.13
Preoccupying Cognitions (Total)	-.02	.15	.17*
Preoccupying Cognitions (Body)	-.02	.16*	.18*
Preoccupying Cognitions (Food)	.02	.10	.12
Preoccupying Cognitions (Diet)	-.03	-.02	-.01
PM Cortisol	.24**	—	—

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

Figure 1

Scatterplot of Correlation Between BAAS and Cortisol Change Scores (N=170)



Hierarchical Regression Analyses

The BAAS scores and TFEQ (Flexible and Rigid Control Scales were summed) scores were entered into a hierarchical regression analysis with PM cortisol as the dependent variable. Hierarchical regression was used to control the order of entry of the independent variables, and to assess both the unique and overlapping variability that each variable contributes to the dependent variable (Tabachnik & Fidell, 2001). BAAS scores contributed significantly to afternoon cortisol variance, $F(1, 164)=5.94$, $p<.05$, and the addition of TFEQ scores to the equation did not result in a significant increment in R^2 .The BAAS scores and TFEQ scales were each significant predictors of afternoon cortisol when entered first into the regression analysis ($R^2= .03$, $\beta =.19$, $p=.02$, and $R^2= .02$,

β =.15, p<.05, respectively). However, both were rendered nonsignificant when combined in the model, ps>.05. These scales were also regressed onto residualized change cortisol scores. The same pattern of results emerged (see Table 4), where each was a significant

Table 4

Summary of Hierarchical Regression Analysis using BAAS, FC, and RC as Predictors of Cortisol (N= 167)

Variable	R^2 (Adj)	b	β	p
Predicting PM Cortisol				
Step 1	.03	—	—	.02
Beliefs about Appearance	—	.00	.19	.02
Step 2 (BAAS + FC)	.03	—	—	.26
Beliefs about Appearance	—	.00	.15	.08
Flexible Control	—	.01	.09	.26
Predicting Residualized Cortisol				
Step 1	.03	—	—	.01
Beliefs about Appearance	—	.01	.20	.01
Step 2 (BAAS + FC + RC)	.04	—	—	.24
Beliefs about Appearance	—	.01	.15	.09
Flexible Control + Rigid Control	—	.01	.10	.24

Note. FC=Flexible Control, RC=Rigid Control, BAAS= Beliefs about Appearance Scale.

predictor when added to the model first ($ps<.05$), but the effects were no longer significant when combined in the equation. There was no evidence of any suppressor effects.

Factor Analyses

Because there were such large intercorrelations between most of the measures in the study, an exploratory factor analysis was performed in order to elicit the most parsimonious constructs/factors among the overlapping set of measures of eating and body attitudes. All items were entered into a factor analysis. Principal Components Analysis was used as the method of factor extraction. An analysis of the scree plot revealed a break after seven factors. However, the first factor in the factor analysis accounted for 27.04% of the variance, and had a very large eigenvalue of 30.82. The next two factors only added an additional 7.34% and 5.91%, respectively, to the variance. Factor loadings larger than .30 were retained. After these considerations, as well as for conceptual reasons, it was decided that the current model would include three factors. Together, these three factors accounted for 40.29% of the variance. A direct oblimin oblique rotation was then performed on the data, in order to allow for overlap between the factors. This rotation rendered the pattern matrix rather simple to interpret. Factor I consisted of body-image and appearance-related items. It included the entire BAAS scale, all of the SIBID scale (except for one item), and all but three of the body shape items in the Preoccupying Cognitions Scale. Thus, this factor can be seen as a concern with body-image and appearance factor. Factor II contained the Eating Self-Efficacy items that form the eating-when-experiencing-negative-affect factor. Factor III consisted mainly of items related to dieting, including items from both the TFEQ Flexible and Rigid Control scales, diet-related preoccupying cognitions, and some body-related items as well (these had lower factor loadings than those that made up Factor I).

Regression Analysis with Factor Scores

Because performing the aforementioned factor analysis presumably decreases some of the redundancy of the independent variables, the regression analyses were repeated using the three factors as independent variables in order to get a better sense of the contribution of the various constructs in question to cortisol variability. A hierarchical regression analysis was performed, using the PM cortisol as the dependent variable, and the three factors as the independent variables. The only significant factor to emerge was Factor I. Factor I was added to the regression first for theoretical reasons. It was reasoned that body-related dysphoria and appearance beliefs should predate, or at least underlie, dieting motivations and behaviour. This factor accounted for a significant proportion of the variance in cortisol, $F(1, 163)=5.7$, $p<.05$, and the addition of the other two factors did not result in a significant increase in R^2. Factor I remained significant with the addition of the second factor to the equation ($R^2= .03$, $\beta =.17$, $p=.03$), but its effects washed out with the addition of the third factor to the model (see Table 5). The same regression analysis was run using the residualized change scores as the dependent variable. The same pattern emerged, where Factor I accounted for a significant proportion of variance in residualized cortisol ($R^2= .03$, $\beta =.20$, $p=.01$). Once again, this factor accounted for a significant portion of the variance when Factor II was added to the model ($\beta =.20$, $p=.02$), and its effects were still significant with all three factors in the model ($p=.05$). This factor was a significant predictor of residualized cortisol, yet still only accounted for a small proportion of the variance (3%).

Table 5

Summary of Hierarchical Regression Analysis using Factor Scores as Predictors of Cortisol (N=167)

Variable	R^2 (Adj)	*b*	β	*p*
Predicting PM Cortisol				
Step 1	.03	—	—	.02
Factor I	—	.05	.18	.02
Step 2 (Factor I + II)	.02	—	—	.66
Factor I	—	.05	.17	.03
Factor II	—	.01	.04	.66
Step 3 (I + II + III)	.02	—	—	.50
Factor I	—	.04	.15	.08
Factor II	—	.01	.03	.69
Factor III	—	.02	.06	.50
Predicting Residualized Cortisol				
Step 1	03	—	—	.01
Factor I	—	.20	.20	.01
Step 2 (Factor I + II)	.03	—	—	.92
Factor I	—	.20	.20	.02
Factor II	—	-.01	-.01	.92
Step 3 (I + II + III)	.03	—	—	.29
Factor I	—	.17	.17	.05
Factor II	—	-.01	-.01	.87
Factor III	—	.09	.09	.29

Note. Factor I= Body Image/Appearance, Factor II = Eating Self-Efficacy, Factor III= Diet/Restraint

The results were also examined to ensure that current dieting status did not account for the main findings. The 32 women who indicated that they were currently dieting to lose weight were excluded from the analyses, and the overall pattern of results was not altered. Also, there was no significant difference in cortisol values between current dieters and non-dieters (p>.05).

Perceived Stress

Although there was no relationship between cortisol levels and perceived stress in this study, one of the questions it sought to address was the relationship between various eating and body attitudes and stress. The main purpose was to examine these factors with respect to physiological stress, but regression analyses were performed in order to examine the nature of the association between these constructs and self-reported stress. Once again, this time with perceived stress as the dependent variable, regression analyses were run both with the individual scales and the factor scores as predictors. Because all six (that is, FC, RC, ESES, PC, SIBID, BAAS) scales were significantly correlated with the PSS, these were all entered into a regression analysis. When all six scales were added to the model, the only two scales that remained significant were the SIBID and BAAS (ΔR^2 = .05 and .03, respectively, and both β =. 24, ps<.05) (see Table 6). The three factor scores were also regressed onto the PSS. All three factors accounted for 24% of the variance in perceived stress. In this analysis, both Factor I (the body-image and appearance-related factor) and Factor II (the eating self-efficacy factor) predicted a significant amount of variance in perceived stress (ΔR^2 = .13 and .10, respectively, and β =. 40 and .21, respectively, ps<.01).

Table 6

Summary of Hierarchical Regression Analysis for Variables Predicting Perceived Stress (N=168)

Variable	R^2 Change	*p*	*b*	β	*p*
Flexible Control	.03	.02	.24	.12	.33
Rigid Control	.00	.77	-.35	-.26	.08
Eating Self-Efficacy	.08	.00	.04	.12	.13
Preoccupying Cognitions	.04	.00	.03	.07	.64
Body-Image Dysphoria	.05	.00	.12	.24	.03
Beliefs about Appearance	.03	.01	.12	.24	.01
Factor I	.13	.00	3.09	.39	.00
Factor II	.10	.00	1.65	.21	.00
Factor III	.01	.12	-.10	-.01	.86

Note. Factor I= Body Image/Appearance, Factor II = Eating Self-Efficacy, Factor III= Diet/Restraint

Discussion

This was the first study to assess the relationship between cortisol secretion and a variety of eating behaviour and body attitudes. The association between elevated cortisol and dietary restraint had already been established in the literature, and thus the purpose of this study was to shed light on which constructs associated with restraint may contribute to this finding. Both the Cognitive Restraint scales and Beliefs about Appearance (BAAS) scores contributed a small but significant amount of variance to afternoon cortisol, as well as to residualized change scores in cortisol. None of the other eating or body-related scales was significantly related to cortisol. However, after a factor analysis was performed to derive a more distilled picture of the eating and body-related variables, beliefs about appearance, combined with body-related dysphoria emerged as the only significant construct that predicted PM cortisol and change in cortisol. This was a small effect, but, still significant considering that this study was using a) a psychological construct to predict variance in a physiological one, and b) only using two cortisol samples, from a single day. Thus, from the current findings, it appears as though dissatisfaction related to one's appearance or body shape, as well as the belief that this aspect is critical for a variety of life domains may be a significant part of the cortisol-restraint link.

It was disappointing to learn that the morning peak cortisol levels were not related to any of the eating or body-related measures. However, the results suggest that the strain elicited by appearance or eating attitudes is likely not chronic and stable in nature, but may vascillate in response to daily stressors, which only emerge over the course of the day, and not immediately upon awakening. A heightened morning surge in cortisol appears to be a marker of more severe, chronic stress (e.g., Steptoe et al., 2000; Wust et al., 2000). Perhaps it is necessary to encounter meal times, media images, mirror reflections, or other eating and body-image stimuli for this

type of stress to emerge. In fact, in one study that did not find any relationship between restraint and cortisol, urinary cortisol was collected overnight (Pirke et al., 1990). Other researchers have noted that perhaps the lack of food-related cue exposure during sleep may explain these null findings (e.g., McLean et al., 2001b). It is possible that this same phenomenon can explain the current pattern. In contrast, Anderson et al. (2002) collected salivary cortisol samples between 9:15 and 11:00 AM, using a smaller sample, and found that restrained eaters had elevated cortisol. But, they did not collect this sample at the participants' home, and no attention was made to the time of awakening. Therefore, there may have been sufficient time for participants to encounter stressful cues.

We also suspected that the act of filling out eating and body-related questionnaires might be stress-inducing in itself, but an unexpected, but interesting finding was that the women who completed the questionnaires before providing their saliva samples had lower levels of cortisol than those who provided them before answering the questions. Perhaps filling in the questionnaires and staying seated for the hour was sedating. Alternately, answering questions about their eating attitudes and body image had a subtle cathartic effect. Another possibility is that these lower values represent the natural diurnal rhythm of cortisol: since cortisol values gradually decrease over the day, and the women who provided the samples after the questionnaire were, on average, providing these one hour later, and hence, farther along in their downward slope. However, this speculation must be tempered by the fact that these differences were noted in a small subset of the total sample.

An interesting finding was that both subscales of TFEQ Restraint (and in most analyses, only the Flexible Control subscale) were related to cortisol. It was hypothesized that the Rigid Control subscale, given its relationship with disinhibited and problematic eating, would be more responsible for the relationship between cortisol and restraint. In this study, it was the measure of

more 'successful' restraint that was related to cortisol. This is unexpected, but actually consistent with the literature. Anderson et al. (2002), in their study on dietary restraint and cortisol, actually found that restraint as measured by the TFEQ was more strongly related to cortisol than findings from the Restraint Scale (RS). The impetus for the development of the TFEQ was to tease out disinhibition from restraint (Stunkard & Messick, 1985), whereas the RS has been criticized for confounding these two constructs, and thus reflect more unsuccessful dieting (Heatherton et al., 1988). Moreover, we have seen that current dieters display greater deficits in their cognitive performance than restrained eaters who are not actively dieting (Green et al., 1994). However, Lowe and Timko (2004) point out that current dieting status may also reflect a history of more frequent dieting. Perhaps the resolve needed to take this more flexible (and perhaps more successful) approach to restriction takes greater commitment, and, as a result, is more taxing. Or, alternatively, it may be that cognitive restraint, independent of disinhibited eating and weight fluctuation, is the more stress-inducing component of restraint.

One would think that constantly confronting the conflict between one's desire to restrict intake, and the lack of successful weight loss would be highly stressful. However, it appears that there is something about Flexible Control that is stress-inducing. Although some have argued that it (along with the TFEQ as a whole) is a measure of more successful restraint, others have pointed out that restraint, as measured by the commonly used measures, does not accurately reflect caloric restriction (e.g., Stice et al., 2004). Unfortunately, the distinction between Rigid and Flexible control was not made by the authors of this study. It is possible that the weight gain (or higher body weight) characteristic of rigidly controlled restrained eaters and the more successful weight loss attempts that mark more restrained eaters (as claimed by Westenhoefer et al., 1999) cancel each other out when caloric intake is measured using the entire scale. In the

present study, as in others, Rigid Control was positively associated with BMI, whereas Flexible Control was not. However, we cannot say that Flexible Control is a measure of more successful restraint, as it did not have a negative relationship with BMI. These data demonstrate that Flexible Control does not appear to be marked by the same dietary pitfalls that seem to be associated with Rigid Control (regardless of the direction of the BMI-restraint relationship). This leaves us with the interpretation that dietary restraint (that may or may not reflect true restriction) that is not associated with disinhibited eating is positively related to cortisol excretion.

Although in this study, perceived stress was not related to cortisol, similar variables that were related to higher levels of cortisol release were also related to perceived stress. Body-image dysphoria and beliefs about appearance were the only constructs that predicted a significant amount of variance in perceived stress when all of the scales were added to the regression equation. When the factor scores were used to predict perceived stress, it was the body-image and appearance related factor, as well as eating self-efficacy that were related to perceived stress over and above the effects of the restraint measures. Previous research has found that self-efficacy, in general, predicts perceived stress (Bandura et al., 1988). It is therefore interesting to note that in the current study eating-self efficacy, more specifically, predicted perceived stress. On the surface, these three scales are the most emotionally charged. Feeling less competent at controlling one's overeating, believing that one would be more successful if one were more attractive, and body-image dysphoria are presumably related to distress more than restraint should be, in theory. However, at least one study has found that scores on the PSS were higher among restrained women (McLean & Barr, 2003). In the current study, Flexible Control was no longer a significant predictor of perceived stress once the appearance-related

measures were added. Given that restrained eaters are more dissatisfied with their bodies, the restraint-stress relationship already established may have been a result of the distress surrounding appearance and body-image, and not restraint per se. The current finding that body and appearance-related constructs contribute to the prediction of both perceived stress and cortisol adds to our understanding of restraint-related stress. These data suggest that appearance concerns are related to two possibly different indicators of stress—namely, physiological activation and perceived stress.

Just as perceived stress did not explain the relationship between restraint and irregular menstrual cycles found by McLean & Barr (2003), in the current study, perceived stress does not mediate the relationship between appearance beliefs and cortisol, since the PSS scores were not related to cortisol in the first place. Interestingly, a study that examined the effects of perceived stress on wound healing (Ebrecht et al., 2004) did not find that perceived stress was related to cortisol awakening responses, even though perceived stress was related to wound healing, and wound healing was related to cortisol. These authors surmised that the PSS, given that it assesses stress during the previous month, is not as much of a reflection of chronic stress as is the morning cortisol response. Rideout et al. (in press) did not find that perceived stress or daily stress was related to cortisol elevations in postmenopausal women. Moreover, women with bulimic tendencies, despite scoring higher in trait anxiety and showing physiological markers of stress, such as greater cardiovascular reactivity to an interpersonal lab task and urinary cortisol excretion, also did not report higher levels of overall perceived stress (Koo-Loeb et al., 2000). It is possible that this construct of stress is not related to HPA-axis activation. Given that the PSS assesses stress levels over the previous month, while the cortisol sampling may reflect changes in HPA activation over the last half hour or so (Kirschbaum & Hellhammer, 1989), the PSS may

not have been picking up on the current state that was indexed, more subtly, by cortisol excretion. It may be that the type of activation related to restraint and appearance beliefs taps into two different aspects of stress—self-reported stress and cortisol excretion. That some body and eating related measures were related to cortisol, while perceived stress was not, suggests that perhaps another form of stress, or distress, may be accounting for sympathetic activation, or increases in cortisol release among women who are highly concerned about their body size or appearance.

Although the factor scores only slightly increased the regression coefficients in the prediction of variance in cortisol in this particular study, the high intercorrelations between the various constructs warranted simplification to reduce redundancy, both from a theoretical and statistical standpoint. The fact that one of the factors alone accounted for almost a third of the variance in the items points to the fact that there is much overlap in many of the eating and body-related measures. This model may be useful for future research in this field.

The most robust finding of this study was that body-image and appearance-related beliefs and dysphoria were related to afternoon cortisol secretion. It may be that the elevated cortisol findings among women high in dietary restraint of past studies are actually a reflection of distorted appearance beliefs and distress about body-image. This idea is also consistent with the current finding that preoccupying cognitions regarding body shape, but not food or diet, were associated with higher levels of afternoon cortisol. It was interesting to note that similar cognitions were believed to mediate the cognitive deficits seen in dieters in the study by Green et al. (2003). Because the current study was the first among the restraint-cortisol literature to include measures of body-image and appearance beliefs, as well as other measures of eating attitudes, it is possible that this unmeasured construct may have accounted for those findings in

these other studies. From a theoretical standpoint, it seems logical that overvalued beliefs about the importance of appearance and having a thin physique would preclude the motivation to restrict. Beliefs about the consequence of one's appearance are thought to underlie the desire to diet (Spangler & Stice, 2001). In fact, the BAAS has been found, in past research, to predict restraint over and above BMI and body dissatisfaction (Spangler & Stice, 2001). In the current study, BAAS scores were also uncorrelated with BMI. Thus, as we know, it is not simply excess weight that leads to dietary restriction.

Beliefs about the importance of one's appearance across different aspects of one's life likely represent some of the core values and set of attitudes that lead to the desire to be thinner, and, ultimately, to engage in dieting behaviour. The literature seems to show that the level of body dissatisfaction predicts dietary restraint (e.g., Paa & Larson, 1998). Underlying discrepancies between one's current and ideal body size are also thought to underlie dieting behaviours (Harrison, 2001). Moreover, it is body dissatisfaction, and not restraint, that appears to predict stress, depression, and problematic eating (Johnson & Wardle, 2005). Past research also suggests that dieting that is motivated by aesthetic reasons is associated with more problematic eating and higher levels of restraint (Putterman & Linden, 2004). Since appearance beliefs appear to predict body dissatisfaction (Spangler, 2002), these overvalued beliefs about the significance of one's appearance may be first step in the downward spiral of eating and weight issues. Conceptually, it makes sense to say that believing one's appearance is highly important should predate body dissatisfaction—negative emotions surrounding one's body would seem unlikely if appearance were considered less relevant. Thus, taking a step back from restraint, and perhaps even body dissatisfaction, and examining the dysfunctional cognitions and beliefs that fuel such behaviour is likely a ripe target for intervention. Moreover, it is likely that it is these

feelings of 'not measuring up' in terms of appearance that give rise to negative emotions, such as anxiety and dysphoria. Indeed, beliefs about the importance of appearance predicted perceived stress in the current study. Importantly, the current data suggest that these beliefs are related to markers of physiological activation, which other studies have shown can eventually take their toll on women's bone health and reproductive systems (e.g., Barr, Prior, & Vigna, 1994; Schweiger et al., 1992).

Interestingly, overvalued beliefs about the importance of one's appearance for one's self-view, emotions, relationships, and achievement are also thought to heighten one's focus on appearance-related stimuli (Spangler & Stice, 2001). Since in the current study, BAAS scores were related to afternoon, and not morning cortisol levels, it may be that women who harbour these beliefs are more sensitive to these ubiquitous stimuli that we are exposed to over the course of the day. They may be more likely to notice, and thus react negatively to such cues. This may be a result of activation of body related self-discrepancies—the disparity between one's current and ideal size, as body dissatisfaction has been conceptualized in this manner in the past (e.g., Williamson et al., 1993), which is also related to heightened sympathetic activation (Strauman et al., 1993). We know, from previous research, that more highly restrained women, who are less satisfied with their bodies, are more susceptible to laboratory-induced body dissatisfaction (through imagining body-focused situations) (Tiggemann, 2001). A fruitful direction for future research would thus be to manipulate exposure to appearance and body-image cues to see if women higher in restraint or with more firmly entrenched appearance beliefs are also more physiologically responsive to the activation of such beliefs or self-discrepancies.

One of the strengths of the study was the attention paid to the time of waking up. Many studies measuring salivary cortisol in the afternoon or morning in the laboratory do not take the

time of awakening into account. Participants were scheduled to come to the laboratory six to eight hours after they planned to wake up, thus assuring a moderate amount of consistency in where participants were in their diurnal rhythm of cortisol secretion.

The decision to use using factor analysis as an analytical strategy for the data was borne out of the evidence for such high intercorrelations, and thus, redundancy in the various measures on eating and body attitudes. There are many measures in use in research on dieting and restraint, and much confusion still exists about what underlying constructs such measures tap into. Paring the measures down may be helpful in further developing the theory in this field. The factor analysis therefore served as a useful way to reduce overlap, and thus present a more parsimonious way of understanding the constructs and current findings.

There were a number of limitations to this study. The most significant was that only two cortisol samples were taken from each participant, and only on a single day. There is generally high intra-individual variability in unstimulated cortisol levels (Coste, Straugh, Letrait, & Bertagna, 1994), and this was also reflected in the fairly low intercorrelation between morning and afternoon cortisol readings in this sample. More data points for each participant might have produced larger effects. Having had multiple samples, and over various days, would have possibly yielded more reliable information, and would have allowed for both within and between analyses, as well as more sophisticated analyses of cortisol patterns. However, the pattern of the current data does not suggest that the cortisol *awakening* response, a presumed index of more chronic and severe stress, is at all related to dietary restraint, since the morning peak levels in these data were not related to restraint, whereas afternoon cortisol levels were consistently related. Cortisol sampling over multiple days would have been ideal for increasing the reliability of this index but it is also very burdensome for participants and would have negatively affected

recruitment for the large sample needed for factor analyses of the critical psychological constructs. In addition, having included another measure of overall distress, as opposed to body-related distress and perceived stress, may have also helped clarify the current picture.

To conclude, despite having a relatively small sampling of cortisol values from the women who took part in this study, some patterns emerged that shed light on the relationship between dietary restraint and stress. This was the first study to examine the relationship between other measures of eating and body attitudes besides restraint, and cortisol secretion. The current results suggest that appearance beliefs and body-related concerns and cognitions are related to both higher levels of perceived stress and afternoon elevations in cortisol more than is restraint on its own. It may be that identifying women higher in restraint, as past studies have done, may represent an identification of women who are more concerned with their bodies and appearance in general. It may be these dysfunctional beliefs that contribute to the physiological markers of stress discovered by other researchers. These beliefs likely represent a critical area of intervention, in that they may contribute to both unhealthy dieting behaviours and stress. Future research should investigate this pathway using longitudinal data, models of mediation, or laboratory manipulations of various body dissatisfaction or appearance-related stimuli.

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Appendix I: Questionnaire

ID:

Please complete the following questions as truthfully as you can. There are no right or wrong answers. Thank you.

1. Age:_____ Height:_____ Weight:_____

2. Marital Status (Please circle one):

Single Married Common-Law Living with Partner

3. How many hours of physical activity do you engage in during a typical week (hours per week)?

0-1 2-3 4-6 7-9 10+

4. Are you currently taking oral contraceptives? Yes No

5. Are you *currently* dieting? Yes No

6. Are you currently dieting in order to lose weight? Yes No

7. Please indicate the extent to which the reason you are dieting (or have dieted in the past) is to improve your **appearance** (such as fit into another size clothing/ change your body shape/ look younger):

1	2	3	4	5	6	7	8	9	10
Not at all			Somewhat			Mostly		Very much so	

8. Were there any particularly unusual or stressful experiences or circumstances in your life in this week? Please explain:

_____

_____

_____

_____

_____

TFEQ

FC

(1) When I have eaten my quota of calories, I am usually good about not eating any more.

True False

(2) I deliberately take small helpings as a means of controlling my weight.

True False

(3) While on a diet, if I eat food that is not allowed, I consciously eat less for a period of time to make up for it.

True False

(4) I consciously hold back at meals in order not to gain weight.

True False

(5) I pay a great deal of attention to changes in my figure.

True False

(6) How conscious are you of what you are eating?

1	2	3	4
not at all	slightly	moderately	extremely

(7) How likely are you to consciously eat less than you want?

1	2	3	4
unlikely	slightly likely	moderately likely	very likely

(8) If I eat a little bit more on one day, I make up for it the next day.

True False

(9) I pay attention to my figure, but I still enjoy a variety of foods.

True False

(10) I prefer light foods that are not fattening.

True False

(11) If I eat a little bit more during one meal, I male up for it the next meal.

True False

(12) Do you deliberately restrict your intake during meals even though you would like to eat more?

1	2	3	4
always	often	rarely	never

RC

(1) I have a pretty good idea about the number of calories in common food.

True False

(2) I count calories as a conscious means of controlling my weight.

True False

(3) How often are you dieting in a conscious effort to control your weight?

1	2	3	4
rarely	sometimes	usually	always

(4) Would a weight fluctuation of 5 lbs. Affect the way you live your life?

1	2	3	4
not at all	slightly	moderately	very much

(5) Do your feelings of guilt about overeating help you to control your food intake?

1	2	3	4
never	rarely	often	always

(6) How frequently do you avoid 'stocking up' on tempting foods?

1	2	3	4
almost never	seldom	usually	almost always

(7) How likely are you to shop for low calorie foods?

1	2	3	4
unlikely	slightly unlikely	moderately likely	very likely

(8) I eat diet foods even if they do not taste very good.

True False

(9) A diet would be too boring a way for me to lose weight.

True False

(10) I would rather skip a meal than stop eating in the middle of one.

True False

(11) I alternate between times when I diet strictly and times when I don't pay much attention to what and how much I eat.

True False

(12) Sometimes I skip meals to avoid gaining weight.

True False

(13) I avoid some foods on principle even though I like them.

True False

(14) I try to stick to a plan when I lose weight.

True False

(15) Without a diet plan I wouldn't know how to control my weight.

True False

(16) Quick success is most important for me during a diet.

True False

The following questions are regarding the projected food/meal plan that you completed this morning.

a) Please rate, on the following scale, the degree to which you followed through with your projected meal plan for the day:

1 2 3 4 5 6 7 8 9 10

Did not follow at all — Followed extremely well/ I had no plans

b) Please rate, on the following scale, how you feel about how you ate today so far:

1 2 3 4 5 6 7 8 9 10

Very disappointed — Don't care — Very satisfied

ESES

For numbers 1-25 you should rate the likelihood that you would have **difficulty controlling your overeating in** each of the situations listed using this scale:

1 2 3 4 5 6 7
No Difficulty Moderate Difficulty Most Difficulty

How **DIFFICULT** is it to control your **OVEREATING**....

1. After work or school. ____
2. When you feel restless. ____
3. Around holiday time. ____
4. When you feel upset. ____
5. When tense. ____
6. With friends. ____
7. When preparing food. ____
8. When irritable. ____
9. As part of a social occasion dealing with food—like at a restaurant or dinner party. ____
10. With family members. ____
11. When annoyed. ____
12. When angry. ____
13. When you are angry at yourself. ____
14. When depressed. ____
15. When you feel impatient. ____
16. When you want to sit back and enjoy some food. ____
17. After an argument. ____
18. When you feel frustrated. ____
19. When tempting food is in front of you. ____
20. When you want to cheer up. ____
21. When there is a lot of food available to you (refrigerator is full). ____
22. When you feel overly sensitive. ____
23. When nervous. ____
24. When hungry. ____
25. When anxious or worried. ____

BAAS

1. The opinion others have of me is based on my appearance.

0	1	2	3	4
not at all				extremely

2. The amount of influence I have on other people depends upon how I look.

0	1	2	3	4
not at all				extremely

3. People will think less of me if I don't look my best.

0	1	2	3	4
not at all				extremely

4. People would be more interested in me if I looked better.

0	1	2	3	4
not at all				extremely

5. My relationships would improve if I looked the way I wished.

0	1	2	3	4
not at all				extremely

6. The amount of success I have in my (future) job or career depends largely upon how I look.

0	1	2	3	4
not at all				extremely

7. My appearance influences my ability to do things.

0	1	2	3	4
not at all				extremely

8. My performance in activities (e.g., school, work, hobbies, etc.) is influenced by how I look.

0	1	2	3	4
not at all				extremely

9. The opportunities that are available to me depend upon how I look.

0	1	2	3	4
not at all				extremely

10. My school and work performance or opportunities would improve if I looked the way I wished.

0	1	2	3	4
not at all				extremely

11. My value as a person depends upon how I look.

0	1	2	3	4
not at all				extremely

12. How I feel about myself is largely based on my appearance.

0	1	2	3	4
not at all				extremely

13. I would think more highly of myself if I looked the way I wished.

0	1	2	3	4
not at all				extremely

14. How I look is a large part of who I am.

0	1	2	3	4
not at all				extremely

15. It is difficult to feel good about myself when I am not looking my best.

0	1	2	3	4
not at all				extremely

16. My ability to feel happy depends upon how I look.

0	1	2	3	4
not at all				extremely

17. Improving my appearance is one of the few activities that makes me feel good or like I am accomplishing something.

0	1	2	3	4
not at all				extremely

18. My life will be more exciting or rewarding if I look good.

0	1	2	3	4
not at all				extremely

19. My moods are influenced by how I look.

0	1	2	3	4
not at all				extremely

20. I would enjoy life more if I looked the way I wished

0	1	2	3	4
not at all				extremely

SIBID-S QUESTIONNAIRE

INSTRUCTIONS:

At various times and in various situations, people may experience negative feelings about their own physical appearance. Such feelings include feelings of unattractiveness, physical self-consciousness, distress, or dissatisfaction with one or more aspects of one's appearance. This questionnaire lists a number of situations and asks how often you have uncomfortable feelings about your physical appearance in each of these situations.

Think about times when you have been in each situation and indicate how often you've had negative feelings about your physical appearance in that situation. Use the 0 to 4 scale below to indicate **HOW OFTEN** you have such negative emotional experiences:

0	1	2	3	4
Never	Sometimes	Moderately Often	Often	Always or Almost Always

There may be situations on the list that you have not been in or that you avoid. For these situations, simply indicate how often you believe that you would experience negative emotions about your appearance if you were in the situation.

Please answer accurately and honestly by entering a number from 0 to 4 in each space to describe your experiences. There are no right or wrong answers.

HOW OFTEN?

_____ 1. At social gatherings where I know few people

_____ 2. When I look at myself in the mirror

_____ 3. When people see me before I've "fixed up"

_____ 4. When I am with attractive persons of my sex

_____ 5. When I am with attractive persons of the other sex

_____ 6. When someone looks at parts of my appearance that I dislike

HOW OFTEN DO YOU HAVE NEGATIVE FEELINGS ABOUT YOUR APPEARANCE?

0 = Never 1 = Sometimes 2 = Moderately Often 3 = Often 4 = (Almost) Always

HOW OFTEN?

_____ 7. When I look at my nude body in the mirror

_____ 8. When I am trying on new clothes at the store

_____ 9. After I have eaten a full meal

_____ 10. When I see attractive people on television or in magazines

_____ 11. When I get on the scale to weigh

_____ 12. When anticipating or having sexual relations

_____ 13. When I'm already in a bad mood about something else

_____ 14. When the topic of conversation pertains to physical appearance

_____ 15. When someone comments unfavorably on my appearance

_____ 16. When I see myself in a photograph or videotape

_____ 17. When I think about what I wish I looked like

_____ 18. When I think about how I may look in the future

_____ 19. When I am with a certain person

_____ 20. During certain recreational activities

The questions in this scale ask you about your feelings and thoughts *during the last month.* In each case, you will be asked to indicate ***how often*** you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up the number of times you felt a particular way, but rather circle the alternative that seems like a reasonable estimate.

In the last month, how often....	never	almost never	some-times	fairly often	very often
1. ...have you been upset because of something that happened unexpectedly?	1	2	3	4	5
2. ...have you felt that you were unable to control the important things in your life?	1	2	3	4	5
3. ..have you felt nervous and "stressed"?	1	2	3	4	5
4. ...have you dealt successfully with irritating life hassles?	1	2	3	4	5
5. ...have you felt that you were effectively coping with important changes occurring in your life?	1	2	3	4	5
6. ...have you felt confident about your ability to handle your personal problems?	1	2	3	4	5
7. ...have you felt that things were going your way?	1	2	3	4	5
8. ...have you found that you could not cope with all the things that you had to do?	1	2	3	4	5
9. ...have you been able to control irritations in your life?	1	2	3	4	5
10. ...have you felt that you were on top of things?	1	2	3	4	5
11. ...have you been angered because of things that happened that were outside of your control?	1	2	3	4	5
12. ...have you found yourself thinking about things that you have to accomplish?	1	2	3	4	5
13. ...have you been able to control the way you spend?	1	2	3	4	5
14....have you felt difficulties were piling up so high that you could not overcome them?	1	2	3	4	5

PCS

1. I have noticed the shape of other women and felt that my own shape compared unfavourably.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

2. Being with thin women has made me feel self-conscious about my shape.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

3. I am aware of the sugar and fat content in foods.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

4. I have been worried that my flesh is not firm enough.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

5. I am scared about being overweight.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

6. I think that I am this shape because I lack control.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

7. Worry about my shape has made me feel I ought to exercise.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

8. I think a lot about wanting to be thinner.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

9. I am aware of the energy content in food.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

10. I have been particularly self-conscious about my shape when in the company of other people.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

11. I have worried about other people seeing rolls of flesh around my waist or stomach.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

12. I spend most of the day thinking about food.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

13. I think a lot about having fat on my body.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

14. I am preoccupied with thoughts about food and eating.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

15. I spend a lot of time thinking about my weight.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

16. I am so worried about the shape of my body that I have been feeling the need to diet.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

17. I give too much time and thought to food.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

18. Thinking about my shape has interfered with my ability to concentrate.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

19. I have a food-dominated life.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always

20. I am preoccupied with thoughts about the shape of my body.

1	2	3	4	5	6
Never	Rarely	Sometimes	Often	Very Often	Always