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The Effects of Exogenous and Endogenous Gonadal Hormones and Hormonal Sensitivity on Eating Disorder Symptoms

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PhD Dissertation

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Abstract

A previous study found that a history of oral contraceptive (OC) side effects was associated with greater body dissatisfaction and eating dysfunction (Bird & Oinonen, 2011). This finding contributes to the growing body of research that suggests an etiological role for gonadal hormones in eating disorder (ED) symptoms. The purpose of this study was to further examine: (a) the relationship between OC use and ED symptoms using a prospective design, and (b) the relationship between levels of endogenous gonadal hormones and ED symptoms. Six-hundred-forty-two female participants completed a questionnaire examining OC experiences, body dissatisfaction, and eating dysfunction. A portion of these participants completed follow-up questionnaires six months and one year later. Fifty-two women also provided saliva samples to be analyzed for levels of estradiol (E), progesterone (P), and testosterone (T). The proposed structural model (with post-hoc modifications) indicated that greater hormonal sensitivity was associated with higher eating disorder symptoms. The presence of direct/indirect effects of OCs as well as hormonal sensitivity on ED symptoms was suggested by an increase in bulimia scores (but not BMI) in women after starting OC use (p = .002), and significantly higher Drive for Thinness scores in current versus never OC users (p = .002). A relationship between endogenous hormones and ED symptoms was also supported, as circulating T levels were correlated positively with Body Dissatisfaction in the mid-luteal phase (p = .020), and E and T levels together significantly explained Drive for Thinness in the post-menses phase (p = .022). These findings provide further evidence for a link between hormones and disordered eating attitudes and behaviours.

The Impact of Exogenous and Endogenous Gonadal Hormones and Hormonal Sensitivity on Eating Disorder Symptoms: A Prospective Study

Recently a new area of research in the field of eating disorders has emerged. Traditionally, research on eating disorders has centered on psychosocial factors that contribute to the disorders, including personality, familial and developmental factors, and psychiatric comorbidity (e.g., see reviews by Lilenfeld, 2004; Michel & Willard, 2004; Steiger & Bruce, 2004). Societal pressure on women to be thin and the role of the media has also been widely studied (see review by Fallon, 1990; Stice, Schupak-Neuberg, Shaw, & Stein, 1994). Lately, however, some studies have focused on biological and genetic factors that might contribute to the etiology of anorexia nervosa (AN) and bulimia nervosa (BN; e.g., see review by Bulik, 2004; Monteleone et al., 2003). Gonadal hormones have been implicated (Klump et al., 2006), and this line of research has prompted genetic studies focusing on estrogen (E) and serotonin genes (5-HT; e.g., Eastwood, Brown, Markovic, & Pieri, 2002; Gorwood, 2004). Far more studies are needed to understand the complex role that both endogenous and exogenous hormones might play in eating disorder symptomatology. The present study examined body dissatisfaction, drive for thinness, and bulimic symptoms, key aspects of eating disorder symptomatology, and their relationship to (a) the use of the exogenous hormones in oral contraceptives (OCs), (b) the experience of OC side effects, and (c) levels of endogenous gonadal hormones.

Eating Disorder Symptomatology

Eating disorders are characterized as disturbances in eating behaviour and the way in which one perceives one's body shape and weight. AN is characterized by a

refusal to maintain a normal body weight, an intense fear of gaining weight, disturbance in the way one's body shape and weight is experienced, and absence of three consecutive menstrual cycles (American Psychiatric Association [APA], 2000). The other major eating disorder, BN, involves cycles of binge eating and compensatory actions such as purging to avoid weight gain (APA, 2000). Similar to AN, individuals with BN are overly concerned with body shape and weight, however those affected are usually of normal weight. The lifetime prevalence rates are approximately 0.5% for AN and 1 to 3% for BN in females, who outnumber males affected by approximately 10 to 1. Sub-clinical eating disorders are also frequently seen in a clinical setting (Franko & Omori, 1999). Despite relatively low prevalence rates, the full spectrum of eating disorders have been described as a significant public health concern given the high rates of impairment, medical complications, comorbidity, mortality, and suicide associated with these disorders (Swanson, Crow, Le Grange, Swendsen, & Merikangas, 2011).

Disturbances in body image have long been viewed as a major factor in maintaining eating disorders, including AN, BN, and overeating (Allison, 1995). Research indicates that body image dissatisfaction is both a highly important antecedent to eating disorders, as well as the most important factor in predicting treatment success (Rosen, 1995). Dissatisfaction often resides with particular body parts, including the hips, thighs, and abdomen (Rosen, 1990). Dissatisfaction is expressed as the belief that the body part is too fat and accompanying thoughts that the part is ugly or disgusting. In clinical eating disordered populations it has been found that patients' self-worth is based upon their physical attributes of weight and shape. These features of body dissatisfaction

are fundamental in the clinical picture of eating disorders, but are also found to varying degrees in large numbers of women in the non-clinical population (Morris, 2001).

Disordered eating in patients with AN and BN describes a number of behaviours. Weight loss is accomplished mainly through a reduction in food intake, especially foods perceived to be high in calories (APA, 2000). Bingeing is a main feature of BN but also occurs in the binge/purge subtype of AN. It involves consuming, in a discrete period of time, a quantity of food that is much larger than what most people would eat in a similar period. Excessive exercise, dieting, and fasting are utilized for weight loss as well as for compensation following a binge episode. Many individuals with AN or BN also engage in purging behaviours that include self-induced vomiting, and the misuse of laxatives or diuretics. Disordered eating behaviours are also found to some degree in non-clinical populations. Avoidance of dietary fat, a behaviour observed in clinical studies of anorexic and bulimic patients, was found to be the dietary feature most strongly associated with increased degree of eating pathology in female university students (Rock, Gorenflo, Drewnowski, & Demitrack, 1996).

Both body dissatisfaction and eating dysfunction are risk factors for the development of AN and BN (Jacobi et al., 2004). Body dissatisfaction has been named as the strongest predictor of eating disorder symptomology in women (Tylka, 2004). Furthermore, a study by Gross and Rosen (1988) found that body dissatisfaction was a better predictor of bulimic eating attitudes and behaviours than self-esteem, depression, and social anxiety combined. Unfortunately, several studies have demonstrated that these dangerous thoughts, beliefs, and behaviours can also occur in non-clinical populations of young women (Rosen, 1990). While body dissatisfaction and eating dysfunction develop

into full-blown eating disorders in only a small percentage of women, the existence of these symptoms no doubt causes psychological distress and impairment in many women. Therefore, it is important to examine factors that might contribute to body dissatisfaction and eating dysfunction in both clinical and non-clinical populations.

The Effects of Gonadal Hormones on Hunger, Satiety, and Eating Behaviours

The gonadal steroid hormones, including estrogens, progestins, and androgens, have a variety of functions within the hypothalamic-pituitary-gonadal (HPG) axis, including sexual differentiation (Breedlove & Hampson, 2001) and reproductive functioning (McCarthy & Becker, 2001). However, steroid hormones also demonstrate a number of actions outside of reproductive functioning. For several decades both animal and human research has shown that steroid hormones have an effect on patterns of eating behaviours (Asarian & Geary, 2006). Both activational and organizational effects on eating have been noted; activational effects are those reversible effects produced by current circulating hormones, and organizational effects are those permanent changes enacted by hormones on the CNS and other bodily systems usually during early development (Geary, 2004a). The effects of steroid hormones on eating behaviours and the underlying mechanisms are not well understood, particularly in humans. Despite this, compelling evidence suggests that gonadal hormones play a significant role in human food intake, hunger, and satiety.

In general, there are few differences between the sexes when examining eating behaviours, hunger, and satiety (Asarian & Geary, 2006). In humans and rats, both sexes display similar meal size and frequency, with total food intake being proportional to body size. One notable difference found between male and female rats occurs after

gonadectomy. Following ovariectomy (OVX), females increase their meal size leading to greater food intake, and following orchiectomy, males decrease their meal frequency resulting in reduced food intake (Asarian & Geary, 2002; Wallen, Belanger, & Wittnich, 2001). This suggests that circulating sex hormones may have disparate activational effects on food intake.

Another important difference between males and females is the level of gonadal hormones across time. Aside from circadian variation (Piro, Fraioli, Sciarra, & Conti, 1973), testosterone (T) levels in males remain nearly constant over time until they decrease with advanced age (Asarian & Geary, 2006). In contrast, the levels of estrogens and progestins in females change across the phases of the menstrual cycle. The human menstrual cycle begins with the first day of menses (denoted as day 1 of the cycle), which marks the beginning of the follicular phase (see review by Hampson & Young, 2008, p. 64). During the early follicular phase, one dominant follicle grows and becomes the preovulatory follicle. As the follicle matures, aided by a cyclical increase in follicle-stimulating hormone (FSH), it secretes increasing amounts of estradiol that trigger a surge of luteinizing hormone (LH). Twenty-four to thirty-six hours after the LH surge, ovulation (the release of a mature oocyte by the ovary) occurs. This period is known as the periovulatory phase, and typically occurs around day 14 of the cycle. Ovulation and the formation of the corpus luteum mark the beginning of the luteal phase of the cycle, which lasts about 13 to 15 days. During the luteal phase, both estradiol and progesterone contribute to the development of the endometrium. In the late luteal phase, production of estradiol and progesterone drop. Then, the endometrium begins to shed, indicating the start of menses and the beginning of a new cycle.

It has been observed that eating patterns change along with hormone levels across the cycle. In human females, daily food intake is lowest during the periovulatory phase, when estrogen levels are highest and progesterone (P) levels are low (Buffenstein, Poppitt, McDevitt, & Prentice, 1995; Gong, Garrel, & Calloway, 1989; Goodall, Whittle, Cookson, Cowen, & Silverstone, 1995). Studies have also demonstrated greater average food intake during the luteal phase, which is characterized by higher progesterone compared to estrogen, in contrast to the follicular phase, when estrogen is higher than progesterone. These cyclical changes in food intake can reflect a significant change in energy balance given that women may eat up to 10% less during up to one-third of their cycle (Asarian & Geary, 2006). Thus, while hormone levels in males are generally stable, hormone levels in women are constantly waxing and waning. Interestingly, levels of food intake in females appear to fluctuate and correlate with levels of gonadal hormones. It has been suggested that these changes in food intake with hormone levels may be adaptive. Increased food intake in the luteal phase may be related to increased energy costs of maintaining the endometrium or in anticipation of pregnancy, while the decrease in food intake in the periovulatory may be an adaptation to reduce the competition between mating and other behaviours (i.e., eating, drinking) during the fertile period (see review by Fessler, 2003).

Role of estrogen. As is suggested by menstrual cycle data, the activational effects of estrogen appear to be to decrease appetite (see review by Eckel, 2004). Based on human and animal studies, it is also believed that estrogen regulates the growth of fat and fat-free tissues, and is also involved in energy expenditure (Richard, 1986). According to Geary (2001), circulating estrogens are generally negatively correlated with

feeding, whereas other steroid hormones are not. It has been observed that the periovulatory decrease in appetite in women follows 96 hours after an increase in estradiol (E2), which suggests that estradiol may activate a physiological cascade dependant on genetically controlled protein synthesis (see review by Geary, 2001).

Evidence suggests that estrogen demonstrates both phasic and tonic inhibitive effects on eating behaviour. Phasic, or cyclic, effects refer to the reductions in meal size and food intake during high estrogen portions of the ovarian cycle (Geary & Asarian, 2001). The tonic inhibitive effects refer to the inhibitive influence of estrogen on food intake throughout the cycle, which is illustrated by higher food intake in males and OVX females compared to intact females (e.g., Drewett, 1973). It is hypothesized that the neuronal effects of estrogen are carried out by its impact on a number of substances that are involved in hunger and feeding behaviours. Thus, estrogen has been found to produce an anorexic effect, which occurs both tonically and phasically.

Cholecystokinin (CCK) is released from the small intestine during meals and produces an effect of satiety in both animals and humans (Geary, 2004b). Antagonism of endogenous CCK increases meal size, and delivery of exogenous CCK decreases meal size in a dose-dependent fashion (Butera, Bradway, & Cataldo, 1993; Eckel & Geary, 1999). Substantial evidence indicates that the satiating potency of CCK is under the control of estrogen. Studies suggest that CCK is involved in the decreases in food intake associated with the rat estrous cycle, as the satiating potency of CCK was found to be greater during the estrous phase compared to the diestrous phase (Asarian & Geary, 1999; Eckel & Geary, 1999). Therefore, when estrogen levels are high, the satiety-inducing potency of CCK is increased. CCK satiation also appears to be sexually

differentiated in humans as well as rats. In addition, one study reported that prandial CCK secretion was greater in women than in men (Nolan, Guss, Liddle, Pi-Sunyer, & Kissileff, 2003). While the cause of this sex difference in the secretion of CCK is not known, it may be under the control of estrogen, as are cyclical increases in CCK sensitivity (Geary & Lovejoy, 2008).

There is also substantial evidence that 5-HT is implicated in feeding behaviours and satiety (Frank et al., 2001; Monteleone, Branbilla, Bortolotti, & Maj, 2000). Research has shown that an increase in, or direct activation of, 5-HT receptors tends to reduce food consumption, whereas a decrease in 5-HT neurotransmission leads to increased food consumption and weight gain (see review by Kaye, Gendell, & Strober, 1998). The effects of 5-HT on eating are believed to be under the control of estrogen (Asarian & Geary, 2006). Supporting evidence includes findings that 5-HT agonists inhibit eating more in female rats than males, and more during the estrous phase compared to the diestrous phase (Eckel, Rivera, & Atchley, 2005). However, the anorectic effect of 5-HT agonists was not affected by chronic administration of estradiol in OVX rats (Salamanca & Uphouse, 1992). These, along with other studies suggest a phasic, but not tonic, influence of estradiol on 5-HT (Asarian & Geary, 2006).

Some data suggest that the site of action for this relationship between 5-HT and estrogen is the amygdala (Eckel & Geary, 2001; Eckel, Houpt, & Geary, 2002). In addition to searching for brain structures where 5-HT and estrogen interact, studies have examined possible mechanisms though which estrogen may affect 5-HT. Recent information indicates that estradiol can regulate 5-HT reuptake rapidly through non-genomic actions of the estrogen receptor alpha (ERα; Koldzic-Zivanovic, Seitz, Watson,

Cunningham, & Thomas, 2004). In addition, 5-HT_{1A} receptors, which are autoreceptors that decrease 5-HT functioning, have been directly implicated in the relationship with estrogen. Evidence for this includes the ability of 5-HT_{1A} agonists to stimulate feeding less during proestrous and estrous compared to diestrous in cycling rats, and a decrease in eating stimulation by 5-HT_{1A} agonists by estradiol, but not progesterone, treatment in OVX rats (Salamanca & Uphouse, 1992; Uphouse, Salamanca, Caldarola-Pastuszka, 1991). Thus, the anorectic effect of estrogen may be bolstered by estrogen's regulation of 5-HT via ERα or 5-HT_{1A} receptors.

Ghrelin is another compound that is known to control food intake and energy balance in both rats and humans (Clegg et al., 2007). Secreted in response to the emptying of the gut, ghrelin is unique in that it is the only peripheral control of eating that increases, rather that inhibits, food intake (Asarian & Geary, 2006; Kojima & Kangawa, 2005). Peripheral administration of ghrelin increases meal size and decreases the time to the next meal (Azzarra, Schuss, Hong, & Schwartz, 2005). A study by Clegg and colleagues (2007) found that estradiol mediates the effects of ghrelin, resulting in sex differences in its eating-stimulatory effects. Compared to male and OVX female rats, intact females required more exogenous ghrelin to stimulate feeding. Furthermore, when estradiol was administered to OVX females, feeding was no longer stimulated by moderate doses of ghrelin. Therefore, estradiol appears to inhibit the stimulatory effects of ghrelin on food intake.

The effects of ghrelin on eating also changed across the ovarian cycle; ghrelin increased feeding during phases diestrous 1 and 2, but not during proestrous or estrous. In support of these findings, additional research suggests that estrogen directly regulates

ghrelin expression by decreasing ghrelin-producing cells and ghrelin mRNA in the stomach of rats (Matsubara et al., 2004). Therefore, reduced stimulation of eating by ghrelin in the presence of estrogen likely contributes to the anorectic effect of estrogen.

Data on the relationship between estrogen and ghrelin are also available for humans. The effect of unopposed estrogen on active plasma ghrelin was examined in postmenopausal women having normal nutritional balance (Kellokoski et al., 2005). Firstly, an inverse relationship was confirmed between body mass index (BMI) and ghrelin levels in women with and without estrogen replacement therapy (ERT). More importantly, the use of ERT increased plasma ghrelin levels, which were positively associated with the relative change in estradiol concentrations. These results diverge from what would be expected based on animal and other human studies. The difference in results may be due to species differences, the use of a postmenopausal female sample, or the type (i.e., exogenous) and length of steroid hormones administered. Despite the unexpected findings, the results support a role for ghrelin in energy balance and indicate a relationship with estrogen in human females.

Melanin-concentrating hormone (MCH), most widely known for its role in regulating pigmentation in a variety of species, has more recently been found to regulate food intake (Santollo & Eckel, 2008a). In rodents, administration of MCH to the brain increases food intake, and chronic administration can lead to hyperphagia and weight gain (Della-Zuana et al., 2002; Shearman et al., 2003). Recent work by Santollo and Eckel (2008a), suggests that both exogenous and endogenous estradiol suppress the orexigenic effect of MCH. Thus, female rats were much less sensitive to the effects of MCH infusion and ate less, compared to males. Furthermore, female rats were less

sensitive to the effects of MCH during the estrous phase of the cycle, compared to the lower-estrogen diestrous phase. Sex- and estrous-cycle differences in food intake may therefore be related to the attenuation of MCH's orexigenic effect by estradiol in females. This estrogenic effect is likely activational rather than organizational given that the magnitude of the orexigenic effect of MCH was similar in male and untreated OVX females. In humans, genetic studies have linked MCH receptors to obesity, and some studies are beginning to examine the possibility of MCH receptor antagonists as a possible treatment for obesity (see review by Luthin, 2007), however the impact of estrogen on MCH in humans has not yet been determined.

Glucagon is another substance which meets criteria for a satiety signal, based on its ability to act as a negative feedback control of meal size in rats and humans (Asarian & Geary, 2006; Geary, Kissileff, Pi-Sunyer, & Hinton, 1992). Geary and Asarian (2001) found that estradiol treatment in female OVX rats increased the potency of prandial glucagon infusions, leading to a decrease in feeding. Similarly, estradiol treatment also increased the ability of glucagon antibodies to stimulate feeding. Whether this estrogenic effect is cyclic or tonic, and whether it occurs in regularly cycling rats has not been determined. Furthermore, while the satiating effect of glucagon has been demonstrated in men (Geary et al., 1992), such an effect has not been examined in women. Thus, glucagon has the potential to play a role in the sexual differentiation of eating behaviour by increasing the anorexigenic effect of estrogen.

Leptin is a peptide known to be involved in adiposity, pubertal development, and food intake (see review by Asarian & Geary, 2006). Studies have shown that leptin has differential effects on food intake in male and female rats: leptin has been shown to more

strongly suppress eating in females (Clegg, Riedy, Blake, Smith, Benoit, & Woods, 2003). In humans, it has been reported that leptin concentrations are two to three times higher in women and are under the control of the HPG axis (Rosenbaum et al., 1996). While some data suggest that estrogen increases the sensitivity to leptin in animals, there are also negative findings, which call into question the relationship between estrogen and leptin at physiological doses (see review by Asarian & Geary, 2006). Further research should be done to clarify the impact of estrogen on leptin, particularly examining the effects on feeding using physiological doses in humans.

Several lines of research suggest that neuropeptide Y (NPY) is an important modulator of food intake (Santollo & Eckel, 2008b). For example, hypothalamic infusions of NPY strongly stimulate feeding (Levine & Morley, 1984), and antagonism of NPY 1 and 5 receptors inhibits food intake in male rats (Daniels, Grizzle, Wiard, Matthews, & Heyer, 2002; Kanatani et al., 1996). A recent study demonstrated that NPY is under the control of estradiol. Santollo and Eckel (2008b) found that an acute, physiological dose of estradiol reduced the ability of NPY to stimulate feeding in female OVX rats. The reduction in NPY signaling by estradiol may be due to its ability to reduce NPY expression and release in the CNS (Baskin, Norwood, Schwartz, & Koerker, 1995; Bonavera, Dube, Kalra, & Kalra, 1994), and to reduce the number and affinity of NPY receptors (Xu, Urban, Hill, & Levine, 2000). However, the latter findings are based upon chronic pharmacological estradiol treatment in OVX rats. Therefore, it is unknown whether these effects are present in normally cycling female rats, or human females, for that matter.

The ability of estrogen to influence eating behaviour is likely due to its interactions with numerous orexigenic and anorexigenic neuropeptides, including CCK, 5-HT, glucagon, ghrelin, MCH, leptin, and NPY. In the future, research on the contributions of the various compounds modulated by estrogen on its anorexic effect will be important (Santollo & Eckel, 2008a). Furthermore, studies examining these relationships in humans are also crucial, as some findings (e.g., ghrelin-producing cells are down-regulated by estradiol in rats, but ghrelin levels are positively associated with estradiol in humans) have suggested that rats and other animals may not be appropriate analogues for these relationships in humans. Early research examining the effects of gonadal hormones on eating behaviour in rats suggests that organizational, as well as activational effects, are important. Research indicates that the masculinization of the brain during early development decreases sensitivity to the effects of estrogens on feeding (see review by Asarian & Geary, 2006). Conversely, feminization of the brain does not alter sensitivity to the effects of testosterone on food intake. An important direction for future research will be to elucidate whether the sex-specific effects of substances in control of feeding, such as MCH or ghrelin, are dependent upon organizational as well as activational effects.

While the structural and cellular mechanisms involved in the effects of estrogen on feeding behaviours are not fully understood, some important pieces of the puzzle have been identified. Evidence suggests that the estrogenic effects on feeding are mediated via estrogen receptor alpha (ERα; Geary, Asarian, Korach, Pfaff, & Ogawa, 2001). Specifically, activation of ERα decreases food intake and meal size in OVX rats (Santollo, Wiley, & Eckel, 2007). However, there is also support for the role of estrogen

receptor beta (ERβ) in producing the anorectic effect of estradiol, following experiments on OVX rats and guinea pigs (see review by Butera, 2010). Sites in the brain rather than the periphery appear to play a key role, although Asarian and Geary (2006) note that indirect effects have not yet been excluded. It remains unclear which sites are involved in the effects of estrogen on feeding.

Despite the fact that direct administration of estrogen to several brain sites, including the ventromedial nucleus (VMN), paraventricular nucleus (PVN), and the medial preoptic area (MPA), have been reported to suppress eating, it is not clear whether theses sites are involved in the physiological actions of estrogen on feeding (Thammacharoen, Lutz, Geary, & Asarian, 2008). Recent use of c-Fos immunocytochemistry in OVX rats following estradiol treatment has implicated the PVN, central nucleus of the amygdala, and the nucleus tractus solitarius (NTS) in the estrogenic effects on feeding (Eckel & Geary, 2001; Thammacharoen et al., 2008). The results suggest estradiol may exert its effects on food intake by amplifying the response of those brain regions to negative-feedback signals that follow food intake. While these studies provide some clarification, the complex circuits involved in the anorexic effect of estrogen are still to be discovered.

Role of progesterone. While the effect of estrogens on food intake is often the focus of hormonal research on feeding, progesterone also appears to play a role in eating behaviours. It is believed that endogenous progesterone increases food intake in females, for example, during the luteal phase of the menstrual cycle and during pregnancy (Asarian & Geary, 2006; Douglas, Johnstone, & Leng, 2007). Exogenous progesterone is also known to stimulate eating. Pharmacological doses of progesterone can increase the

food intake of rats and mice by acting on $GABA^A$ receptors (Asarian & Geary, 2006; Kaur & Kulkarni, 2001). In humans, high-dose progestins [i.e., megestrol acetate (MA) and medroxyprogesterone acetate (MPA)] have been used to stimulate appetite in cancer patients (Maltoni et al., 2001). In their review of 15 randomized placebo-controlled trials, Maltoni and colleagues report that high-dose progestins were found to significantly improve appetite in cancer patients. In addition, they noted that there appeared to be a dose-response relationship, based on studies that examined different drug dosages compared to placebo. Thus, there is experimental data supporting a stimulatory effect of progestins on appetite.

However, some evidence suggests that typical doses of exogenous progesterone have no direct effect on women. For example, in a randomized, placebo-controlled study, one injection of depot MPA did not alter energy intake in young women (Pelkman, Chow, Heinbach, & Rolls, 2001). The difference in findings may be due to different dosages and formulations used: high doses of MPA were used in the cancer studies (300 mg to 1000 mg per day), compared to a 150 mg slow-release intramuscular dose in the study by Pelkman and colleagues. In the case of smaller doses of exogenous progestins, it may be that only women who are particularly sensitive to progestins may show increased appetite. For example, progestins are believed to contribute to overeating in women with premenstrual tension (Giannini, Price, Loiselle, & Giannini, 1985).

It has been suggested that progesterone can influence feeding behaviours by blocking the anorexic effects of estrogen (see review by Young, 1991). For example, Asarian and Geary (2006) note that the lack of impact of combined hormonal contraceptives on eating on most users is explained by the progestin components

counteracting the estrogenic components. However, given that high-dose progestins are useful in treating undereating in male as well as female cancer patients, progestins may also impact appetite via other mechanisms. In sum, animal and human research exists that supports the ability of progestins to increase appetite. While this effect may be restricted to higher doses, it is possible that lower doses of progestins may be related to increased appetite in groups who are particularly sensitive to the effects of progesterone, such as women with premenstrual mood disorders. Further research with a variety of populations and doses is required to further understand the relationship between progesterone and food intake.

Role of androgens. Little is known about the effects of androgens on eating behaviours, particularly in humans and human females (Asarian & Geary, 2006). Testosterone is known to increase meal frequency, in contrast to estrogen, which decreases meal size. It is reported that orchiectomy in rats results in decreases in eating and body weight, and this effect is reversed by administration of low doses of testosterone or dihydrotestosterone (DHT; Geary, 2004b; Mooradian, Morley, & Korenman, 1987). Interestingly, supraphysiological doses of testosterone decrease food intake. This seemingly contradictory effect is likely caused by the aromatization of the excess testosterone into estrogen (Nunez, Siegel, & Wade, 1980). Evidence for this is that the decrease in food intake caused by high doses of testosterone is blocked by administration of progesterone (Geary, 2004b). Another way in which androgenic effects differ from estrogenic effects is that the impact of androgen withdrawal on food intake in the male rat is relatively permanent and much less dramatic compared to estrogen withdrawal in females (Blaustein & Wade, 1976; Petersen, 1978). This suggests that the

effect of androgens on food intake is likely slower-acting compared to estrogens (Chai et al., 1999). Therefore, androgenic effects on food intake differ in a number of ways from estrogenic effects. Most importantly, however, is that the general effect of testosterone is to increase food intake, while estrogen decreases it.

While estrogen has been found to interact extensively with a variety of satiety signals, little analogous research has been conducted with testosterone and other androgens. Asarian and Geary (2006) point out that while several peripheral controls of meal size are known, very few physiological controls of meal frequency are understood. They further suggest that because testosterone affects food intake via meal frequency rather than meal size, as does estrogen, testosterone may affect feeding through fundamentally different mechanisms. Like estrogen, testosterone also appears to influence food intake via the VMN (Chai et al., 1999; Nunez, Siegel, & Wade, 1980). However, the aromatization of testosterone to estrogen (the conversion of testosterone to estrogen via the aromatase enzyme) likely plays a role as administration of DHT, a non-aromatizable androgen, had no effect on food intake whereas estrogen was more effective at reducing food intake in male rats (Petersen, 1978). Thus, the mechanisms and structures involved in the effects of androgens on eating are still not well understood.

While the connection between estrogen and ghrelin has been examined extensively, there is also a small amount of research linking ghrelin with androgens. In women with polycystic ovary syndrome (PCOS), high androgen levels have been found to be associated with low ghrelin levels (Pagotto et al., 2002). As ghrelin is inversely related to BMI in postmenopausal women (Kellokoski et al., 2005), low ghrelin levels

may be associated with increased food intake. When women with PCOS were treated with antiandrogen therapy, a significant increase was seen in their total plasma ghrelin levels (Gambineri et al., 2003). Thus, there appears to be a connection between the anorexigenic peptide ghrelin and androgens in women with PCOS.

Another way in which androgens may affect food intake is via a connection between testosterone and insulin (Clegg, Brown, Woods, & Benoit, 2006). Alterations in testosterone directly affect insulin sensitivity in adipose tissue. Insulin is known to exhibit both short- and long-term anorexigenic effects on food intake regulation in mammals (Air et al., 2002). Testosterone may also impact levels of NPY in the VMN; castration has been shown to reduce NPY in the VMN and testosterone replacement restores levels (Sahu, Kalra, Crowley, & Kalra, 1989; Sahu, Kalra, Crowley, & Kalra, 1990). Thus, although the mechanisms are not well understood, testosterone is implicated in the regulation of a number of important peptides related to food intake, including ghrelin, insulin, and NPY.

Dehydroepiandrosterone (DHEA) and DHEA sulfate (DHEA-S) are precursors to testosterone and estrogen, and are known to affect feeding, mood, and cognition (Rupprecht & Holsboer, 1999). These effects are likely carried out via gamma-aminobutyric acid (GABA) and 5-HT receptors. One study found that subchronic treatment of female mice with DHEA-S for 28 days led to significant decreases in food intake (Kaur & Kulkarni, 2001). Furthermore, DHEA-S blocked the hypophagic effects of progesterone treatment. Unfortunately, the mechanisms underlying the anorectic effect of DHEA-S are unknown. However, one study showed that the anorectic effects of

DHEA in rats were mediated by alterations in 5-HT and dopamine levels in the lateral hypothalamic area (Porter, Abadie, Wright, Browne, & Svec, 1995).

Gonadal hormones are known to modulate food intake, hunger, and satiety, in humans and animals. The presence of estrogens decreases food intake, possibly through the amplification of satiety signals such as CCK and 5-HT. Progesterone appears to increase food intake, and it is believed that this occurs though progesterone's antagonism of the anorectic effect of estrogen. While estrogen affects meal size, testosterone affects meal frequency. The effect of physiological doses of testosterone is to increase eating, while supraphysiological doses decrease eating, likely due to the aromatization of testosterone to estrogen. The effects of testosterone on feeding may be due to its interaction with substances such as ghrelin and insulin. DHEA and DHEA-S, precursors to estrogen and testosterone, also demonstrate anorectic effects. The ability of these gonadal hormones to regulate food intake suggests that they may be important in explaining states of dysregulated food intake, such as occurs with eating disorders.

Gonadal Hormones and Mood

Research indicates connections between eating disorders and low mood, including high comorbidity rates between eating disorders and depression (e.g., Milos, Spindler, Buddeberg, & Crameri, 2003), as well as a purported genetic link between these disorders (Wade, Bulik, Neale, & Kendler, 2000). In addition to the association with eating disorders, there may also be a relationship between gonadal hormones and mood. In order to understand the larger picture of factors impacting eating disorder symptoms, it is important to examine the interrelations between mood, gonadal hormones, and eating disorder symptomatology.

Epidemiological evidence suggests a link between mood and gonadal hormones. Firstly, depressive disorders occur twice as often in women than in men (Kessler et al., 2003). Rates of depression in women are also greater after puberty and before menopause (Weissman & Olfson, 1995), with an increase during the peri-menopausal period (Schmidt, 2005). Furthermore, disruptions in mood are also associated with times of changing sex hormones, such as puberty, post-partum, menopause, and the premenstrual phase of the ovarian cycle (Steiner & Young, 2008). Thus, alterations in mood in women may be related to absolute or changing hormone levels (Douma et al., 2005).

According to Arpels (1996), when estrogen levels in the brain drop below what is required, a woman may experience dysfunctions in mood, memory, and cognition. Miller and Rogers (2005) explain the reason for the estrogen-depression link: similar to anti-depressants, estrogen modulates the synthesis, release, and metabolism of neurotransmitters, including serotonin, dopamine, and norepinephrine. They suggest that with such a complex and wide-reaching relationship between estrogen and important mood-related neurotransmitters like serotonin, fluctuating levels of estrogen are likely to affect mood.

While the literature is complex and difficult to interpret, it appears that sudden drops, sustained low levels, and fluctuations in estrogen may be associated with depression (Arpels, 1996). Estrogen drops during the premenstrual period have been associated with low mood, which coincides with a time of low estrogen. Joffe and Cohen (1998) also report that women with histories of depression are also more sensitive to recurring episodes of depression during times when gonadal hormones are fluctuating,

such as pregnancy and menopause. For example, Warren and Brooks-Gunn (1989) found that negative affect in adolescent females was associated with rapid increases in estradiol levels. Thus, it has been suggested that certain women are vulnerable to mood difficulties that are either caused or revealed by regular fluctuations in gonadal hormones.

The large estrogen drop after childbirth has been implicated in postpartum depression: mild depression is reportedly found in up to 70% of new mothers, with approximately 10% experiencing symptoms in the clinical range (Gregoire, Kumar, Everitt, Henderson, & Studd, 1996; Kornstein & Sloan, 2006). Research by Bloch and colleagues (2000) provides more direct evidence linking hormonal changes with postpartum depression. The authors simulated pregnancy with hormone replacement and found that women with a history of postpartum depression developed significant depressive symptoms during the withdrawal from elevated hormone levels, compared to women without a history of postpartum depression. A small study found significant improvements in depressive symptoms in women with postpartum depression following treatment with 17β-estradiol (Ahokas, Kaukoranta, Wahlbeck, & Aito, 2001). In a larger double-blind, placebo-controlled trial, 17β-estradiol treatment for three months resulted in a significant improvement of clinical symptoms in severely depressed women in the postpartum period (Gregoire et al., 1996). Although analogous studies are not available in humans, studies in postpartum rats have linked the postpartum withdrawal in gonadal hormones with changes in serotonergic signaling. It is argued that these changes may result in mood disorders in women who are vulnerable or who have a genetic predisposition (Steiner & Young, 2008).

Another period of changing hormone levels is the perimenopause. According to Prior (1998), average estrogen levels are higher, and there are significantly more fluctuations in estrogen levels in perimenopause compared to other life stages. Studies have found an increased risk of depressive symptoms during the menopausal transition, as well as an increased risk of recurrence in women with a history of depression (see review by Kornstein & Sloan, 2006). Several studies have indicated that treatment with estrogen or estradiol improves mild to clinical-level mood symptoms in these women. Studies have implicated fluctuations in estrogen in perimenopausal depression (Brace & McCauley, 1997; Dennerstein, Dudley, Hopper, Guthrie, & Burger, 2000). While rates of depression appear to decline in women after menopause (Kessler, McGonagle, Swartz, Blazer, & Nelson, 1993), some studies suggest that estrogen can improve depressive symptoms in menopausal women (see review by Kornstein & Sloan, 2006), indicating that low estrogen levels may be associated with depression in some menopausal women.

Another paradigm for examining rapid changes in gonadal hormone levels was examined by Bloch and colleagues (2011), who measured depression and anxiety symptoms in women undergoing in vitro fertilization. Quickly and steeply declining E_2 levels following a period of E_2-dominant gonadotropin administration was significantly associated with increases in depressive symptoms. There were no associations between depressive symptoms and hormone levels during the E_2-dominant phase and the P-dominant phase, suggesting that the links between depression and E_2 only occurred when E was rapidly declining. This study provides further evidence linking fluctuations in estrogen levels and the experience of mood symptoms across the female lifespan.

The ways in which estrogen alters mood by modulating the functioning of neurotransmitters such as serotonin continue to be clarified by human and animal studies (see review by Joffe & Cohen, 1998). Estrogen binds to intracellular receptors to carry out its wide-ranging cellular effects. These effects include the transcription of genes encoding regulatory enzymes, such as those involved in the synthesis and metabolism of neurotransmitters and neuropeptides. Estrogen can rapidly affect electrical excitability and synaptic functioning directly via G-protein-coupled receptors, ligand-gated ion channels, and neurotransmitter transporters (Wong, Thompson, & Moss, 1996). It is suggested by Rubinow and colleagues (1998), that estradiol regulates serotonin receptor number and function, thus altering the response to serotonin and drugs that modulate serotonin. Estrogens are known to exhibit a number of antidepressant-like actions: they can increase the number of 5-HT_{2A}, decrease the 5-HT_1 receptor binding sites, and increase 5-HT synthesis (see review by Steiner & Young, 2008). When compared with men, women have been reported to have decreased serotonin synthesis in the brain, increased serotonin metabolites in the cerebrospinal fluid, and decreased ability to bind 5-HT_{2A} receptors in certain areas of the brain (see review by Joffe & Cohen, 1998). Estradiol is therefore able to alter mood via its effects on serotonergic activity, and this leads to sex differences in the experience of negative mood.

While more attention has been placed on estrogen as a modulator of mood, progesterone and its metabolites have also been shown to be involved in depression and anxiety. Increased levels of progesterone are generally linked with decreases in positive mood (Douma et al., 2005); this may be associated with the ability of progesterone to decrease levels of serotonin (Sherwin, 2003), or its oppositional effect on estrogen.

Progesterone is synthesized in the CNS and can also be synthesized in the periphery and transported into the brain, where it is converted to 5α-dihydroprogesterone (5α -DHP) and allopregnanolone (ALLO; Monteleone, 2003). This family of neuroactive steroids have both genomic and nongenomic effects (see review by Guidotti & Costa, 1998). For example, ALLO affects neural excitability at GABA and glutamate receptors, and progesterone and 5α-DHP affect gene expression and neuronal plasticity. According to Andreen and colleagues (2005), ALLO has been reported to have bimodal effects: low doses decrease concentration and induce negative mood and aggression while high doses have anxiolytic, sedative, and hypnotic effects. Thus, progesterone metabolites appear to influence mood.

It also appears that, like estrogen, progesterone and its metabolites affect some women differently. For example, premenstrual dysphoric disorder (PMDD) may be related to progesterone drops in the late luteal phase (see review by Sundström-Poromaa, Smith, & Gulinello, 2003). However, affected women have similar absolute levels of progesterone when compared to unaffected women. Thus, similar progesterone levels must have different effects in different women. Various progesterone metabolites appear to function differently and perhaps even with opposite effects. For example, one study found that higher levels of 5α-DHP and ALLO in the luteal phase were associated with improved PMS symptoms, while higher levels of pregnenolone were related to worse mood symptoms (Wang, Seippel, Purdy, & Backstrom, 1996). Clearly, examinations of progestational effects on mood must look at variables other than just progesterone levels (e.g., amount and type of metabolites).

Decreased levels of ALLO have been linked with anxiety and depression in various models of mood disorders, according to Sundström-Poromaa and colleagues (2003). Andreen et al. (2005) noted that studies of hormonal contraceptives and hormonal replacement therapy (HRT) have indicated that women tend to experience the most negative mood side effects when taking smaller doses of progestins. The effects of high levels of ALLO have also been witnessed in human studies. In research by de Wit and colleagues (2001), intramuscular injections of progesterone resulted in ALLO levels beyond those seen in the menstrual cycle. Participants experienced sedation and decreased ratings of vigor and friendliness. When progesterone was administered orally, high levels of ALLO correlated with fatigue, confusion, and decreased verbal memory and symbol copying in female subjects (Freeman, 1993). Thus, there appear to be differential effects in humans associated with varying doses of progesterone and its metabolites (i.e., low levels of ALLO associated with low mood, high levels with sedation).

The study by Andreen and colleagues (2005) examined levels of ALLO, progesterone, and pregnenolone, in addition to symptoms of negative mood in women receiving HRT. Plasma progesterone, ALLO, and pregnenolone concentrations increased with progesterone dose. Significantly more negative mood symptoms were observed during the progesterone phase compared to treatment with unopposed estrogen or placebo. Women who had medium levels of ALLO (similar to concentrations seen in the luteal phase of ovulating women), experienced significantly more negative mood and physical symptoms compared to women with high or low levels. This study also provided evidence that the progestin content in HRT may induce cyclical mood and

physical effects, similar to those observed in the luteal phase of the ovulatory cycle and in premenstrual dysphoric disorder.

Two studies have indicated that there are reduced concentrations of 3α neuroactive steroids such as ALLO, and increased levels of its stereoisomer, 3β, 3α-tetrahydroprogesterone (3β, 3α-THP), in the plasma and cerebrospinal fluid of depressed patients (Romeo et al., 1998; Uzunova, 1998). Increased levels of 3β, 3α-THP and reduced levels of ALLO have also been observed in patients with anxiety disorders such as panic disorder (Strohle et al., 2002). In two trials, taking fluoxetine over several weeks increased levels of 3α neuroactive steroids (Romeo et al., 1998; Uzunova, 1998). Research by Eser and colleagues (2006) further supports the finding that selective serotonin reuptake inhibitors (SSRIs) may work directly on 3α-reduced neuroactive steroids (e.g., ALLO, 3α, 5ß-tetrahydroprogesterone). Guidotti and Costa (1998) have hypothesized, based on animal and human studies, that fluoxetine reduces the conversion of ALLO to 5α-DHP, thus increasing ALLO levels. In their study, Guidotti and Costa found that treatment of unipolar depression with fluoxetine increased levels of ALLO, and the greatest increases were found in subjects with the most improvement of depressive symptoms. These studies suggest that reduced levels of the progesterone metabolite ALLO are associated with negative affect.

Investigations have also linked androgen levels with mood in women (see review by Steiner & Young, 2008). Rohr (2002) suggests that both low and high testosterone levels in women are associated with depression, such that testosterone plasma levels correlate with depression in a parabolic curve. A study by Angold and colleagues (1999) found a positive correlation between testosterone levels and negative affect in pubertal

girls. While some findings have conflicted, it has been found that women with PMS or premenstrual dysphoric disorder (PMDD) have elevated testosterone levels during the luteal phase of the menstrual cycle, although these levels are still considered to be within the normal range (Eriksson, Sundblad, Lisjo, Modigh, & Andersch, 1992). Thus, androgens appear also to be related to negative affect in women, and like progesterone, some women may be particularly sensitive to altered levels of testosterone.

A reduction in PMS symptoms in women experiencing elevated androgens in the luteal phase has also been reported with treatment with androgen antagonists (Burnet, Radden, Easterbrook, & McKinnon, 1991). It is believed that negative mood during the menstrual cycle is associated with androgens because of the known link between androgens and both irritability and aggression (Ho, Olsson, Westberg, Melke, & Eriksson, 2001). Several studies have also implicated DHEA, an androgenic compound, in mood difficulties in women. One study found that women with PMS had higher serum concentrations of DHEA around ovulation compared to controls (Eriksson et al., 1992). According to a review by Seidman (2006), studies have found that DHEA significantly reduced depressive symptoms in multiple placebo-controlled studies. Mood enhancing effects were also noted in non-depressed subjects, but not in placebo-controlled studies. While the mechanisms behind the androgenic effects on mood are not well understood, evidence suggests that androgens are important modulators of mood in women.

In sum, gonadal hormones, including estrogens, progestins, androgens, and their metabolites, have been associated with changes in mood. While the particular relationships are not always clear, it appears that fluctuating hormone levels or unusually high or low levels can result in negative mood symptoms in women. Depression may also

be associated with the ratio of estrogen to testosterone; when both estrogen and testosterone levels are low, and when estrogen is low but testosterone is high, depression may result (Rohr, 2002). A similar relationship has been posited between estrogen and progesterone, as progesterone appears to oppose estrogenic effects. Therefore, research should examine not only the effects of individual hormones, but also the complex interplay between various hormones.

In addition, research demonstrates that certain women, (e.g., those with a history of PMS or post-partum depression), are differentially sensitive to the mood-disturbing effects of gonadal hormones (Rubinow, Schmidt, & Roca, 1998). Despite similar plasma levels of gonadal hormones, there is a correlation between mood disturbance and ovarian hormones only in women with a history of PMS. Thus, certain women appear to have a predisposition to hormonal mood effects. The impact of hormonal mood effects may be particularly important in eating disorder symptoms, given that there is a link between eating disorders and mood disturbances such as depression and anxiety.

Mood and Eating Disorder Symptoms

Several studies have examined the relationship between mood and eating disorder symptoms. A 1994 study by Cash examined the structure of the body image construct using a factor analysis of 11 body image measures completed by 279 college women. The results indicated that in addition to a cognitive component, there is also a distinct affective component to body image. A study by Rowe and colleagues (2002) examined BN symptoms and their relation to psychiatric symptoms in a large sample of twins. They found that bulimic symptomology was strongly and significantly related to both depression and anxiety symptoms. These relationships were not accounted for by

differences in BMI. Thus, negative affective states appear to be relevant to both body dissatisfaction and dysfunctional eating.

A French study examined correlations between scores on the Eating Disorder Inventory (EDI) and Beck Depression Inventory (BDI; Bizeul, Brun, & Rigaud, 2003). They found that EDI scores were significantly higher in patients with AN that were severely depressed, compared to those who were less-depressed and non-depressed. These data suggest that there is an interaction between depression and body image, and that the presence of depressive symptoms may exacerbate eating disorder symptomatology.

A study that examined comorbidity in eating disorder patients found that 50% of the 248 participants also suffered from an affective disorder (Milos, Spindler, Buddeberg, & Crameri, 2003). Major depressive disorder was the most common affective disorder present, found in 35% of the sample. There is also evidence that AN and major depressive disorder may have a shared genetic risk. The results of a population-based twin study by Wade, Bulik, Neale, and Kendler (2000) indicate that the proportion of shared genetic variance between AN and depression is 34%. They concluded that there are both common and unique genetic effects involved in the etiology of these disorders. Common etiological factors could therefore be involved in both mood and eating disorder symptoms.

In addition to the commonly-known link between serotonin and depression, there is also evidence (discussed above) that serotonergic action is related to feeding behaviours and satiety (Frank et al., 2001; Monteleone, Branbilla, Bortolotti, & Maj, 2000). This is further evidence for a link between mood and eating disorders at the

biological level. Research has shown that an increase or direct activation of 5-HT receptors tends to reduce food consumption, whereas a decrease in 5-HT neurotransmission leads to increased food consumption and weight gain (see review by Kaye, Gendell, & Strober, 1998). Studies have also demonstrated disruptions in serotonergic neurotransmission in individuals during anorexic and bulimic episodes. For example, a study by Monteleone and colleagues (2000) concluded that impaired serotonergic transmission occurs in underweight anorexic patients and bulimic patients with a high frequency of bingeing, but not in patients with milder BN or binge-eating disorder patients. Hence, serotonin could be involved in the etiology of dysfunctional eating.

To determine whether altered serotonin activity in anorexics is simply a byproduct of malnutrition and low weight, Frank and colleagues (2001) examined restricting-type anorexic patients who had been weight restored in an inpatient treatment program. Meta-chlorophenylpiperazine (m-CPP), a selective serotonin agonist that can be used to assess serotonin functioning, was administered to the weight-restored anorexic patients and a group of controls. The administration of m-CPP in the experimental group was associated with a reduction in negative mood states, distortions of body image, and the feeling of being too fat, supporting the hypothesis that disruptions in serotonin activity may contribute to the pathophysiology of AN. Similar results were found for bulimic patients in m-CPP studies (Brewerton et al., 1992; Levitan et al., 1997).

Other studies have shown that despite weight restoration and improved nutrition, disturbed eating and affective regulation, as well as a drive for thinness, continue in a number of anorexic patients (see review by Kaye, Gendell, & Strober, 1998).

Furthermore, women who are recovered from BN continue to experience body dissatisfaction, low mood, and show abnormal eating behaviour. These symptoms may be the result of continued disruptions in serotonin signaling. Therefore, altered serotonin activity may play an etiological role in eating disorders and associated negative mood.

Eating Disorder Symptomology and Hormones

As Klump and colleagues (2006) point out, epidemiological evidence is strong in suggesting a role of gonadal hormones in the development of AN and BN. The first piece of epidemiological evidence supporting a hormonal role in eating disorders lies in gender differences. Greater than 90% of cases of AN and BN occur in females (Allen, Byrne, Forbes, & Oddy, 2009; APA, 2000; Nicholls & Viner, 2009), and while social factors such as differing gender roles and expectations no doubt play a role, it is likely that biological factors such as sex steroid hormones may also be involved. The previously described activational and organizational effects of gonadal hormones on mood and food intake are compelling, and suggest the need for further examination of the interplay between hormones and eating disorder symptoms.

Organizational effects. Recent studies have suggested that organizational effects of gonadal hormones play a role in eating disorders. Two types of studies have been utilized to examine the relationship between the organizational effects of hormones and eating disorders. In the first type of study, eating disorder symptoms are examined in association with presumed anthropometric markers of prenatal hormone levels (i.e., digit ratio). The ratio of the lengths of the second and fourth digits (2D:4D) is a proposed marker of exposure to prenatal androgens during the first trimester of fetal life (Manning, 2002). Lower 2D:4D is believed to be a marker of higher prenatal testosterone, and there

exists strong evidence of sex differences with women having higher 2D:4D compared to men (Manning et al., 1998). An association between digit ratio and eating disorder symptoms would suggest that a particular prenatal hormone environment may increase or decrease the risk of eating disorders. The second type of study used to examine the organizational effect of hormones on eating disorders utilizes opposite-sex and same-sex twin pairs. Research suggests that the prenatal hormone environment can differ depending upon whether a female's co-twin is male or female (Culbert, Breedlove, Burt, & Klump, 2008). Therefore, differences in the prevalence rates of eating disorders or eating disorder symptoms between same-sex and opposite-sex twin pairs would suggest an organizational hormone effect (e.g., prenatal hormone exposure).

Klump and colleagues (2006) suggest that higher prenatal testosterone exposure in males reduces their probability of experiencing eating disorders. Furthermore, they posit that the increase in estrogen that arises during puberty increases the risk of eating disorders in females. Klump and colleagues examined digit ratios and found a positive correlation between 2D:4D and eating disorders symptoms (total score on the Minnesota Eating Behaviors Survey assessing body dissatisfaction, weight preoccupation, binge eating, and compensatory behaviors) in non-clinical women. Similarly, a positive relationship was found between 2D:4D and Eating Disorder Inventory-2 (EDI-2) measures of Body Dissatisfaction and Bulimia in a group of heterosexual university-aged women (Oinonen & Bird, 2012). A study in non-clinical males also found a positive correlation between 2D:4D and both drive for leanness and disordered eating (e.g., restricting, bingeing, compensatory behaviours, weight/shape concerns) (Smith, Hawkeswood, & Joiner, 2010). A small sample study by Quinton, Smith, and Joiner

(2011) found differential relationships with 2D:4D across diagnostic groups, such that women diagnosed with AN had significantly lower 2D:4D and women with BN had higher 2D:4D. A group of non-clinical woman had intermediary measures of 2D:4D. Considering all of these studies together, the results suggest that greater levels of eating disorder symptoms are associated with a putative marker of lower prenatal testosterone exposure. The finding that AN was associated with greater prenatal testosterone was divergent from expectations, but fits with the complex nature of findings in studies examining the relationships between gonadal hormones and eating disorder symptoms. Nevertheless, these studies provide evidence that the organizational effects of gonadal hormones may play a role in the occurrence of eating disorders.

An alternate paradigm for examining the organizational effects of gonadal hormones on eating behaviours utilizes opposite-sex and same-sex twins (e.g., Culbert et al., 2008). Female twins who share a prenatal environment with a male co-twin are believed to be exposed to greater levels of androgens while in utero. Animal studies have shown that females adjacent to males are exposed to greater androgen levels in the prenatal environment which, during critical periods of development, leads to the masculinalization of sexually dimorphic traits such as eating behaviours (Madrid, Lopez-Bote, & Martin, 1993). Several lines of evidence indicate that the effect of testosterone on feeding behaviour is to increase food intake and body weight, for example, as found in female neonate rats treated with testosterone (Wade, 1972). Similarly, increased food intake and sensitivity to the effects of testosterone on feeding is found in ovariectomized female rats treated with androgens. Therefore, it is expected that females with opposite sex co-twins would be exposed to greater androgens via their mother's bloodstream or

the amniotic fluid (Even, Dhar, & vom Saal, 1992; Meulenberg & Hofman, 1991). Thus, this group will likely display masculinized eating behaviours, and be at reduced risk for experiencing eating disorder symptoms.

Culbert and colleagues (2008) examined the impact of the organizational effects of testosterone in a community sample of twin pairs. They hypothesized that high prenatal testosterone exposure would act as a protective factor against disordered eating. Thus, they hypothesized that members of female-female twin pairs would display the greatest eating dysfunction, followed by female twins of opposite-sex twin pairs, males twins of opposite sex-twin pairs, and lowest disordered eating would be displayed by members of male-male twin pairs. The 582 twins were also compared with nontwin female controls raised with at least one brother. The results confirmed that the linear trend of magnitude of disordered eating was significant, and having a male co-twin significantly predicted decreased disordered eating scores. Furthermore, levels of disordered eating in females with opposite-sex twins were significantly lower than levels of disordered eating in controls who grew up with at least one brother, thus reducing the likelihood of a socialization effect. In sum, the results are consistent with the previous 2D:4D findings (i.e., Klump et al., 2006; Oinonen & Bird, 2012; Smith, Hawkeswood, & Joiner, 2010) which suggest that increased prenatal testosterone exposure can act as a protective factor against disordered eating.

These studies provide further indirect evidence that gonadal hormone exposure during prenatal development may be associated with disordered eating behaviours later in life. Thus, prenatal hormone exposure may play a role in sex differences for risk of developing AN and disordered eating.

Activational effects. Beyond the sex differences in eating disorders, there also appears to be an effect of age. These disorders rarely occur before puberty or after the age of 40 (American Psychiatric Association, 2000), suggesting that the higher estrogen and progesterone levels associated with the female reproductive years may be a factor. It has been demonstrated in both cross-sectional and longitudinal studies that the heritability component of eating disorders is only significant in girls who have reached puberty (Culbert et al., 2009; Klump et al., 2006; Klump, Burt, McGue, & Iacono, 2007a; Klump, McGue, & Iacono, 2003). More specifically, genetic effects are not found in early adolescence but account for nearly half of the variance in disordered eating by mid-adolescence, and genetic influences on eating disorder symptoms increase linearly as puberty progresses (see review by Culbert, Racine, & Klump, 2011). This suggests that hormonal changes during puberty may activate or "turn on" relevant genes. Psychosocial (e.g., peer groups, pressure to be thin), physical (e.g., changes in BMI), and psychological factors (e.g., mood, anxiety) are likely not able to account for the increase in genetic effects, which occurs quickly and dramatically during the pubertal period when ovarian hormones become active (Klump et al., 2007a). Furthermore, the above factors would need to act by increasing genetic influences and decreasing environmental influences, suggesting these non-hormonal factors are less likely. Evidence similar to that above was reported by Rowe and colleagues (2002), who found that a significant rise in bulimic symptoms occurs after menarche. However, findings have demonstrated that using menarche as an indicator of pubertal development is less sensitive to differences in genetic effects compared to early- to mid-pubertal indicators (Culbert et al., 2009).

Overall, epidemiological evidence related to age and developmental stages supports the notion that gonadal hormones may be involved in disorders such as AN and BN.

A number of studies have demonstrated links between the gonadal hormones and eating disorder symptoms. One paradigm used for examining the link between the activational effects of hormones and eating disorders is to examine whether eating disorder symptoms fluctuate with hormonal changes across the menstrual cycle (e.g., Altabe & Thompson, 1990). Another more direct route of study is to examine correlations between levels of circulating hormones and eating disorder symptoms (e.g., Klump et al., 2006). Comparisons have also been made between the levels of circulating hormones in patients with eating disorders compared to controls (e.g., Monteleone et al., 2001). The connection between gonadal hormones and eating disorders has also been made by examining rates of menstrual disturbances and hormonal disorders in eating disorder patients compared to controls (e.g., Hirschberg, Naessen, Stridsberg, Bystrom, & Holte, 2004). Using a treatment model, researchers in this field have also used gonadal hormones and their antagonists as pharmacological treatments for eating disorders (e.g., Miller, Grieco, & Klibanski, 2008). Thus, the relationship between eating disorders and the activational effects of hormones such as estrogen, progesterone, and testosterone have been examined using a variety of methods and models.

Altabe and Thompson (1990) examined fluctuations in body image over the menstrual cycle and found that the higher a participant's menstrual distress, the higher her eating dysfunction. They also found a main effect for menstrual phase, wherein participants experienced greater body image dissatisfaction during the premenstrual phase when compared with the intermenstrual phase. Participants also experienced

greater dissatisfaction with their physical appearance during the premenstrual phase. In addition, participants with higher menstrual distress had poorer body image than those with lower menstrual distress. These results suggest that hormone levels may affect levels of body dissatisfaction and eating dysfunction in certain individuals.

A study conducted by Gladis and Walsh (1987) examined the relationship between menstrual cycle phase and frequency of binge eating in 15 normal weight females with BN. They found a modest but significant rise in binge behaviour during the premenstrual phase. Similarly, Price, Torem, and DiMarzio (1987) found increased self-reports of binge eating in the premenstrual period compared with the menstrual period in 10 women with BN. Lester, Keel, and Lipson (2003) also found correlations between bulimic symptomology and menstrual cycle phase. They examined women with BN and controls over an entire menstrual cycle and found that binge frequency in the experimental group increased significantly in the mid-luteal and premenstrual phases. This body of research suggests that there are phasic increases in both dysfunctional eating behaviours and body dissatisfaction.

According to the review by Dye and Blundell (1997), food craving is positively related to depression during the menstrual cycle. Severe depression was found to be related to increased food cravings, and both depression and food cravings were more severe during the premenstrual phase. However, other data suggest that changes in mood do not mediate the association between mid-luteal/premenstrual exacerbations in binge eating (Gladis & Walsh, 1987; Klump, Keel, Culbert, & Edler, 2008; Lester et al., 2003). In the study by Klump and colleagues, increases in binge eating symptoms occurred prior to premenstrual increases in negative affect. If the changes in symptomology are

not due to fluctuations in mood, then they may be due to changing levels of gonadal hormones. Increased symptoms appeared in the latter half of the cycle during the mid-luteal phase when progesterone levels are peaking and estrogen levels are moderately high, and during the premenstrual phase when both estrogen and progesterone levels are falling.

In addition to the effect of changing levels of hormones across the cycle, changes in eating behaviour may also be due to hormonal sensitivity. As previously described, women with PMS may be especially sensitive to gonadal hormones (Rubinow, Schmidt, & Roca, 1998). Some studies have reported a greater luteal increase in food intake in women who experience PMS compared to those who do not (Hill & Blundell, 1989; Wurtman, Brzezinski, Wurtman, & Laferrere, 1989). Studies have also found increased premenstrual food cravings in women with PMS (see review by Dye & Blundell, 1997). Therefore, women with a history of PMS may experience increased food intake across the cycle due to a sensitivity to changes in hormone levels. In sum, evidence indicates that food intake, disordered eating behaviour, and body dissatisfaction change across the menstrual cycle, and may be related to sensitivity to changes in gonadal hormones.

In addition to studying links between eating disorder symptomatology and the menstrual cycle, the activational effects of gonadal hormones have been examined more directly. Klump and colleagues (2006) examined the activational effects of estrogen on disordered eating in two small non-clinical samples of young adult females. Participants were tested during the follicular phase of the menstrual cycle and were not using oral contraceptives or any other hormonal medication. Salivary estradiol samples were analyzed using radioimmunoassay and enzyme immunoassay. A moderate positive

partial correlation between estradiol levels and scores on the Minnesota Eating Behavior Survey (MEBS) was discovered in both samples (r = .34 and r = .26), indicating that after controlling for BMI, higher circulating levels of estrogens increase the probability of disordered eating.

Klump, Keel, Sisk, and Burt (2010) followed up on studies suggesting a genetic effect for disordered eating attitudes and behaviours that emerges in early- to mid-puberty, and evidence that circulating levels of estrogens are related to disordered eating. Given that both circulating levels of estradiol and the genetic effects on disordered eating both increase in a linear fashion across puberty (Klump, Perkins, Burt, McGue, & Iacono, 2007b), a pilot study was designed to examine whether estradiol might moderate the genetic influences on disordered eating during puberty. They examined 129 female twin pairs between the ages of 10 and 15 years using salivary estradiol samples and MEBS scores, and twin pairs were grouped based on low versus high estradiol levels. In the low estradiol group, monozygotic (MZ) and dizygotic (DZ) twin correlations were nearly equal, suggesting little or no influence of genetic effects. Conversely, in the high estradiol group MZ twin correlations were more than double DZ correlations, suggesting the presence of moderate to substantial genetic effects on disordered eating. These effects were present after controlling for age, BMI, and physical changes of puberty. The authors suggest that the increased genetic effects on disordered eating that occur as puberty progresses may be due to increases in estradiol and its genomic effects on the structure and function of the CNS.

Monteleone and colleagues (2001) examined plasma levels of neuroactive steroids in drug-free women with AN and BN, and matched controls. Patients with AN

and BN exhibited significantly higher plasma levels of ALLO, DHEA, DHEA-S, but significantly lower levels of 17β-estradiol. While these results differ from the findings of Klump and colleagues in terms of estradiol levels, it should be noted that Klump's study examined two non-clinical samples of women, while Monteleone's study examined women with clinical levels of eating disorder symptoms. It has been suggested that these differences in steroid hormones in eating disorder patients may be the body's attempts to counteract aberrant feeding and mood (Monteleone et al., 2001). In addition, low levels of estradiol may be due to the effects of malnutrition. The effects of DHEA and DHEA-S however, are consistent with the studies indicating those hormones have an anorectic effect (Kaur & Kulkarni, 2001; Porter, Abadie, Wright, Browne, & Svec, 1995). Despite the opposing results, these studies nevertheless suggest altered hormone levels are associated with eating disorder symptoms.

To examine whether the changes in neuroactive steroids in AN and BN patients are due to nutritional deficits, Monteleone and colleagues (2003) studied females with binge eating disorder (BED). These patients share eating pathology such as bingeing, but do not suffer from malnutrition. When obese women with BED were compared with obese women who do not binge, the former showed increased plasma levels of neurosteroids including ALLO, DHEA, and DHEA-S. Similar results were found when non-obese BED patients were compared with non-bingeing, healthy subjects. These results are consistent with animal studies in which ALLO has been shown to induce hyperphagic effects in food-deprived rats (Reddy & Kulkarni, 1998). The results may also indicate, like in the case of AN and BN, altered hormones may be the body's attempt to counteract inappropriate feeding behaviours. Nevertheless, these studies

suggest that levels of progesterone metabolites and gonadal hormone precursors may be associated with dysfunctional eating.

The association between ovarian hormone levels and bulimic symptoms was examined across the menstrual cycle in a study by Edler, Lipson, and Keel (2007). Nine women with BN and 8 healthy controls were recruited from the community for five weeks of daily hormone sample collection and logging of mood and behavioural symptoms. Confirming the results of previously described studies, symptom exacerbation occurred in the mid-luteal and premenstrual phases, compared to the follicular and ovulatory phases. No differences in negative affect across the cycle phases were found. Within-subject cycle-day analyses showed that negative affect, estradiol, and progesterone were significant predictors of binge frequency. Estradiol and progesterone together accounted for 42% of the variance in binge eating after controlling for negative affect, which accounted for 10% of the variance. This study further confirms the relationship between gonadal hormone levels and bulimic symptoms, and adds to the literature that suggests this relationship is not solely the result of increased negative affect.

The association between hormones and binge eating was assessed by Klump and colleagues (2008), with the assumption that a connection between hormones and binge eating in a community sample would provide further support for an etiological role of hormones in disordered eating. Nine women provided 65 days of saliva samples for estradiol and progesterone assay, as well as mood and binge-eating scores for those days. The women were college students of normal BMI and were not significantly different on a measure of binge eating compared to a large sample of young women (Minnesota State

University Twin Registry). After controlling for BMI and negative affect, increases in binge eating were associated with decreased estradiol and increased progesterone. A significant negative correlation between estradiol and binge eating, as well as a significant positive association between progesterone and binge eating was found. Changes in ovarian hormones predicted changes in binge eating scores across the menstrual cycle. These findings are similar, including the size of the correlations, to previous studies (Lester et al., 2003; Edler et al., 2007), and are consistent with the known effects of estradiol and progesterone on food intake.

Another line of research that suggests a link between hormones and eating disorders is the consistent finding of menstrual disturbances in women with AN and BN. Amenorrhea is both a symptom and diagnostic indicator of AN (APA, 2000). Amenorrhea is believed to occur in women with AN and other women with a low percentage of body fat because of malnutrition, which impairs luteinizing hormone secretion (Pinheiro et al., 2007). However, there are reports that amenorrhea can occur before significant weight loss and can continue following weight restoration (Brambilla et al., 2003; Katz & Vollenhoven, 2000). Persistent amenorrhea in weight-recovered patients with AN has been associated with dysregulation of the hypothalamic-pituitary-gonadal (HPG) axis, reflected in lower than normal plasma levels of estradiol, progesterone, and luteinizing hormone (LH; Brambilla et al., 2003). Furthermore, variability in estradiol levels could only be accounted for by EDI scores in interoceptive awareness, interpersonal distrust, and ineffectiveness, indicating a link between hormone dysregulation and eating disorder symptomatology.

Amenorrhea is also reported in patients with BN, despite the fact that body weight is kept within the normal range (Pinheiro et al., 2007). Furthermore, Garfinkle and colleagues (1996) noted that there were no differences in the amount of weight loss in women with BN who did and those who did not menstruate. Menstrual disturbances are significantly more common in women with BN, and irregular menstrual cycles, known as oligomenorrhea, are reported in approximately half of all women with BN (Crow, Thruras, Keel, & Mitchell, 2002; Naessen, Carlstrom, Garoff, Glant, & Hirschberg, 2006; Pinheiro et al., 2007). In addition to irregular menses, a number of women also fail to ovulate, despite a normal weight (Cantopher, Evans, Lacey, & Pearce, 1988). Menstrual abnormalities in BN have been found to be associated with low levels of luteinizing hormone, estradiol, noradrenaline, and thyroxine (T_4; Gendell, Bulik, Joyce, McIntosh, & Carter, 2000; Pinheiro et al., 2007). Thus, amenorrhea may be more than an artifact of nutritional deficiencies in some women with AN and BN; it may reflect disturbance in the HPG axis, which contributes to the onset and maintenance of the eating disorder.

Beyond high levels of menstrual disturbance in women with BN, there is also a higher than normal incidence of PCOS (Hirschberg et al., 2004). PCOS is a common endocrine disorder associated with polycystic ovaries, acne, obesity and elevated levels of serum testosterone (Naessen et al., 2006; Pederson, Brar, Faris, & Corenblum, 2007). Patients with PCOS are reported to have disturbed appetite and higher than average scores on tests of bulimic symptoms (McClusky, Evans, Lacey, Pearce, & Jacobs, 1991). Based on laboratory findings, it has been proposed that the high levels of testosterone

associated with PCOS may promote bulimic behaviour by increasing food cravings and decreasing impulse control (Naessen et al., 2006).

A study by Naessen and colleagues (2006) reported greater menstrual disturbance, hirsutism, presence of PCOS, and a higher testosterone/sex hormone-binding globulin ratio in women with BN compared to controls. The authors suggest that the association between BN and PCOS may be explained by hyperandrogenism, which predisposes women to BN. According to Sundblad, Bergman, and Eriksson (1994), depression, carbohydrate craving, and impaired impulse control are prominent features of both PMS and BN. Given that there are increased levels of serum free testosterone in women with PMS, they posited that similar elevations of free testosterone may be found in women with BN.

Sundblad and colleagues (1994) examined 11 normal-weight women with BN, along with 11 age-matched controls. Participants gave blood samples in the luteal phase of their cycles. Serum testosterone levels were significantly higher in patients with BN. Levels of endogenous hormones in women with bulimia were also examined by Cotrufo and colleagues (2000). Compared to controls, the 33 patients with BN demonstrated significantly lower plasma levels of 17β-estradiol and prolactin, and significantly higher mean plasma levels of cortisol and testosterone. In the women with BN, testosterone levels correlated significantly with measures of aggression and irritability. Thus, high levels of testosterone and low levels of estradiol are associated with a diagnosis of BN. This is consistent with the literature suggesting androgens increase food intake and food cravings, and estradiol decreases food intake.

In support of this theory is a placebo-controlled study which found that the androgen receptor antagonist, flutamide, significantly reduced symptoms in two bulimic patients, with normal weight and menses (Bergman & Eriksson, 1996). One patient was given flutamide only, while the other started with fluvoxamine (which gave some mastery of bingeing and vomiting) and flutamide was later added. Marked reductions in food cravings and compulsive behaviours were noted in the first week, and gradual further improvement followed in the next two months. When flutamide treatment was stopped, food cravings and impulsive behaviours returned. Treatment was reinstated after a further two months, at which time the patient reported reduced symptoms once again. Thus, a decrease in androgens was associated with reduced bulimic symptoms in this small study.

To further examine the effects of flutamide on bulimic symptoms, Sundblad, Landen, Eriksson, Bergman, and Eriksson (2005) examined the effects of flutamide and the serotonin reuptake inhibitor citalopram over three months in a double-blind study. Four groups were created with 9 to 15 participants in each: flutamide only, citalopram only, flutamide and citalopram, and placebo. A significant reduction in binge eating compared to baseline was found in both groups given flutamide, but not in the groups given citalopram only, or placebo. Thus, this study provides further evidence that the blockage of androgen receptors may provide symptom reduction in some women with BN.

Abnormalities in androgen levels are also found in women with AN, however, the findings indicate that low rather than high levels of androgens are found (Miller et al., 2007). In a study of patients with AN, Miller and colleagues found that after

controlling for weight and menstrual status, levels of free testosterone were significantly lower in women with elevated depression and anxiety. Furthermore, lower testosterone was also associated with increased scores on the EDI-2 (Garner, 1991), interpersonal distress, perfectionism, ineffectiveness, and social insecurity subscales. Thus, in addition to possible impacts on appetite, low androgen levels may also affect levels of negative mood and anxiety. This may be due to direct effects of androgens in various brain regions, or may be due to the aromatization of testosterone into estradiol.

Miller, Grieco, and Klibanski (2008) treated 33 women with AN with three weeks of low-dose testosterone replacement or placebo, administered in a double-blinded fashion. At baseline, free testosterone correlated with BMI, depression and general ratings of well-being. Participants receiving testosterone experienced an increase in free testosterone to normal levels, however there was no change in levels of estradiol, SHBG, or DHEA-S. Testosterone significantly improved mood compared to placebo in those women who were not taking antidepressants. Participants taking testosterone also showed improvements on the mental rotation task, a measure of spatial cognitive function. Unfortunately, the impact of androgens on eating disorder symptoms were not examined in this study.

While eating disorders occur much more frequently in females, there are a small percentage of male patients who are treated for AN and BN. Although research on men with eating disorders is scant, there is some evidence that hormones may be relevant to that population as well. In a study by Tomova and Kumanov (1999), six males with AN were examined. Serum testosterone was significantly lower compared to controls, and below the lower limit for the norm in men, with the exception of one patient. Basal levels

of triiodothyronine (T_3), T_4, and thyroid-stimulating hormone (TSH) were also significantly lower. These findings are consistent with the findings in female patients with AN, and with the literature on the hyperphagic effects of androgens. A study on osteoporosis in men with eating disorders also mirrored the findings in women regarding androgen levels: men with BN had significantly higher testosterone levels than those with AN (Andersen, Watson, & Schlechte, 2000). A further piece of evidence that links hormones with eating disorders in men is that, similar to women, the onset of BN was found to occur at a mean age of 13.4 years (Olivardia, Pope, Mangweth, & Hudson, 1995). The onset of AN was also found to coincide with gonadal development in the study by Tomova and Kumanov (1999). This coincides with the average age of puberty in males, and consequently a sharp increase in androgens. While the evidence linking hormones to eating disorders in men is sparse and tentative at this time, it is supportive of the theory that gonadal hormones may play an important role in eating disorders.

Hunger and Satiety Signaling in Eating Disordered Populations

Given that peptides such as ghrelin and leptin influence food intake, it is not surprising to find abnormalities in these peptides in eating disordered populations. Shiiya and colleagues (2002) studied patients with AN, simple obesity, and healthy controls. They found that mean plasma concentrations of ghrelin, believed to stimulate feeding, differed significantly in the experimental groups compared to controls; levels in anorexic and obese patients were 225% and 68%, respectively, of the mean value found in controls. In addition, the mean plasma fasting ghrelin concentration in all three groups was negatively correlated with BMI. The authors suggest that the up-regulation of ghrelin in AN may be a negative feedback mechanism aimed at maintaining energy

balance. As patients with AN in this study demonstrated high ghrelin levels, this suggests that they may have decreased sensitivity to ghrelin, or some other system regulating energy balance may be overcoming the effect of ghrelin.

Another study examined the impact of estrogen treatment on ghrelin levels in anorexia and severe undernutrition (Grinspoon, Miller, Herzog, Grieco, & Klibanski, 2004). Grinspoon and colleagues treated 78 female AN patients with an oral contraceptive over 6 months. They found that ghrelin levels increased significantly compared to the control group in the context of stable weight and caloric intake, which the authors point out rules out any effects of nutritional status. While weight gain did not occur, this may have been prevented by significant behavioural attempts to control weight. It should be pointed out that the effects of the progestin in the combined hormonal contraceptive cannot be ruled out. However, the results of this study are similar to those of the study by Kellokoski and colleagues (2005), who found that administration of ERT increased plasma ghrelin levels. While the clinical implications of this study are unknown, it demonstrates the link between steroid hormones and ghrelin in an eating disordered population.

Baranowska, Radzikowska, Wasilewska-Dziubinska, Roguski, and Borowiec (2000) examined gut peptides in 78 women with AN, moderate obesity, and healthy controls. Compared to controls, women with AN had significantly lower plasma leptin and CCK. The opposite trend was found in obese women, who had significantly greater plasma leptin and CCK. No correlations were found between BMI and gut peptides in women with AN. However in women with obesity, leptin was related to BMI. Low levels of leptin associated with AN have also been reported by other researchers. Misra

and colleagues (2005) sampled leptin levels overnight in 23 adolescent girls with AN, and 21 healthy controls. Compared to controls, girls with AN showed overall decreased leptin levels, with lower basal leptin secretion and decreased leptin secretory burst mass. Leptin secretion did not significantly increase after weight restoration, although a trend in that direction was found. A trend towards increased leptin secretion in girls who resumed menses compared to those who had not was also noted. Leptin secretion was an independent predictor of estradiol levels, contributing to approximately 11% of the variability. Total T_3 and T_4 were also significantly predicted by leptin concentration. Although the authors suggest that there may be a lag in the relationship between weight restoration and restoration of normal leptin levels, it is also possible that low leptin levels were pre-existing and contributed to the disorder.

Impaired satiety is often implicated in BN, as many persons with BN report difficulty knowing when they are full at the end of a meal (Kissileff et al., 1996; Pyle, Mitchell, & Eckert, 1981). Geracioti and Liddle (1988) examined CCK secretion in 14 women with BN and 10 matched control subjects. Participants were fed a 400mL liquid meal, similar in caloric content to a typical binge. Following the ingestion of the meal, plasma CCK and satiety levels were measured. Patients with BN had significantly lower plasma CCK after eating, despite similar basal levels of CCK. Women with BN also demonstrated reduced ratings of satiety. CCK functioning was examined in 8 women with BN and 10 healthy controls, similar in age and BMI (Devlin et al., 1997). CCK area under the curve and peak postmeal CCK response was significantly less in women with BN compared to controls after the largest 600g meal (but not the 400 or 200g meals). The major finding was that patients with BN had a blunting of postprandial CCK release,

particularly with larger meal sizes. It is possible that the low levels of estrogen found in women with BN may be related to the increased levels of CCK, resulting in decreased satiety.

To summarize, the organizational effects of gonadal hormones appear to alter susceptibility to eating disorders, with prenatal estrogen increasing the risk of AN and prenatal testosterone decreasing the risk (Culbert et al., 2008). These prenatal effects may contribute to the substantial sex difference in eating disorder risk. Hormonal links with eating disorder symptomatology (body dissatisfaction, bulimic symptoms, and eating dysfunction) have been demonstrated by an increased severity of symptoms in the mid-luteal and premenstrual phases of the menstrual cycle (Altabe & Thompson, 1990; Gladis & Walsh, 1987; Lester et al., 2003). These points in the cycle correspond to estrogen and progesterone levels that are either relatively high or dropping. High levels of estrogen have been associated with decreased appetite (Gong et al., 1989) and higher disordered eating in a non-clinical sample (Klump et al., 2006). Low levels of testosterone and estrogen are associated with AN (e.g., Miller et al., 2007). High levels of progesterone and testosterone, and low levels of estrogen have been found to be associated with binge eating and bulimic symptoms (Cotrufo et al., 2000; Edler et al., 2007; Klump et al., 2008). Furthermore, increased levels of the progesterone metabolite ALLO have been found in patients with AN, BN, and binge eating disorder (Monteleone et al., 2003; Strohle et al., 2002). Gonadal hormone levels may also be related to altered satiety signals, such as ghrelin and CCK in women with eating disorders (e.g., Devlin et al., 1997). While the impact of the cumulative effect of these altered hormone levels is

not yet clear, it seems likely that gonadal hormones are involved in the occurrence of disordered eating.

Oral Contraceptive Use

Use of hormonal contraceptives, such as the oral contraceptive (OC) pill, in Canada is widespread. The Sex Information and Education Council of Canada polled approximately 1,500 women and found that 84% of all respondents had used the OC pill at some time in their life, with an average duration of 6.3 years (Fisher, Boroditsky, & Bridges, 1998). Furthermore, it is reported that over 100 million women worldwide currently utilize OCs as a method of reversible birth control (Petitti, 2003). OC use appears to be quite common in the young adult years, with approximately half of all women aged 20 to 24 in the United States using the birth control pill (Mosher, Martinez, Chandra, Abma, & Willson, 2004). Therefore, OCs are one of the most common drugs used by women, particularly young women in their post-secondary education years.

Oral contraceptives are composed of synthetic estrogens and progestins (see review by Dickey, 2000). The most commonly used synthetic estrogen in OCs is ethinyl estradiol (EE). The dose employed in modern contraceptive formulations ranges from 20 μg to 50 μg of EE (Petitti, 2003). In contrast, there are several types of progestins currently in use. Derived from 19-nortestosterone are two classes of progestins: estranes and gonanes (Kurshan & Epperson, 2006). Estranes include norethindrone acetate, norethynodrel, and ethynodiol diacetate. The newer class of progestins, gonanes, includes several commonly used compounds including levonorgestrel, norgestimate, gestodene, and desogestrel. Another more recent progestin called drospirenone, is derived from 17-α-spirnolactone. The dose of the progestin component varies, and

depends on the potency of the progestin and the OC formulation. The biological activity of the various OCs is based upon the dose, type, and interactions between the estrogen and progestins composing each formulation, and the duration of treatment (Kurshan & Epperson, 2006; Sitruk-Ware, 2005). As a result, each brand of OC may have a different biological effect. The degree to which the CNS effects of the estrogens and progestins incorporated in most OCs are similar to each other or those of their naturally occurring counterparts is not known (Kurshan & Epperson, 2006).

OCs are typically taken for 21 days, followed by a 7-day pill-free period when withdrawal bleeding often occurs. Monophasic OCs contain constant levels of estrogen and progestin throughout the 21-day pill period, while biphasic and triphasic (i.e., multiphasic) OC preparations vary the progestin component to mimic the fluctuations of progesterone during the natural menstrual cycle (Petitti, 2003). Combined oral contraceptives (i.e., containing both an estrogen and progestin component) function as birth control primarily by interfering with the release of gonadotropin-releasing hormone (GnRH) from the hypothalamus and by suppressing the release of luteinizing hormone (LH) and follicule-stimulating hormone (FSH) from the pituitary (Mishnell, 2004, p. 907). The suppression of these compounds serves to inhibit ovulation.

The influence of OCs on gonadal hormones. In addition to blocking ovulation through suppression of FSH and LH, research indicates that the ingestion of the exogenous hormones in OCs can also inhibit the hypothalamic-pituitary-ovarian axis and significantly reduce levels of 17β-estradiol (E2), progesterone, total and free testosterone (Greco, Graham, Bancroft, Tanner, & Doll, 2007; De Leo, Lanzetta, Vanni, Antona, & Severi, 1991). Levels of free testosterone (T) are suppressed when T is bound by

increased levels of sex hormone-binding globulin (SHBG), caused by the estrogen component of OCs (Greco et al., 2007). The amount by which SHBG is increased depends upon the net effect of the estrogen and progestin components of the OC formulation (Wiegratz et al., 2003). Progestins with androgenic properties oppose EE, resulting in less suppression of free T (Moutous, Smith, & Zacur, 1995), and formulas with greater EE levels result in greater reductions in free T (Greco et al., 2007). The extent of the suppression of free T differs based on the actions of the particular OC formula, however the newer progestins found in a number of commonly used OCs have weak or no androgenic effects, thus resulting in marked increases in SHBG (Greco et al., 2007; Panzer et al., 2006).

In the study by Wiegratz and colleagues (2003), the serum levels of SHBG increased progressively over time after the commencement of OC use, and reached their highest values at the end of the sixth cycle. In general, it is reported that with OC use free T is reduced to approximately half of the levels found in nonusers (Panzer et al., 2006; Wiegratz et al., 2003). The study by Panzer and colleagues examined SHBG values in women who had discontinued OC use. After six months of discontinuation, the SHBG values remained significantly higher than the average values of women who had never used OCs. Therefore, changes in SHBG due to OC use may not be completely reversible after discontinuation, which may be a particular problem for women who discontinue because of adverse side effects. However, no difference was found in SHBG levels between previous OC users and never users in another study (Graham, Bancroft, Doll, Greco, & Tanner, 2007), indicating that further research is required.

In addition to the reductions in free and total T, some OC formulations also appear to reduce serum levels of DHEAS (Coenen, Thomas, Borm, Hollanders, & Rolland, 1996; Greco et al., 2007; Moutous, Smith, & Zacur, 1995; Thorneycroft et al., 1999; Wiegratz et al., 2003). Similar to T, levels of DHEAS appear to be increasingly suppressed with time. In the study by Wiegratz and colleagues, a decline in the range of 25 to 30% was noted at the end of the sixth cycle of OC use. Higher doses of EE appear to result in a stronger suppression of DHEAS (Moutous, Smith, & Zacur, 1995). Thus, levels of various androgens are reduced in OC users.

A few studies have also examined the effects of OC use on progesterone and the progesterone metabolite, ALLO. A study by Follesa and colleagues (2002) examined ALLO levels after OC administration in both rats and humans. In rats, levels of progesterone and ALLO in both plasma and the cerebral cortex were significantly reduced. In women, the increase in both ALLO and P levels, which occurred in the luteal phase prior to OC use, no longer occurred after three months of treatment. In another study, women in the free-cycling control group showed higher ALLO and P levels in the luteal phase compared to the follicular phase. However, in the OC group, levels were reduced in the luteal phase after three cycles of OC treatment (Paoletti et al., 2004). Therefore, OC treatment appears to dampen the natural fluctuations in progesterone and ALLO found in untreated women.

While the use of OCs generally causes a decline in E levels, this reduction is not always consistent. As van Heusden and Fauser (1999) point out, many publications have described recovery of ovarian activity during the hormone-free interval or after pill omissions. While ovulation generally does not occur, significant rises in E2 have been

reported beginning at the mid-point of the pill-free period (Spona et al., 1996; van Heusden & Fauser, 1999). Estradiol levels continue to rise even when the next cycle of active pills is initiated and then slowly cease after about two weeks (Vandever et al., 2008). Estradiol levels have been found to rise to levels similar to those of nonusers in the early follicular phases. The extent of ovarian suppression (or lack thereof) appears to depend upon the dose and nature of both the estrogen and progestin components of the OC (Spona et al., 1996).

This review of the literature suggests, in addition to introducing exogenous hormones into the body, OC use also causes changes in levels of endogenous hormones. Levels of total T, free T, and DHEAS are substantially reduced (Greco et al., 2007; Wiegratz et al., 2003). Overall levels of P are reduced, and the natural rise in P and ALLO, which occurs in the luteal phase in normally cycling women, is eliminated (Follesa et al., 2002; De Leo et al., 1991). Levels of E2 are also substantially reduced (De Leo et al., 1991), and yet in some women levels of E2 can rise during the cycle to levels found in nonusers (Vandever et al., 2008). These altered hormone levels may lead some OC users to experience mood, somatic, and sexual changes during treatment, in either the positive or negative direction. It is important to understand why these side effects occur, the outcomes associated with various side effect profiles, and what individual characteristics may be associated with positive and negative experiences with OCs.

Oral contraceptive side effects. Given the changes in both endogenous and exogenous hormone levels that occur with OC use, it is not surprising that users often experience side effects. For example, 87% of 21-day OC formulation users experienced

more than one side effect in a double-blind study (Spona et al., 1996). A study of quality of life and OC use indicated that approximately half of new OC users experienced an increase in quality of life, presumably stemming predominantly from reduced fear of unwanted pregnancy, the resulting reduction in stress, and improved sexual experience (Egarter, Topcuoglu, Imhof, & Huber, 1999). Conversely, about a quarter of women experienced a deterioration in their quality of life, likely due to adverse physical, mood, and sexual side effects. Therefore, while some women's overall experience with OCs can be described as positive or neutral, other women's experience with OCs appears to be negative.

While many of the few placebo-controlled studies that have been conducted examining OC side effects suggest that there is no difference in side effects between active pill and placebo formulations, Kutner and Brown (1972) suggest that women who experience negative side effects are much less likely to be included in cross-sectional studies as they discontinue OC use early on. Known as the "survivor effect", this phenomenon makes it difficult to study adverse OC effects; women who experience difficulties with OCs stop using them, resulting in a group of OC users who have had a more positive experience (Kutner & Brown, 1972). One study found that changes from baseline on mood and sexuality measures were the strongest predictors of early discontinuation within the first year (Sanders, Borsos, Graham, Bass, & Bancroft, 2001). While studies may find no net difference in the experience of side effects (e.g., acne, weight gain, headaches), this may be due to the averaging of effects across all participants. For example, if 30% of new OC users experience less acne, and 10% of new OC users experience more acne, measures of central tendency would suggest that

increases in acne do not occur. However, the small yet significant percentage of women experiencing negative side effects will struggle with finding an acceptable and reliable form of contraception.

Despite opinions to the contrary (e.g., Goldzieher & Zamah, 1995), product monographs and research studies continue to delineate side effects associated with OC use. Physical side effects are one aspect of reactions to OCs. As found in one study, approximately half of new users and one third of continued users experience nausea and vomiting (Sulak, Scow, Preece, Riggs, & Kuehl, 2000). Nausea and vomiting may be related to either estrogen excess or progestin deficiency. Other physical side effects associated with estrogen excess or progestin deficiency include headaches, migraines, and breast pain (Coney et al., 2001; Dickey, 2000).

Menstrual-type symptoms, including irregular bleeding, heavy bleeding, and breakthrough bleeding are another type of physical side effect. While bleeding during the hormone-free interval is usually lighter with OC use, many women experience break-through bleeding during the first few months of OC use (Nelson, 2007, p. 242). While this side effect is reduced for most women after a few months, 10% to 20% may still experience some spotting. This may be due to insufficient estrogenic activity of the pill, and appears to be more common in low-dose formulations (Sabatini & Cagiano, 2006). Vandever and colleagues (2008) suggest that break-through bleeding may also be caused by recovery of estrogenic activity in the hormone-free interval of the previous cycle.

Weight gain is another common physical side effect that tends to lead to increased rates of discontinuation (O'Connell, Davis, & Kearns, 2007). Cyclic weight gain (in breasts, hips, and thighs) may be related to increased estrogen, while non-cyclic

weight gain may be related to increased progestins or androgens (Dickey, 2000; Nelson, 2007, p.243). While the three placebo-controlled, randomized trials that have been conducted found no net effect of weight gain, a systematic review indicates that there is currently insufficient evidence to determine the effect of OCs on weight (Gallo, Grimes, Schulz, & Helmerhorst, 2004). Difficulties with the studies that have been conducted so far include a lack of rigorous methods for measuring weight, an inability to account for the various combinations and preparations of hormones in OCs, effects of early attrition due to weight gain, and the impact of possible weight loss in some participants resulting in a net result of no effect.

Given that OCs tend to reduce levels of T overall, physical androgenic side effects such as acne and hair growth tend to be reduced for most women (e.g., Thorneycroft et al., 1999). Despite this, some women still experience an increase in these symptoms. Reduced androgen levels have also been reported to lead to sexual side effects such as decreased libido. A study by Graham and colleagues (2007) found that reductions in T and free T three months after starting OCs were related to some sexual side effects, including reduced frequency of sexual thoughts and reduced feelings of arousal during sexual activity. Greco and colleagues (2007) found that while some women experienced an increase or no change in sexual interest, a subgroup of women showed decreased sexual interest.

Mood side effects are also prominent with OC use, and are reported to be one of the main contributors to OC discontinuation (Patten & Lamarre, 1992; Rosenberg & Waugh, 1998). Most studies of mood side effects find, as with physical and sexual side effects, that a subgroup of women experience improvements in mood, others experience

no change, while a third group experiences a worsening of mood with OC use (i.e., depression, anxiety, irritability; Graham et al., 2007; Greco et al., 2007; Oinonen & Mazmanian, 2001). A review of the current literature suggests that OCs with lower EE doses tend to be associated with more side effects than higher EE doses (Greco et al., 2007), despite the 1974 report by the Royal College of General Practitioners. In addition, a review by Kurshan and Epperson (2006) suggests that triphasic formulations may be associated with more negative mood change than monophasic preparations. Furthermore, a woman's experience of mood side effects may also be related to or predicted by her experience of PMS and depression prior to OC use (Greco et al., 2007; Joffe, Cohen, & Harlow, 2003; Oinonen & Mazmanian, 2002). Thus, although the evidence is not strong at this point, it appears that a subset of women experience negative mood change with OC use, and factors such as PMS may mediate the relationship between OC use and mood change.

There has been limited success in correlating the experience of OC side effects with levels of exogenous and endogenous hormones. However, changes in hormone levels as well as rate of change may also moderate the experience of side effects (see DeSoto, Geary, Hoard, Sheldon, & Cooper, 2003). Specifically, fluctuating hormone levels may have a strong impact on physical and emotional symptoms if the hormone acts by up- or down-regulating neurotransmitter receptors. For example, estradiol is known to down-regulate the 5-HT_{1A} autoreceptor (Steiner & Young, 2008), and fluctuating estradiol levels may therefore lead to rapid changes in serotonin signaling.

While OCs are generally thought to cause fewer hormonal fluctuations across the monthly cycle, it has been shown that daily fluctuations occur (Sabatini & Cagiano,

2006). Two to three hours after ingesting each pill there is a sharp increase in estrogen levels (Beck, Cowsar, & Pope, 1980; Fotherby, 1996). Estrogen levels reach their lowest point approximately 22 to 24 hours later. Evidence that these daily fluctuations may result in more side effects is found in a study by Sabatini and Cagniano (2006). They compared two types of OCs to the vaginal ring, which provides consistent exposure to hormones. Women who used the vaginal ring experienced significantly fewer side effects, including early and/or late withdrawal bleeding, irregular bleeding, negative mood symptoms, vaginal dryness, and decreased sexual desire. It is possible that the improved cycle control and decreased frequency of mood and sexual side effects in vaginal ring users may be related to the lack of daily fluctuations in hormone levels.

Thus, while many women experience no side effects with OC use, a number of women experience changes in physical, sexual, and mood symptoms – in both the negative and positive directions. While clinical studies have not always supported the presence of side effects in OC users (e.g., O'Connell, Davis, & Kerns, 2007), methodological limitations and the conceptual approach to studies may be masking effects in subgroups of OC users. In addition to changes in endogenous hormone levels, some factors relating to the OC formula have been implicated in side effects, such as the dosage, type, and ratio of hormones, as well as whether the OC is monophasic or multiphasic. Furthermore, some predisposing factors have been suggested, such as history of clinical depression and premenstrual mood dysfunction. Despite all of these hypotheses, there is no clear answer as to why some women experience negative OC side effects, others show no changes, and still others show positive side effects.

Individual differences in the experience of OC side effects. One reason why the experience of side effects can differ so much between individuals is that plasma levels of hormones vary in women following oral administration, such that women may have different levels of circulating hormones after taking the same dose of oral contraceptive (de Wit, Schmitt, Purdy, Richard, & Hauger, 2001). Thus, the impact of OCs on women is highly variable and not easily predicted by type or brand of OC. As reviewed by Fotherby (1996), multiple large-scale studies have found inter-subject differences in the bioavailability [as measured by area under curve (AUC)] of the EE component of OCs to be more than ten-fold. Similarly, findings in the area of five- to ten-fold differences have been found for various progestins, such as norethindrone and levonorgestrel. There is also marked individual variation in the return to ovarian activity (and concomitant rise in estradiol) during the pill-free period of OC users. Thus, the bioavailability of hormones, as well as women's physical reaction to these exogenous hormones, varies significantly. Individual differences in side effect profiles may be partially attributed to differential bioavailability of the components of OCs.

According to Fotherby (1996), these differences in bioavailability between users are mainly due to variations in hepatic metabolism and elimination. Several factors may influence the pharmacokinetics of sex steroids, including smoking, diet, and the use of other drugs. Very few studies of OC side effects take into account circulating levels of EE and progestins and metabolic rates of these hormones, and most do not control for factors such as smoking and diet. Therefore, it is not surprising that studies often fail to find a correlation between hormone levels and specific side effects. A failure to find correlations between absolute hormone levels (or change in hormone levels) and side

effects may also occur because target tissues may respond differently at various doses of exogenous hormones (see review by Wierman & Kohrt, 2007). For example, a dose of hormone may result in subphysiologic, normal, or supraphysiologic steroid hormones levels at various target tissues within an individual. Therefore, circulating hormone levels may not always be reflective of hormone levels in various regions of the body, making it difficult to find a relationship between the occurrence of side effects and hormone levels.

Given the vast differences in women's emotional and physical responses to OCs, it is possible that some women are particularly predisposed to experience negative OC side effects. In support of this idea, one large twin study has been conducted which found that genetic factors play an etiological role in OC-related weight gain, swelling, and depression (Kendler, Martin, Heath, Handlesman, & Eaves, 1988). The heritability for the symptoms ranged from 30% to 45%, and was distinct from heritability for basal psychiatric symptoms. Furthermore, there was no evidence for familial environmental influences on OC-related side effects. Thus, it is possible that women who experience negative OC side effects may do so because of the presence of a particular gene or set of genes.

Research centered on individual responses to hormone therapy has also included genetic studies. Some studies have examined polymorphisms on estrogen receptor (ER) genes, with limited success, however, because of a low incidence of genetic polymorphisms (see review by Wierman & Kohrt, 2007). Importantly, a recent study has found new enhancer regions in estrogen-modulated genes that have not been previously evaluated (Carroll et al., 2005). It has been suggested that these diverse

polymorphisms may explain individual differences in response to similar E levels. Further research in this area may uncover specific genetic links to negative side effects associated with exogenous hormone use.

Overall, few individual factors have been found to be associated with a negative OC side effect profile. However, two studies have found that anthropometric indicators of androgen exposure are useful as predictors of OC mood side effects (e.g., crying, sadness, increased aggression) and OC physical side effects (e.g., headaches, fatigue, decreased menstrual cramps; Oinonen, 2009). In addition, women's extremely different experiences with OCs may be related to genetic factors, differences in bioavailability, and the varied reactions of target tissues to hormones (Fotherby, 1996; Kendler et al., 1988; see review by Wierman & Kohrt, 2007). The inclusion of these factors in research studies may assist in understanding why certain women experience negative side effects with OC use. One potentially important factor, which has not been frequently discussed in the literature, is sensitivity to hormones (see below). Certain women may be more likely to experience negative side effects when using OCs, which may reflect a sensitivity to either exogenous or endogenous hormones, or both.

OC Use and Eating Disorder Symptoms

As discussed above, eating disorder symptoms have been shown to be associated with hormone levels (e.g., Monteleone et al., 2001). OC use is associated with changes in endogenous hormone levels (Greco et al., 2007), which can result in side effects in some users. Therefore, changes in hormone levels associated with OC use may result in alterations in eating disorder symptomology. Women who experience OC side effects may be particularly sensitive to either absolute or changing hormone levels, and may

therefore be more likely to experience a related change in eating disorder symptoms with OC use.

The diagnosis of BN has been associated with high androgen levels (Naessen et al., 2006) and increases in the hyperphagic hormone, ALLO (Monteleone et al., 2001). OC use reduces levels of androgens, including free and total T (Greco et al., 2007), and attenuates the luteal phase spike in ALLO (Follesa et al., 2002). Therefore, OC use may be helpful in attenuating symptoms of BN. One study examined this possibility in women with BN and controls (Naessen, Carlstrom, Bystrom, Pierre, & Hirschberg, 2007). Participants were given an OC containing drospirenone, with potent antiandrogenic properties. Prior to treatment, women with BN had significantly higher levels of T compared to controls, but had similar levels of CCK and ghrelin. As expected, OC treatment caused a significant decrease in T and free T in both groups. Compared to baseline responses to a meal prior to OC use, women with BN showed significantly less craving for sweets and fat. Compared to the control group, participants in the BN group showed decreased ratings of hunger and gastric distention with OC use. A reduction in the frequency of compensatory behaviours and the hunger response was also correlated with reduced levels of T. Thus, OC use appears to provide some treatment for the symptoms of BN.

Interestingly, women in the control group of the Naessen (2007) study responded differently to OC treatment compared to the clinical group. Hirsutism and acne scores decreased in women with BN following OC treatment, but not in controls. In addition, controls demonstrated increased cravings for fat during OC treatment. Treatment with OCs also significantly decreased meal-related CCK response in the control group,

whereas no change was noted in the clinical group. Reduced CCK secretion would result in decreased satiety following a meal (Geary, 2004a). Previous studies have also found significant reductions in serum CCK levels with OC use (Hirschberg, Bystrom, Carlstrom, & von Schoultz, 1996; Karlsson, Linden, & von Schoultz, 1992). The authors note that reduced CCK secretion may have a role in the increased appetite found in controls during OC treatment, however appetite ratings were not significantly correlated with CCK levels. Therefore, while OC treatment appears to be helpful in reducing clinical symptoms in women with BN, particularly those with higher levels of T and more severe symptoms, OC treatment increased appetite and reduced the CCK response in controls. Women without clinically significant symptoms of BN may thus experience an increase in appetite, and possibly eating disorder symptoms with OC use. The different findings in the two groups further suggest that women with and without BN may be differentially sensitive to hormones.

Similar to the study by Naessen and colleagues (2007), a 2011 study by McVay and colleagues found differences between OC users and non-users on eating disorder symptom variables across the monthly cycle. They found that OC non-users with a high fear of fatness showed greater menstrual cyclicity in their appetite (i.e., cravings, hunger, and amount eaten), suggesting that women who are sensitive to changes in gonadal hormones show greater dysfunctional eating attitudes. However, OC users high on fear of fatness did not show the same pattern of cyclicity in appetite variables. Therefore, OC use may disrupt the link between eating and appetite variables and fear of fatness. In addition, a finding of increased hunger in OC users was found, consistent with the study by Naessen and colleagues. OC users reported elevated hunger during the week prior to

hormonal withdrawal bleeding and during the pill-free (hormonal withdrawal bleeding) week, while OC non-users reported an increase in hunger only in the week prior to menses. In contrast to this finding of increased hunger in OC users compared to non-users, Tucci, Murphy, Boyland, Dye, and Halford (2010) found no differences between small samples of OC users and non-users in examining caloric intake and hedonic ratings of snack food items during both the follicular and luteal phases of the menstrual cycle.

While the study by Naessen and colleagues (2007) found no changes in ghrelin levels in either group following OC treatment, one study found changes in ghrelin following OC use in a group of women with AN (Grinspoon, Miller, Herzog, Grieco, & Klibanski, 2004). Compared to a group of non-OC users with AN, ghrelin levels increased significantly after six months of OC use. The authors state that the increases in ghrelin occurred in the context of stable weight and caloric intake, suggesting that changes in ghrelin were not related to alterations in nutritional status. While weight gain did not occur in response to the increased ghrelin (changes in appetite were not examined) this may have been due to the significant behavioral abnormalities exhibited by this clinical group. Neither the clinical implications of this finding nor the relevance to non-clinical groups are known. However, this finding suggests the possibility that increased ghrelin and concomitant increases in appetite may be found in OC users.

OC use causes alterations in endogenous hormone levels, and those alterations may be associated with changes in body satisfaction and eating behaviours. The overall reduction in E levels associated with OC use (Greco et al., 2007) may result in increased hunger and food intake. In community samples, low E levels have been associated with binge eating (Klump et al., 2008), while higher E levels have been associated with

general disordered eating (Klump et al., 2006). Thus, the lowered E levels may be associated with increased appetite and bingeing. However, daily and weekly fluctuations of E in OC users (Fotherby, 1996) may cause concurrent fluctuations in levels of hunger and food intake. If such as pattern were to be particularly pronounced in an individual so as to reflect alternating periods of over- and under-eating, such a pattern could be described as disordered eating. This pattern of disordered eating may be particularly likely in women with a pre-existing propensity towards disordered eating and body image concerns. Furthermore, women who are more sensitive to absolute or changing levels of gonadal hormones may also be at increased risk.

While it is possible that lowered and changing E levels may affect eating patterns, alterations in E are only one part of the changes that occur with OC use. Use of OCs is also associated with decreased P and P metabolites, including ALLO (Follesa et al., 2002; Greco et al., 2007). It is possible that low levels of P may lead to decreased appetite (Giannini et al., 1985; Yavuzsen, et al., 2005) and decreased symptoms associated with binge eating (Klump et al., 2008). The decrease in the luteal phase spike in ALLO (Follesa et al., 2002) may lead to decreased eating during that portion of the cycle compared to non-OC users. The final factor to consider is the decrease in androgens, such as T and DHEAS, associated with OC use (Greco et al., 2007). Increased T levels are associated with bulimic behaviours in clinical samples (Naessen et al., 2006). Therefore decreased T may be associated with fewer bulimic behaviours. While little is known about the connection between DHEAS and appetite in humans, rodent studies suggest that DHEAS is associated with an anorectic effect (Kaur &

Kulkarni, 2001). Therefore, the OC-associated decrease in DHEAS (Wiegratz et al., 2003) may result in increased food intake.

Overall, it is quite difficult to predict how OC use may impact eating disorder symptoms in non-clinical samples. Changes in endogenous hormones associated with OC use result in decreases in some orexigenic and some anorexigenic hormones, therefore the net outcome on appetite and eating behaviours is quite difficult to predict. The study by Naessen and colleagues (2007), found that OC use resulted in an increase in appetite in the non-eating disordered group. Thus, there is evidence to suggest that OCs may alter appetite and eating patterns in the average woman. Beyond absolute levels of endogenous hormones, the dose, type, and individual reaction to the particular OC used, are all factors that are likely important.

One study examined the presence of eating disorder symptoms, including body dissatisfaction and eating dysfunction, in a non-clinical group of OC ever users (Bird & Oinonen, 2011). They measured the women's history of both mood and physical OC side effects, in addition to the severity of eating disorder symptoms. The results indicated that women with a history of negative OC side effects were experiencing greater body dissatisfaction and eating dysfunction compared to women with no such history. Furthermore, having a greater number of OC side effects was associated with increased eating disorder symptoms of both types. The number of OC side effects was still predictive of increased eating disorder symptoms, even when current negative mood symptoms, such as depression, and physical symptoms such as weight gain and swelling were controlled. Thus, increased eating disorder symptoms were not likely to be a result of negative mood or dissatisfaction with bodily changes associated with OC use. The

relationship between OC side effects and eating disorder symptoms suggests that some women may be particularly sensitive to alterations or fluctuations in hormones, which may lead to both sets of complaints.

Hormonal Sensitivity

A concept that may be relevant to eating disorder symptoms, OC side effects, and the relationship between the two, is hormonal sensitivity. Certain women may be especially sensitive to endogenous hormones, and possibly exogenous hormones as well. This concept, while difficult to define and measure, may explain why some women experience symptoms while others do not, when they are exposed to similar levels of hormones. According to Rubinow, Schmidt, and Roca (1998), research demonstrates that certain women (e.g., those with a history of PMS), are differentially sensitive to the mood-disturbing effects of gonadal hormones. They state that despite similar plasma levels of gonadal hormones, there is a correlation between mood disturbance and ovarian hormones only in women with a history of PMS.

Kiesner (2009) describes evidence in support of hormonal sensitivity. The author notes that hormones and hormone receptor modulators can have differential effects across various peripheral tissues. Estrogen, for example, is produced and used in peripheral tissues (Labrie, 1991), therefore leading to weak associations between serum hormone levels and tissue-specific hormonal activity. In addition to peripheral tissues, recent brain imaging studies have shown localized changes in brain activity and plasticity associated with the menstrual cycle (e.g., Fernandez et al., 2003; Pletzer et al., 2010). Kiesner states that changes in gonadal hormones across the menstrual cycle will have tissue-specific effects that will differ across individuals, and that these effects are

observable via physical symptoms and aspects of menstrual flow. His study found several physical symptoms that were strongly associated with premenstrual depressive symptoms in a sample of young, non-clinical women. It was concluded that the physical symptoms may be indices of a general reactivity to hormones.

A study by Eriksson, Backstrom, Stridsberg, Hammarlund-Udenaes, and Naessen (2006) examined the responses of women with and without PMDD to an estrogen challenge test. Consistent with the hypothesis described by Rubinow, Schmidt, and Roca (1998), Eriksson and colleagues found that despite similar serum estradiol levels and corresponding FSH responses following the estrogen challenge test, the women with PMDD had significantly different LH responses (i.e., stronger negative feedback response, higher LH levels at the nadir, and more LH surge-like reactions). In addition, LH levels in women with PMDD were related to reports of bloating and irritability. Thus, as Kiesner (2009) suggested, the physical and mood symptoms experienced by the PMDD group were linked with reactivity to changes in gonadal hormone levels.

Sensitivity to steroid hormones is also relevant to eating disorder symptomatology. Menstrual disturbances are common in patients with BN, who are usually of normal weight (Pinheiro et al., 2007), and have been reported to precede significant weight loss and continue after weight restoration in women with AN (Brambilla et al., 2003; Katz & Vollenhoven, 2000). In addition to menstrual disturbances, the association between BN and PCOS suggests that women with disordered eating also experience a higher incidence of endocrine disorders. It has been suggested that underlying hormonal disturbances may account for both sets of symptoms (Naessen et al., 2006). Disordered eating behaviours and endocrine disturbances may be

more likely to occur in women who are particularly sensitive to changing or absolute hormone levels.

Bancroft (1993) discussed hormonal sensitivity in terms of a "vulnerability factor" found in certain women that renders them more vulnerable to experiencing PMS or PMDD. According to Bancroft, women with the "vulnerability factor" are more susceptible to experiencing symptoms when faced with changing hormone levels (as found in the daily hormone fluctuations of all OCs, and the weekly fluctuations in triphasic preparations) and menstruation. This theory highlights the fact that only a subset of women experience strong negative side effects in response to hormonal changes. Some studies have attempted to find predictors of negative side effects in OC users. Joffe, Cohen, and Harlow (2003) found that history of depression was a predictor of negative premenstrual mood change with OC use. In addition, early-onset premenstrual mood disturbance was a predictor of premenstrual mood improvement with OC use. Another study found that women with premenstrual mood change experienced more negative mood change on triphasic OCs compared to monophasic OCs (Bancroft, Sanders, Warner, & Loudon, 1997). Similarly, in women who experienced OC-related negative mood change, a history of depression, PMS, and pregnancy-related mood change were all identified as potential mediators of the relationship between OCs and mood (see review in Oinonen & Mazmanian, 2002).

Based on the marked variability in responses to OCs, Graham and colleagues (2007) suggest that the reductions in T associated with OC use may only cause symptoms in women who are "testosterone sensitive". They further state that little attention has been paid to predictors of negative response to OCs. A study by Naessen

and colleagues (2006) found that women with BN had significantly increased hirsutism scores compared to controls. While hirsutism is considered an indicator of androgen excess, this was not reflected in significantly higher rates of free T in the clinical group compared to controls. The authors suggest that this group of women may have heightened sensitivity to androgens at the hair follicles, which could cause increased hair growth. As circulating hormone levels did not correlate with outcomes as expected, it could be that measured hormone levels are not accurate representations of one's hormone activity. It may also be important to consider prenatal hormone exposure, as well as hormone receptor density and sensitivity (as suggested by Oinonen, 2009).

While the idea of hormonal sensitivity has been mentioned occasionally in endocrine research, the concept is not well-defined. Furthermore, although some attempt has been made to identify predictors of adverse reactions to OCs (a possible outcome of hormonal sensitivity), there have been few consistent findings. Therefore, ways of predicting hormonal sensitivity are necessary. Some possible predictors include: preexisting mood disorders, PMS/PMDD, early/late menarche, irregular menstrual cycles, and a family history of OC-related mood changes. However, more objective measures would be helpful in predicting sensitivity to hormones. Genetic predictors, such as polymorphisms at particular genes may be relevant. Finally, some anthropometric measurements may provide indicators of prenatal hormone exposure and current hormone activity.

As previously mentioned, lower 2D:4D is reflective of higher prenatal testosterone exposure and lower estrogen exposure (see review by Manning, 2002). A study by Manning (2003) indicates that 2D:4D is associated with variability in the

androgen receptor gene, however, 2D:4D does not appear to be related to circulating hormones in adults (see review by Honekopp et al., 2007). While few studies have been conducted in female populations, 2D:4D has been associated with endocrine-related disorders, such as congenital adrenal hyperplasia (Brown et al., 2002), PCOS (Cattrall et al., 2005), and AN (Klump et al., 2006).

Another anthropometric measure that may be useful in assessing hormonal sensitivity or androgen activity is middle-phalangeal hair [or mid-digital hair, phalanx/phalange 2 hair (P2 hair); Oinonen, 2009]. Middle-phalangeal hair refers to hair found on the middle segment of the finger, between the interphalangeal joints. Early studies of middle-phalangeal hair reported interindividual differences, including sex (i.e., males > females), age (i.e., adults > children), and pubertal status (post-pubertal > pre-pubertal) which suggested that the occurrence of middle phalangeal hair may be affected by genetics and circulating hormone levels (Garn, 1951; Saldanha & Guinsburg, 1961). More recent research suggests the possibility that middle-phalangeal hair may be a reflection of an individual's 5α-reductase activity or testosterone metabolism (see review in Oinonen, 2009). Similar to finger length (i.e., 2D:4D), middle phalangeal hair on the fourth digit appears to be most sensitive to androgenic effects, while the second digit appears to be least sensitive (Manning, 2002).

One study has examined both 2D:4D and middle-phalangeal hair counts as a possible measure of hormonal sensitivity in women. Oinonen (2009) examined these anthropomorphic measures in groups of women with positive and negative histories of OC side effects. The findings suggest that women with a history of negative mood and physical OC side effects have lower 2D:4D and fewer middle-phalangeal hairs. Women

with a history of positive OC physical side effects (e.g., a reduction in menstrual cramps) were found to have higher 2D:4D and more middle-phalangeal hairs. Furthermore, both lower 2D:4D and fewer middle-phalangeal hairs were found in OC users who discontinued use due to negative mood side effects.

Overall, both anthropomorphic measures were associated with a number of mood and physical OC side effects. Low 2D:4D may be associated with the experience of adverse OC side effects because higher prenatal testosterone exposure may cause either up-regulation or down-regulation of androgen receptors (resulting in increased or decreased sensitivity of the receptors). Alternately, some women with lower 2D:4D may have been exposed to average androgen levels in utero but may have highly sensitive androgen receptors, which resulted in longer fourth digits. Thus, 2D:4D may also indicate a woman's androgen sensitivity. While the relationship between OC side effects and middle-phalangeal hair is less clear, Oinonen (2009) suggests that women with fewer hairs may have lower androgen bioavailability or sensitivity.

Studies that examined eating disorder symptoms and 2D:4D in non-clinical groups of women and men found that higher 2D:4D was associated with greater eating disorder symptoms (Klump et al., 2007; Oinonen & Bird, 2012; Smith, Hawkeswood, & Joiner, 2010). A study of participants with eating disorders found that low 2D:4D was associated with a diagnosis of AN, while high 2D:4D was associated with a diagnosis of BN (Quinton, Smith, & Joiner, 2011). Therefore, lower prenatal testosterone exposure may be predictive of increased eating disturbance in non-clinical populations, and the relationships between prenatal testosterone and eating disorder symptoms may differ in clinical populations. A link between increased OC side effects (associated with lower

2D:4D) and eating disorder symptoms was also found, and should be replicated. Women who experience both negative OC side effects and eating disorder symptomatology may be a unique group, who show a different pattern of findings. Taken as a whole, the relationships between hormonal sensitivity, 2D:4D, eating disorder symptoms, and OC side effects are complex and are deserving of further study.

The Present Study

The present study examined the link between eating disorder symptoms and hormones by examining: (a) the relationships between eating disorder symptoms, OC use, and the experience of side effects; (b) correlations between circulating hormone levels and eating disorders symptoms (c) the relationships between eating disorder symptoms, OC experiences, and hormonal sensitivity; and (d) correlations between measures of digit ratio (2D:4D) and eating disorder symptoms. Few studies have examined the influence of OCs on eating disorder symptoms and body image. Naessen and colleagues (2007) found that OC use reduced symptoms in women with BN, but increased symptoms in the non-clinical control group. Another study found that the experience of negative OC side effects was associated with greater eating disorder symptoms (Bird & Oinonen, 2011). A relationship between OCs and eating disorder symptoms, whereby the use of OCs may result in increased eating disorder symptoms in some women, may be due to: (a) a direct effect of exogenous or altered endogenous hormones on eating behaviour, (b) an indirect effect whereby side effects of hormonal contraceptives (i.e., low mood, weight gain) increase eating disorder symptoms, and/or (c) the possibility that both hormonal contraceptive side effects and eating disorder symptoms reflect a predisposition to hormonal sensitivity. The current study is designed

to clarify whether there is a direct or indirect effect of OC use on eating disorder symptoms, or if both sets of symptoms (OC side effects and eating disorder symptoms) happen to co-occur, perhaps due to pre-existing sensitivity to endogenous hormones.

Only two studies have looked at the relationship between levels of circulating gonadal hormones and eating disorder symptoms in non-clinical populations. More studies have looked at hormone levels in women with active AN and BN diagnoses. However, in these women it is difficult to rule out the possibility that starvation and purging behaviours affect hormones. Examining the relationships between hormone levels and both eating dysfunction and body dissatisfaction in non-clinical populations such as university students allows one to look at a population where the impact of severe long-term disordered eating on hormones is minimized. Furthermore, using a non-clinical population provides possible information about hormonal differences that may act as precursors to eating disorders. Research by Klump and colleagues (2006, 2008) with non-clinical samples found that the general level of disordered eating was positively associated with E levels, while binge eating scores were negatively associated with E, and positively associated with P, as measured daily across the menstrual cycle. The current study attempted to replicate those findings, and also examined levels of T. Furthermore, our study investigated whether putative measures of hormonal sensitivity moderate the relationship between gonadal hormone levels and eating disorder symptoms.

Part 1 of the present study examined the eating disorder and hormonal symptoms of 642 women. At Time 1 participants completed a questionnaire, which included measures of eating disorder symptoms, OC use and side effects, hormonal markers such

as PMS symptoms, and measures of mood. At Time 2 and Time 3, approximately six months and one year later, 203 and 124 participants respectively, repeated the questionnaire. A small number of women (n = 26) changed their OC use status between the repeated measurements; either from nonuser to user or vice-versa. This allowed for a within-subject prospective comparison of eating disorder symptom levels at times of OC use and nonuse in the same participant. Participants who complete the online questionnaire were also asked to participate in the laboratory phase of Part 1 where measures of 2D:4D, BMI, and waist to hip ratio were taken. Part 2 of this study further examined the link between gonadal hormones and eating disorder symptoms. A group of OC-nonusers who completed the online questionnaire provided salivary samples that were assayed for levels of E, P, and T. The relationship between three types of eating disorder symptoms (drive for thinness, bulimic symptoms, and body dissatisfaction), and hormone levels measures were examined. Based on the review of relevant studies, a priori hypotheses for Part 1 and Part 2 of the study were proposed.

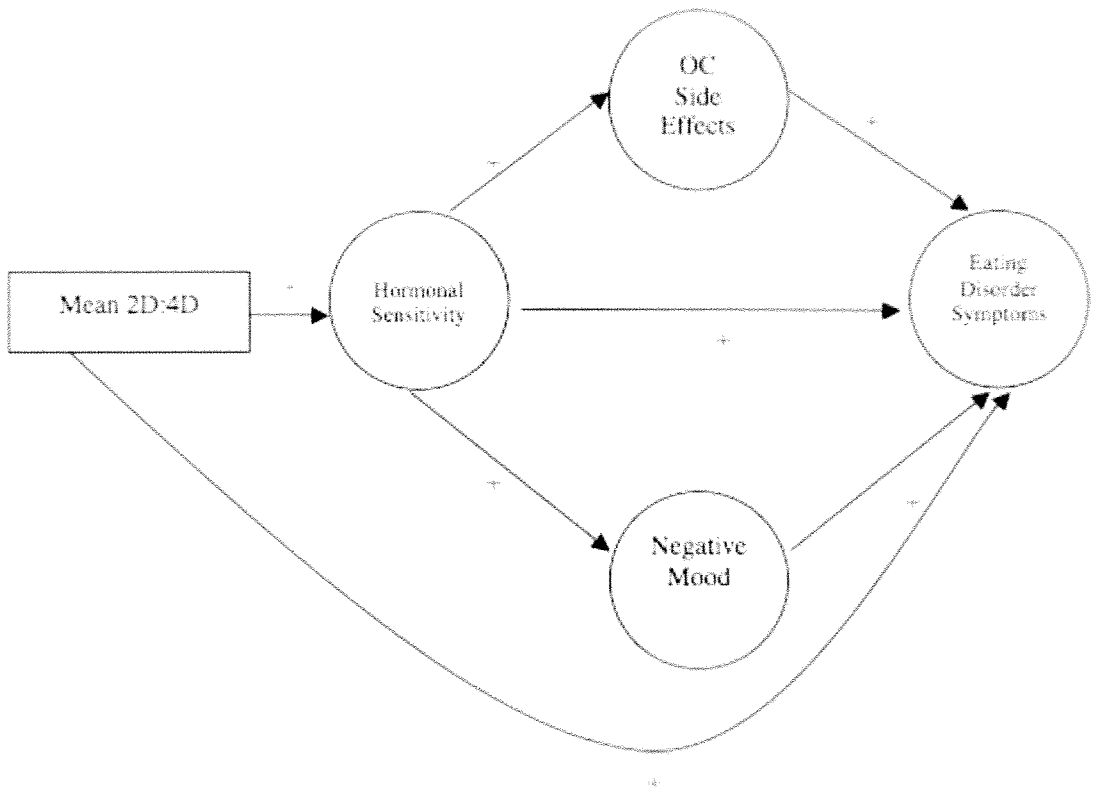

Figure 1. The hypothesized relationships between key variables: negative mood, eating disorder symptoms, OC side effects, OC status, hormonal sensitivity, and mean 2D:4D. The direction of the relationship between mean 2D:4D and hormonal sensitivity was not specified given inconsistent relationships found between 2D:4D and variables relating to hormonal sensitivity (see Oinonen, 2009).

Hypotheses for part 1. ***Hypothesis one.*** The hypothesized structural model is presented in Figure 1. A description of the measures associated with each of the latent variables can be found in Table 1. It was hypothesized that the overall fit of the structural model would be significant at Time 1, Time 2, and Time 3.

Hypothesis two. Severity of eating disorder symptoms is related to the experience of OC side effects. Greater symptom scores on all three subscales of the Oral Contraceptive Side Effects Scale is associated with higher scores on three subscales of the EDI-3 (Drive for Thinness, Bulimia, Body Dissatisfaction). Both current OC side effects (occurring in the past month, current users only) and the overall experience of OC side effects (in both current and previous users) explains eating disorder symptom scores.

Hypothesis three. Levels of eating disorder symptoms fluctuate with changes in OC status within an individual. Greater levels of eating disorder symptoms occur during periods of OC use compared to OC nonuse.

Hypothesis four. In current OC users, Estrogenic Profile scores (indicating the severity of current OC side effects related to an excess of estrogen and a deficiency of progesterone and testosterone; see Table 2) are positively correlated with scores on the Drive for Thinness subscale of the EDI-3, and negatively correlated with scores on the Bulimia subscale. Progestational/Androgenic Profile scores (indicating the severity of OC side effects related to a deficiency of estrogen and an excess of progesterone and testosterone; see Table 2) are positively correlated with scores on the Bulimia scale of the EDI-3, and negatively correlated with scores on the Drive for Thinness scale.

Table 1

Measures Associated with the Latent Variables in Figure 1

Latent Variable	Associated Measures
Negative Mood (Ng Md)	Depression scale of the SCL-90-R
	Anxiety scale of the SCL-90-R
	Negative affect scale of the PANAS
Eating Disorder Symptoms (ED Sx)	Drive for Thinness subscale of the EDI-3
	Bulimia subscale of the EDI-3
	Body Dissatisfaction subscale of the EDI-3
OC Side Effects (OC SE)	Current Physical Side Effects score
	Current Emotional Side Effects score
	Current Sexual Side Effects score
Hormonal Sensitivity (H Sens)	Menstrual Distress Questionnaire score week Before and During Menses
	Acne score
	Hirsutism score

Note. For all scales, a higher score indicates greater problem severity. See text for a discussion of the various scales. SCL-90 = Symptom Checklist-90 Revised; PANAS = Positive and Negative Affect Scale; EDI3 = Eating Disorder Inventory 3.

Table 2

OC Side Effect Profiles and Associated Hormone Levels

Profile	Associated Hormone Levels	Prominent OC Side Effects
Estrogenic	↑ Estrogen	Dizziness
	↓ Progesterone	Visual changes (cyclic)
	↓ Testosterone	Leg cramps
		Heavy menstrual bleeding
		Increased breast size
		Premenstrual negative mood
Progestational/Androgenic	↓ Estrogen	Decreased menstrual bleeding
	↑ Progesterone	Nervousness
	↑ Testosterone	Hot flashes
		Fatigue
		Depression
		Increased appetite
		Acne
		Aggression

Note. Table content is adapted from Dickey, 2000; Nelson, 2007.

Hypotheses for part 2. ***Hypothesis five.*** In women not taking hormonal contraceptives, circulating estrogen, progesterone, and testosterone levels are related to eating disorder symptoms. Scores on the Drive for Thinness subscale of the EDI-3 are positively correlated with estradiol, but negatively correlated with progesterone and testosterone level. Scores on the Bulimia subscale of the EDI-3 are negatively correlated with estradiol, and positively correlated with progesterone and testosterone. The levels of all three hormones are, as a group, significantly explain total scores on the EDI-3.

Hypothesis six. In women not taking hormonal contraceptives, their hormonal sensitivity scores moderate the relationship between gonadal hormone levels (estrogen, progesterone, and testosterone) and eating disorder symptoms (total and subscale scores on the EDI-3).

Method

Participants

A total of 642 women aged 18 to 30 were recruited using in-class announcements at Lakehead University, posters, communication bulletins, class e-mails, postings on websites related to women's health, and pamphlets distributed in the community. All participants complete an online questionnaire on "Women's Health Issues Across Time". There were no exclusion criteria for the online questionnaires. Participants were then invited to participate in one of the laboratory portions of the study (hormonal samples and/or anthropomorphic data). Exclusion criteria for both laboratory sessions included: (a) the current diagnosis of an eating disorder (as this may affect circulating hormone levels) or endocrine disorder, (b) current pregnancy or lactation, and (c) the use of medication that may alter hormone levels (other than OCs, e.g., thyroid medication). In

addition to the above criteria, participants in Part 2 (i.e., the laboratory session) were not to be using any hormonal contraceptives, or have used any hormonal contraceptives in the past three months. Participants in Introductory Psychology courses received one bonus point for each portion of the study in which they participated, including the laboratory portion and the three online questionnaires, to a maximum of three points. As a modest incentive for participation, participants who completed all three online questionnaires were entered in a draw for an iPod, and those who participated in the laboratory portion of the study were entered in a draw for one of three $100 bookstore gift certificates.

For Part 1 of the study, 642 females completed the Women's Health Across Time Questionnaire at Time 1. These participants were primarily undergraduate students at Lakehead University (95.3% described themselves as current Lakehead students). One hundred and seventy-one participants completed the follow-up Time 2 questionnaire, and 115 completed the questionnaire for follow-up at Time 3. Except for where noted below, thirty-two women at Time 2 were excluded for having more than nine months between questionnaires 1 and 2, and seven women at Time 3 were excluded for having less than four months between questionnaires 2 and 3. After completing the initial questionnaire, 137 participants attended one of the two possible laboratory sessions. Eighty-four participants (consisting of OC users, non-users, and previous users) completed the Part 1 laboratory session involving body measurements only, and 52 OC non-users completed the Part 2 laboratory session, which included (in addition to the body measurements) the collection of salivary samples and assessment of current mood and ED symptoms. This study received ethics approval by the Lakehead University Research Ethics Board.

An a priori age-range of 18 to 30 years was chosen for both the questionnaire and laboratory portions of the study to create a relatively homogenous sample of young women. Thus, data from eight respondents over the age of 30 were excluded from all analyses. Twelve women aged 17 at Time 1 participated in the questionnaire portion of the study. Their data were included as they were judged to be "close enough" in age to the target range, and presumably similar in terms of health and hormonal factors. At the initial Time 1 questionnaire, an error in the online survey prohibited 256 of the 642 participants from providing their age. An estimated age was created for those missing age at Time 1 using their reported age at either Time 2, Time 3, or the lab phase, and subtracting the time since between the two measurements. For demographic information on the total sample at each of the three time points, see Table 3. The age of participants at Time 2 and Time 3 was significantly greater when compared to age at Time 1 ($p = .02$ and $p < .001$), as would be expected due to the passage of time. There were no significant differences between BMI measured at the three time points. There were also no significant differences between Time 1 and either Times 2 or 3 in the proportion of those endorsing race as white or non-white ($p = .242$ and $p = .150$). Similarly, there were no significant differences between Time 1 and either Times 2 or 3 in the proportion of those who reported being in steady relationship ($p = .271$ and $p = .803$).

Self-reported rates of eating disorders (presence and severity) are reported in Table 4. Information regarding women's OC use and status across the study is found in Table 5, in addition to the numbers of participants who started or stopped OC use during the study, and the length of current OC use for current users. Table 6 contains information on the OC formulations used by participants at Times 1, 2, and 3. Regarding

Table 3

Demographics for Participants at Times 1, 2, and 3

Characteristic	Time 1 Sample ($N = 642$)	Time 2 Sample ($N = 171$)	Time 3 Sample ($N = 115$)
		M (SD)	
Age	20.24 (3.19)[a]	20.56 (3.20)**	21.07 (2.89)***
Body Mass Index (BMI)	24.00 (5.44)	24.31 (5.64)	24.05 (5.46)
		Frequencies (%)	
Relationship Status			
Married / Living with Partner	77 (13.48)	29 (18.5)	17 (16.5)
Steady Partner Living Apart	196 (35.19)	56 (35.6)	35 (33.0)
No Partner	220 (34.50)	60 (38.2)	42 (41.1)
Multiple/Casual Partners[b]	64 (11.49)	14 (8.9)	11 (10.7)
Race[c]			
White	610 (93.6)	166 (95.4)	111 (96.5)
Aboriginal	37 (5.8)	9 (5.2)	4 (3.5)
Black	7 (1.1)	2 (1.1)	1 (0.9)
Asian	12 (1.9)	4 (2.3)	3 (2.6)
Southeast Asian	6 (0.9)	0 (0.0)	0 (0.0)
Latin American	3 (0.5)	2 (1.1)	1 (0.9)
Arab	1 (0.2)	0 (0.0)	0 (0.0)
Hispanic/Latino	4 (0.6)	1 (0.6)	1 (0.9)
Other	5 (0.8)	0 (0.0)	0 (0.0)

Note. BMI = weight (kg)/ [height (m) * height (m)].

[a] Of the 642 participants, Time 1 age data were missing for 256 participants due to an error in the questionnaire. The reported mean includes only those women who reported age at Time 1. After creating an estimated age at Time 1, for 526 participants the mean age was almost identical, 20.44 ($SD = 3.11$). [b] Includes respondents who indicated they had more than one partner, those who reported they were "casually dating" one or more people, or those who were unable to categorize their relationship status. [c] Participants were asked to choose one or more options that best describe them.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4

Self-Reported Rates of Eating Disorders at Times 1, 2, and 3 by Presence and Severity

Disorder and Presence/Severity	Time 1 (N = 625 - 626)	Time 2 (N = 171)	Time 3 (N = 115)
		Frequency (%)	
Anorexia Nervosa			
No	589 (94.2)	165 (97.1)	110 (96.5)
Yes – Symptoms No Longer Present	21 (3.4)	4 (2.4)	3 (2.6)
Yes – Symptoms Present But Reduced	10 (1.6)	1 (0.6)	1 (0.9)
Yes – Symptoms Currently Present	5 (0.8)	0 (0)	0 (0)
Bulimia Nervosa			
No	602 (96.3)	167 (98.8)	113 (99.1)
Yes – Symptoms No Longer Present	13 (2.1)	1 (0.6)	1 (0.9)
Yes – Symptoms Present But Reduced	7 (1.1)	1 (0.6)	0 (0)
Yes – Symptoms Currently Present	3 (0.5)	0 (0)	0 (0)
Binge Eating Disorder			
No	615 (98.2)	169 (99.4)	113 (99.1)
Yes – Symptoms No Longer Present	5 (0.8)	0 (0)	1 (0.9)
Yes – Symptoms Present But Reduced	5 (0.8)	1 (0.6)	0 (0)
Yes – Symptoms Currently Present	1 (0.2)	0 (0)	0 (0)

Table 5

Oral Contraceptive (OC) Use Status and Length of Use Across Time

OC Use Characteristics	Time 1	Time 2	Time 3
		Frequency (%)	
OC Status	$N = 581$	$N = 170$	$N = 99$
Never User (NU)	147 (25.3)	33 (20.0)	19 (19.2)
Current User (CU)	296 (46.1)	82 (48.2)	55 (55.6)
Previous User (PU)	138 (23.8)	54 (31.8)	25 (25.3)
OC Status Change			
Starters		6	6
Stoppers		13	3[a]
		M (SD)	
Months using current OC (CU)	$N = 202$	$N = 54$	$N = 36$
	22.98 (21.16)	24.76 (15.19)	34.47 (22.65)
Total months using any OC			
CU	$N = 171$	$N = 41$	$N = 37$
	34.70 (27.07)	33.51 (20.20)	45.94 (27.01)
PU	$N = 46$	$N = 19$	$N = 7$
	30.54 (32.34)	45.00 (23.35)	29.71 (21.68)
Months since stopping HC[b] use (PU)	$N = 48$	$N = 7$	$N = 9$
	24.15 (24.50)	32.39 (41.58)	34.44 (17.15)

Note. HC = hormonal contraceptive.
[a] Over the course of the study, 26 participants changed OC status (2 participants changed status more than once). [b] Months since stopping any hormonal contraceptive, including OCs.

Table 6

Current Brand of Oral Contraceptive (OC) Being Used at Times 1, 2, and 3

Brand of oral contraceptive	Frequency (%) of use at Time 1 ($N = 318$)	Frequency (%) of use at Time 2 ($N = 79$)	Frequency (%) of use at Time 3 ($N = 59$)
Alesse/Aviane	105 (33.02)	30 (37.97)	19 (32.20)
Brevicon 1/35	2 (0.63)	0 (0)	0 (0)
Cyclen/Sprintec	6 (1.89)	0 (0)	0 (0)
Demulen 30	0 (0)	1 (1.27)	0 (0)
Demulen 50	1 (0.31)	0 (0)	0 (0)
Diane 35/Cyestra 35	14 (4.40)	5 (6.33)	6 (10.17)
Loestrin 24 Fe	1 (0.31)	0 (0)	0 (0)
Loestrin 30	2 (0.63)	1 (1.27)	0 (0)
Marvelon	12 (3.77)	3 (3.80)	2 (3.39)
Microgestin Fe 1/20	0 (0)	1 (1.27)	0 (0)
MinEstrin	3 (0.94)	0 (0)	0 (0)
MinOvral	6 (1.89)	1 (1.27)	1 (1.69)
Ortho 1/35	2 (0.63)	0 (0)	0 (0)
Ortho 7/7/7	1 (0.31)	1 (1.27)	1 (1.69)
Ortho-Cept	2 (0.63)	0 (0)	0 (0)
Ovral	3 (0.94)	2 (2.53)	1 (1.69)
Linessa	1 (0.31)	0 (0)	0 (0)
Micronor	2 (0.63)	1 (1.27)	1 (1.69)
Portia	5 (1.57)	3 (3.80)	3 (5.08)
Seasonale	2 (0.63)	0 (0)	0 (0)
Seasonique	1 (0.31)	0 (0)	0 (0)
TriCyclen	28 (8.81)	6 (7.59)	5 (8.47)
TriCyclen Lo	50 (15.72)	7 (8.86)	6 (10.17)
Yasmin	56 (17.61)	15 (18.99)	12 (20.34)
Yaz	13 (4.09)	2 (2.53)	2 (3.39)

lifetime number of OC formulations used by participants at Time 1; current users (n = 296) reported a mean of 1.47 (SD = 1.02) different formulations, with maximum of 8 different formulations, while previous users (n = 145) reported a mean of 1.46 formulations (SD = 1.62), with a range of 1 to 14 different formulations.

Materials and Measures

Women's Health Issues Across Time questionnaire.

This questionnaire (see Appendix A) took approximately 30 to 45 minutes to complete. It included sections collecting information on: demographics, reproductive history, contraceptive history, hormonal experiences, medical and health history, experiences with food, psychiatric history, mood, and social factors. The section on psychiatric history included questions about depression, anxiety, bipolar disorder, AN, BN, and binge eating disorder. These were developed based on items used in our laboratory in past studies.

The section on mood examined the level of depressive and anxiety symptoms using the Symptom Checklist 90 Revised (SCL-90-R; Derogatis, 1994). Items on the SCL-90-R measure current psychiatric symptoms using a 5-point scale of distress (0 to 4) ranging from "*not at all*" to "*extremely*". The 13-item Depression scale, and the 10-item Anxiety scale were included with instructions for participants to rate their experience of these symptoms in the past seven days. The internal consistency of these scales has been estimated at .90 and .85, respectively. The Positive and Negative Affect Schedule (PANAS) was included to examine both positive and negative affect (Watson, Clark, & Tellegen, 1988). The PANAS contains a Positive Affect (PA) scale and a Negative

Affect (NA) scale, that are composed of 10 items each. The internal consistency has been estimated at .90 for the PA scale, and .87 for the NA scale.

The section on hormonal experiences included a modified version of the Menstrual Distress Questionnaire (MDQ; Moos, 1989), which taps into somatic, affective, and behavioural symptoms the participant has experienced in association with the menstrual and premenstrual periods. The MDQ contains 47 items on eight scales: pain, water retention, autonomic reactions, concentration, behaviour change, negative affect, arousal, and control. Moos reported finding moderate to high intercycle stability for the MDQ, and internal consistencies for the MDQ subscales ranging from .64 for the control scale to .92 for the negative affect scale. Symptoms are rated on a five-point scale ranging from "*No experience of symptom*" (0) to "*Severe*" (4). While the items on the MDQ were not changed, participants were asked to rate their symptoms both *7 days before* menstrual flow (period), and *during* menstrual flow (period), which differs from the original instructions of the various versions of the MDQ. The modified instructions lessen the requirements for respondents and are more relevant to the current study. This section also contained items about hormonally-related bodily experiences, such as acne and hair growth (described below).

The section on experiences with food included items tapping into food cravings using the Trait Food-Cravings Questionnaire (FCQ-T; Cepeda-Benito, Gleaves, Williams, & Erath, 2000) and eating behaviours (see below). Finally, four infrequency scale items adapted from the Personality Research Form (Jackson, 1984) were included for the purposes of a validity check. No participant endorsed more than one of the

infrequency items, and therefore no participants were excluded based on random or non-purposeful responding.

Eating disorder symptoms. The questionnaire contained portions of the Eating Disorder Inventory-3 (EDI-3) developed by Garner (2004; see question 15 in Appendix A). The EDI-3 assesses psychological symptoms and characteristics common to AN and BN (Allison, 1995). The included portion of the test contains 25 self-report items belonging to three subscales that examine attitudes towards body image and eating [Drive for Thinness (DT), Bulimia (B), and Body Dissatisfaction (BD)].

The eight items on the Drive for Thinness subscale measure preoccupation with dieting and weight, the presence of an intense fear of weight gain, and an extreme desire to be thinner (Garner, 2004). The Bulimia subscale (eight items) measures the tendency to think about and engage in bingeing, purging, and eating in response to being upset. The Body Dissatisfaction subscale (nine items) measures, "discontentment with the overall shape and size of those regions of the body that are of extraordinary concern to those with eating disorders (i.e., stomach, hips, thighs, buttocks)" (Garner, 2004, p.14).

The EDI-3 items are statements for which the respondents choose the degree to which the statement is true about themselves from one of: 3 (*always*), 2 (*usually*), 1 (*often*), 0 (*sometimes*), 0 (*rarely*) or 0 (*never*). However, in order to examine the full range of symptoms in a non-clinical population, the following scoring system was used: 5 (*always*), 4 (*usually*), 3 (*often*), 2 (*sometimes*), 1 (*rarely*) or 0 (*never*) (e.g., Bird & Oinonen, 2011). Norms for the original scoring are available for clinical populations as well as female college students (Allison, 1995). The test-retest reliabilities of the DT, BD, and B subscales after three weeks in a nonpatient sample of college students were

.92, .90, and .97, respectively (Garner, 1991). Garner also reported that the internal reliability estimates of those subscales have been estimated at .86, .89, and .90, respectively. For the current sample, internal reliability estimates for the same EDI-3 subscales were calculated as .84, .92, and .85, respectively. Scores for all three subscales as well as a total score were calculated by summing the responses from the items.

Experiences scale. This 86-item questionnaire (see question 33 in Appendix A) asked participants to rate the severity or frequency of a variety of positive and negative experiences over the past month. The majority of items used the following rating scale: *Not at all* (0), *Mild* (1), *Moderate* (2), *Strong* (3), *Severe/Extreme* (4), and for some items, *Not Applicable*. Appendix B contains a list of all items by subscale, and specifies reverse-scored items and alternate scoring of unique items. Items are grouped into three subscales: physical (33 items), emotional/cognitive (41 items), and sexuality/libido (12 items). While scores on this scale were not used in the current study, in future studies using the current dataset it will provide the opportunity to examine OC side effects while controlling for attributional bias, as well as examining a broad range of physical and emotional symptoms.

Oral Contraceptive Side Effects Scale. This scale (see question 48 in Appendix A) was used to gauge severity of OC side effects by examining the amount of change respondents reported in physical, emotional/cognitive, and sexual functioning that they attributed to the use of OCs. Respondents were asked if they had experienced a change in each item (*No, Yes, Maybe*) compared to when they did not use OCs. For each item where they indicated yes or maybe, participants were asked to describe the amount of change by choosing (*Large Decrease, Moderate Decrease, Mild Decrease, Mild Increase,*

Moderate Increase, Large Increase). Participants at Time 1 were asked to rate change in OC side effects for two periods of time: a) in the past month (current OC users only), and b) for their entire period of OC use (current and previous OC users). At Times 2 and 3 ratings were requested for the past month only. The 83 items on this scale are the same as the 86 items on the Experiences Scale (described above). The wording of some items from the Experiences Scale was changed (e.g., "irritable" was changed to "irritability"), and some pairs of items were collapsed into a single item (i.e., "breast size increase" and "breast size decrease" were changed to "breast size"; "weight gain" and "weight loss" were changed to "weight"; "sleeping less than usual" and "sleeping more than usual" were changed to "amount of sleep"; "appetite increase" and "appetite decrease" were changed to "appetite"; and "increase in food intake" and "decrease in food intake" were changed to "food intake").

All items were scored in the following manner: *Large Decrease* (+3), *Moderate Decrease* (+2), *Mild Decrease* (+1), *No Change* (0), *Mild Increase* (-1), *Moderate Increase* (-2), *Large Increase* (-3). A subset of items were reverse-scored (same as the Experiences Scale, see Appendix B). Scores on the three subscales (physical, emotional/cognitive, sexuality/libido) were calculated using the absolute values of the items, given that both positive and negative change could reflect hormonal sensitivity. A higher subscale score indicates greater OC side effects (both of a positive and negative nature).

Hormonal Sensitivity Score. A hormonal sensitivity score was derived based on items in the questionnaire that likely reflect a sensitivity to fluctuating or absolute (i.e., low or high) levels of hormones. The hormonal sensitivity score was calculated by taking

the sum of the z-scores on the Menstrual Distress Questionnaire (as described above) from measures both before and during menses, as well as the acne and hirsutism scores. The acne scale contained three items that asked the respondent to: (a) rate her teenage/adult experience with acne compared to other women her age, (b) indicate whether nor not she is currently taking medication to treat acne (including OCs when used primarily as an acne treatment), and (c) using the system described by Charoenvisal and colleagues (1996), rate the amount and type of acne she has experienced in the most recent month when not taking hormonal contraceptives. Higher scores on each of these items indicates increased severity of acne. The Ferriman-Gallwey system was included as a measure of hirsutism (Ferriman & Gallwey, 1961). This commonly used system rates the amount of hair on 11 body sites, with a higher score indicating greater presence of body hair. Participants were asked to choose the statement that best describes the presence of hair on the various body sites when not taking hormonal contraceptives. Greater scores on the Menstrual Distress Questionnaire were presumed to indicate greater sensitivity to estrogen and/or progesterone, while greater scores on the acne and hirsutism scales were presumed to indicate greater sensitivity to androgens.

Laboratory questionnaire to accompany saliva sample collection. When participants were providing saliva samples, they were also asked to fill out a questionnaire (see Appendix C) to provide an assessment of the level of eating disorder symptoms, mood symptoms, and food cravings at the time that the sample was collected. This questionnaire contained the three subscales of the EDI-3 (Garner, 2004), as well as the SCL-90-R depression and anxiety subscales (Derogatis, 1994) from the Women's Health Across Time Questionnaire (see above). In addition, this questionnaire also

included the State Food-Cravings Questionnaire (FCQ-S; Cepeda-Benito et al., 2000; see question 5 of Appendix C).

Salivary hormone assays. Salivary samples were utilized to obtain levels of estradiol, progesterone, and testosterone. Measuring biomarkers with saliva sampling has been shown to be accurate compared to other methods (i.e., serum, plasma), and is also less invasive and associated with higher compliance than other types of samples (Edler et al., 2007; Shirtcliff et al., 2000). Laboratory sessions for the collection of saliva occurred between 8:30 AM and 10:30 AM so that samples could be collected within the first hour of waking when estradiol levels are theoretically at their peak due to circadian rhythms, and thus more likely to be in the detectable range (Shirtcliff et al., 2000). Participants were asked to refrain from eating, smoking, exercising, brushing teeth, or drinking anything but water prior to attending the laboratory session to avoid contamination of the sample. Participants rinsed their mouths with cold water before starting to drool into the test tube, filling it with approximately 5 mL of saliva. Given the episodic secretion pattern of steroid hormones, participants were asked to fill their tubes with saliva gradually over the course of 45 minutes to physically average the fluctuations that occur over time (Brambilla, O'Donnell, Matsumoto, & McKinlay, 2007). Saliva samples were collected in 10mL polypropylene tubes and the participant number was written on the tube prior to it being sealed in a plastic bag. Samples were stored in a freezer at -34 degrees Celsius until they were shipped for analysis.

It should be noted that a portion of the samples might have been thawed when the freezer in which they were stored lost power. The samples were quickly moved to another freezer. According to the laboratory where the samples were processed,

defrosting and refreezing is a part of the usual processing of samples, and it was not believed that incident would have impacted the integrity of the samples. A series of *t*-tests were conducted to explore possible differences in assay values between samples that were in the freezer when it failed ($n = 21$), and those that were collected after the incident ($n = 31$). No differences were found for testosterone values [$t\ (50) = -.331, p = .742$], estradiol values [$t\ (50) = -.832, p = .409$], or progesterone values [$t\ (50) = -.589, p = .558$]. The results suggest that the hormone levels of samples collected prior to the freezer disruption are similar to the levels in those samples collected after that time. Therefore, it appears that this disruption did not impact the samples.

Hormone samples were analyzed by Rocky Mountain Analyticals using radioimmunoassay (Calgary, Alberta). For progesterone and testosterone, kits from DRG International Inc. (Germany) were utilized, and the estradiol kit was manufactured by IBL International (Germany). The detection limit was defined as that concentration for which the difference between duplicate samples exceeded 20%, and was 0.8 pg/mL for estradiol, 20 pg/mL for progesterone, and 10 pg/mL for testosterone. The intra-assay coefficients of variation (CVs) ranged from 10 to 15%, and inter-assay CVs ranged from 7 to 10% at concentrations 3 to 4 times above the detection limit.

Anthropometric Measures. The second and fourth digits of each hand were measured to 0.01 mm using Mitutoyo Electronic Digital Calipers (Model MIT-500-171). The digits were measured on their ventral surface from the basal crease to the tip (e.g., Manning et al., 2002). All digits were measured twice to reduce measurement error. A 5X aspheric 2" medical magnifier lens was used to count the middle-phalangeal hairs on each hand. To increase reliability, the hairs on each hand were measured twice. A digital

scale was used to measure the participant's weight. Anthropometric tape was used to measure the participant's height, and the circumference of their waist and hips.

Note that an alpha level of .05 was used for all statistical significant testing.

Procedure

Study Part 1

For the questionnaire phase, women were recruited for a study on "Factors Affecting Women's Health Across Time". Participants were given the internet address where they could complete the questionnaire online. Prior to accessing the survey, participants were shown a cover letter providing details on the study, and Consent Form A (see Appendices D and E). Participants could not proceed into the survey without clicking to indicate that they had read and understood the cover letter and were consenting to participate in the study. After completing the questionnaire (see Appendix A) they viewed Debriefing Form A (see Appendix F), which they could print if a hard copy was desired. Participants were contacted by e-mail with a link to complete the questionnaire again at Times 2 (6 months later) and 3 (12 months later). The mean time between completing the Time 1 and Time 2 questionnaires was 5.97 months (SD = 0.90), with a range of between 3.08 and 8.40 months. The mean time between completing the Time 2 and Time 3 questionnaires was 6.93 months (SD = 0.77), with a range of 4.99 to 8.84 months. For participants who completed all three questionnaires, there was a mean time of 12.98 months (SD = 1.03) between the Time 1 and Time 3 questionnaires, with a range of 10.96 and 15.11 months. At Time 2 participants completed Consent Form A and viewed Debriefing Form B (see Appendix G). At Time 3 participants completed Consent Form A and viewed Debriefing Form C (see Appendix H).

For the laboratory phase of Part 1, all eligible participants were contacted by phone or e-mail, given a description of the session, and were invited to set up an appointment. Attrition occurred when eligible participants declined the opportunity to participate in the laboratory session, although recruitment for this first laboratory phase stopped after a suitable number of participants was reached. Upon entering the laboratory, participants were given a verbal description of the study, informed consent was obtained, and participants were provided with Consent Form B to sign (see Appendix I). Next, the anthropometric measures were taken and recorded. Debriefing Form D (see Appendix J) was then provided, and bonus points were recorded when applicable.

Study Part 2

Participants who completed the questionnaire and did not meet the exclusion criteria described previously (including no current use of hormonal contraceptives or diagnosis of an eating disorder) were asked to provide some additional measures beyond those described in the laboratory phase above. Participants were scheduled for a laboratory session that fell either between days 1 to 3 days after the cessation of their menses (during the follicular phase of their cycle and referred to as the post-menses phase; $n = 36$), or during days -5 to -9 (mid-luteal phase of the cycle) using the reverse counting method, about a week prior to the start of menstruation ($n = 16$). This mid-luteal phase testing period corresponds to days 20 to 24 using a forward count in women with a 28-day cycle. Klump and colleagues (2006) found a positive association between eating disorder symptoms and estrogen levels in the follicular phase, when estrogen and progesterone levels are relatively low. Given that higher levels of hormones may be associated with increased eating disorder symptoms (i.e., hypothesis five), the present

study also investigated the level of symptoms when estrogen and progesterone levels are relatively high, during the mid-luteal phase. Therefore, samples were collected at both points during the menstrual cycle to examine whether hormone levels at both cycle phases are associated with eating disorder symptoms. Testing at two cycle phases also allowed for an examination of whether one cycle phase is associated with a greater likelihood of finding an association between hormone levels and eating disorder symptoms.

Upon arriving in the laboratory between the hours of 8:30 and 10:30AM, participants were provided with Consent Form C (see Appendix K), and were asked to confirm their menstrual status and whether they had conformed to the study protocol (e.g., did not eat or brush their teeth that morning). Participants provided small samples of saliva over the course of 45 minutes to account for the pulsatile release of hormones (see Licinio et al., 1998; Mead & Hampson, 1997). While the participant provided the salivary sample they sat quietly and completed the laboratory questionnaire (see above). Measurements of height, weight, waist, and hip circumference, digit length, and counts of the middle-phalangeal hairs were taken following the procedures outlined above. Participants were then provided with Debriefing Form D (see Appendix J) and a bonus point form if appropriate. A snack was offered (granola bar) as participants had not yet eaten. Finally, participants were reminded to contact the experimenter with the date of the start of their next menses as a way to confirm on which day of their cycle they were tested.

Results

Study Part 1: OC Use and Eating Disorder Symptoms

General data screening and assessment of assumptions. Prior to analyses, all items used in the construction of the eating disorder symptom (EDI-3) and OC side effects scales were screened for missing data points. No more than 5% of data points were missing for any single eating disorder symptom variable, which is suitable according to Tabachnick and Fidell (2001). A total of 594 women had complete data for all three scales of the EDI-3. No differences were found between complete and incomplete responders when compared with respect to a number of key variables (see Appendix L). Given that participants with and without missing EDI-3 data did not differ on any of the variables examined, no measures were taken to replace missing data. Scores on the various scales were only calculated for participants with complete EDI-3 response-sets.

With respect to the OC side effect items, a total of 441 current and previous OC users responded to the Women's Health Across Time Questionnaire at Time 1. Of the 296 current users, 250, 257, and 277 users provided complete response sets for the OC Physical, Emotional, and Sexual Side Effect subscales (past month), respectively. Of the 434 current and previous users, 208, 204, and 239 respondents provided complete responses sets to the three subscales (side effects ever during use). For those missing complete response sets for side effects ever during use, 39.32%, 35.47%, and 35.29% were previous users, for Physical, Emotional, and Sexual Side Effects, respectively. In examining the responses, some respondents completed most of the scale but skipped only a few items. Others appeared to have misunderstood the instructions and only completed

occasional items, presumably leaving the majority of items blank (rather than indicating *No Change*) because they had not experienced those particular side effects.

To ensure that those who did and did not provide complete response sets on the OC Side Effect scales did not differ with respect to the total eating disorder score, a series of *t*-tests were conducted (see Table 7). No differences were found between complete and incomplete responders to the three OC side effect scales when compared on the total eating disorder scores (sum of bulimia, drive for thinness, and body dissatisfaction scales). This was true for both current users who rated symptoms in the past month, as well as for current and previous users who rated symptoms ever during OC use. The internal consistency of the three OC Side Effect scales was examined at Time 1 for ratings during the past month and ever during use. All scales showed good reliability (see Appendix M). For the OC Physical Side Effects scale, scores range from 0 to 87 for ratings for the past month, and 0 to 85 for ratings ever during OC use. OC Emotional Side Effects scores ranged from 0 to 126 for the past month, and 0 to 126 for ratings ever during use. Finally, for OC Sexual Side Effects (prior to transformation described below), scores ranged from 0 to 36 for ratings both in the past month and ever during use.

The main eating disorder and OC side effect variables were examined for violations of the assumptions of normality and linearity. To improve pairwise linearity and to reduce positive skewness and kurtosis, the bulimia subscale of the EDI-3 at Time 1 was given a square root transformation. Both drive for thinness and body dissatisfaction were reasonably normally distributed and were not transformed. An examination for outliers [z scores in excess of an absolute value of 3.29 (Tabachnick & Fidell, 2001, pg.

Table 7

Comparison of Total Eating Disorder (ED) Symptom Scores in Women With and Without Complete OC Side Effect (SE) Response Sets

OC Side Effects Score	*M* (*SD*) Total ED Score	*t*	*df*	*p*
Past Month				
OC Physical SE		.105	270	.917
With (*N* = 192)	50.69 (24.80)			
Without (*N* = 80)	50.34 (25.92)			
OC Emotional SE		-.278	270	.781
With (*N* = 206)	50.34 (24.53)			
Without (*N* = 66)	51.33 (26.94)			
OC Sexual SE		.328	270	.743
With (*N* = 220)	50.83 (24.80)			
Without (*N* = 52)	49.56 (26.51)			
Ever During Use				
OC Physical SE		-.364	401	.716
With (*N* = 187)	50.90 (24.33)			
Without (*N* = 216)	51.81 (25.41)			
OC Emotional SE		-1.112	401	.267
With (*N* = 184)	49.89 (23.59)			
Without (*N* = 219)	52.65 (25.91)			
OC Sexual SE		-1.450	401	.148
With (*N* = 219)	49.74 (23.43)			
Without (*N* = 184)	53.35 (26.45)			

67)] located five elevated scores on the bulimia subscale. These scores were replaced with the next highest values. For OC side effects in the past month at Time 1, the physical and mood scales were given logarithmic transformations. The sexual side effects scale was highly positively skewed, with 70.76% of respondents having a score of 0. Transformations did not result in a sufficiently normal distribution. Therefore, the sexual side effects score was converted into to a dichotomous variables, with 0 indicating no side effects and 1 indicating the presence of any sexual side effects. The above transformations and codings were also used for the same OC side effects variables measured ever during OC use. Following the transformations all variables were reasonably normally distributed. No univariate outliers were found, as there were no z scores with an absolute value greater than 3.29 (Tabachnick & Fidell, 2001).

Variables were also screened for multivariate outliers through Mahalanobis distance. One multivariate outlier was found and deleted (the same participant's scores were outliers for OC side effects in both the past month and ever during use). Scatterplots were used to examine linearity of the relationship between the variables. Linearity appeared to be satisfactory. Examinations of the correlations between the various variables (see Tables 8 and 9) indicated that multicollinearity was not a concern. Note that data are reported for transformed subscales at all times unless otherwise indicated. Correlations between EDI-3 scales and main hormonal variables are found in Appendix N. To increase sample size at Times 2 and 3 for model comparisons, additional participants were included who had previously been excluded based on having longer or shorter response times between questionnaires (32 participants at Time 2 and 4 participants at Time 3).

Table 8

Intercorrelations between Eating Disorder Symptom and OC Side Effects Rated Over Past Month at Time 1

Measure	DT	BD	BUL	PSE	ESE	SSE
DT	—	.709**	.639**	.188**	.203**	.173**
BD	598	—	.586**	.177**	.127*	.063
BUL	608	603	—	.276**	.256**	.227**
PSE	241	240	245	—	.720**	.509**
ESE	249	249	253	214	—	.630**
SSE	268	266	272	225	246	—

Note. Correlations are presented above the diagonal and sample sizes are presented below the diagonal. OC Side Effect correlations include current OC users only and all other correlations include the full sample. DT = Drive for Thinness; BD = Body Dissatisfaction; BUL = Bulimia; PSE = OC Physical Side Effects; ESE = OC Emotional Side Effects; SSE = OC Sexual Side Effects. Correlations were performed using transformed variables. Spearman's correlations were utilized for correlations between the dichotomous OC Sexual Side Effects variable and other variables.
* $p < .05$. ** $p < 0.01$.

Table 9

Intercorrelations between Eating Disorder Symptoms and OC Side Effects Experienced Ever During OC Use at Time 1

Measure	DT	BD	BUL	PSE	ESE	SSE
DT	—	.709**	.639**	.093	.161*	.073
BD	598	—	.586**	.163*	.105	.029
BUL	608	603	—	.158*	.271**	.118
PSE	191	199	201	—	.722**	.281**
ESE	196	196	197	166	—	.420**
SSE	229	229	230	183	198	—

Note. Correlations are presented above the diagonal and sample sizes are presented below the diagonal. OC Side Effect correlations include current and previous OC users only and all other correlations include the full sample. DT = Drive for Thinness; BD = Body Dissatisfaction; BUL = Bulimia; PSE = OC Physical Side Effects; ESE = OC Emotional Side Effects; SSE = OC Sexual Side Effects. Correlations were performed using transformed variables. Spearman's correlations were utilized for correlations between the dichotomous OC Sexual Side Effects variable and other variables.
* $p < .05$. ** $p < 0.01$.

Hypothesis one. The hypothesized structural model is presented in Figure 1. A description of the measures associated with each of the latent variables can be found in Table 1. It is hypothesized that the overall fit of the structural model will be significant at Time 1, Time 2, and Time 3.

Data screening and assumptions for hypothesis one. Prior to conducting structural equation modeling (SEM) analyses, the Menstrual Distress Questionnaire (MDQ) total scores for Before (7 days before menses) and During menses were calculated. To reduce positive skewness and kurtosis, the scores for MDQ Before, MDQ During, and Hirsutism were given square root transformations. The Acne Scores were reasonably normally distributed and were not transformed. Mood scores, including the total scores from Depression and Anxiety scales of the SCL-90-R, and the total Negative Affect score for the PANAS were calculated. To achieve normality, the Depression score was given a square root transformation, and the Anxiety and Negative Mood scores were logarithmically transformed. Given the relationship between BMI and eating disorder symptoms, BMI was added to the hypothesized model as a predictor of both Hormonal Sensitivity and Eating Disorder Symptoms.

Results for hypothesis one. The hypothesized model was examined using AMOS 7 software. It should be noted that AMOS utilizes the full information maximum likelihood (FIML) approach to dealing with missing data. FIML has been shown to provide more unbiased and efficient results compared to other methods of treating missing data when dealing with data missing at random (MAR) or missing completely at random (MCAR) (Enders & Bandalos, 2009). Some values in the current dataset were missing by design (only a subset of participants had 2D:4D measured in the lab, and only

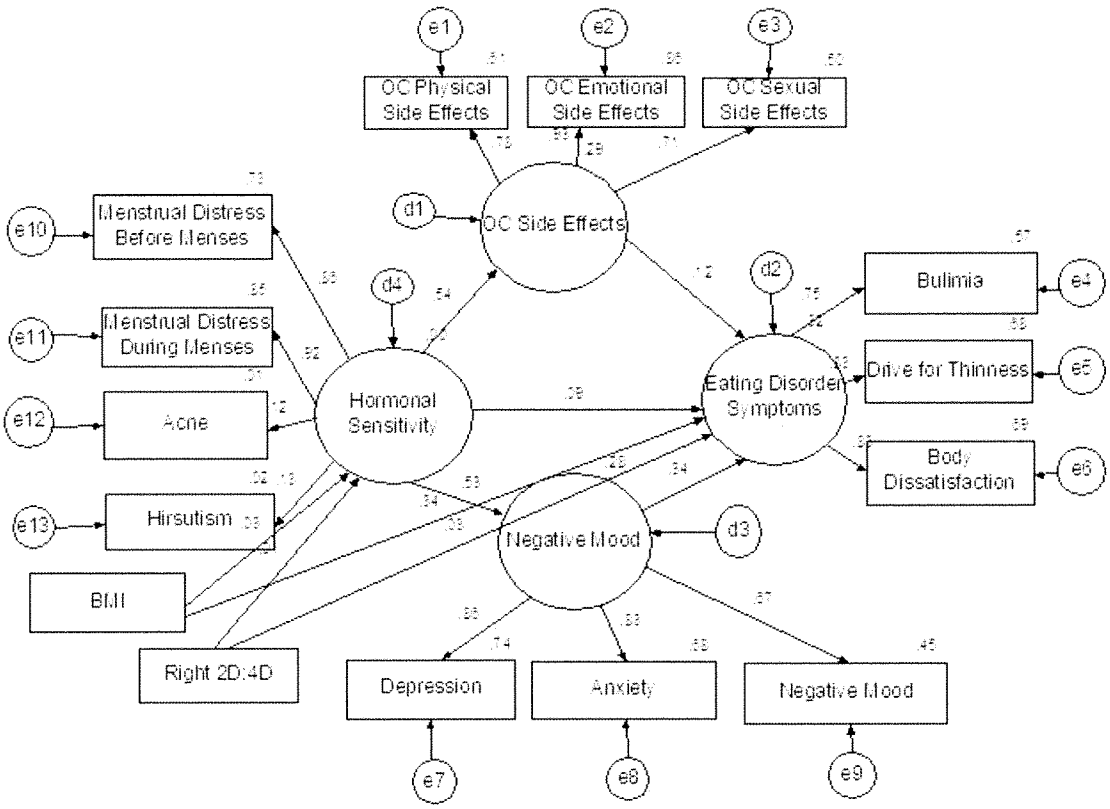

Figure 2. SEM measurement model (hypothesis 1) showing initial loadings of indicator variables onto latent constructs, and standardized path coefficients between latent variables at Time 1. Chi square for the model was significant ($p < .001$) and fit indices suggested the model fit the data well.

current OC users had values of OC side effects variables), and other values are presumed to be MAR or MCAR based on analyses previously conducted (see Appendix L and Table 7). Note that while other variables may have been relevant to the model (e.g., smoking, diet), only the variables of most interest were included to maintain sufficient power. The measurement model (see Figure 2) showed that the indicator variables of latent constructs for OC Side Effects, Eating Disorder Symptoms, and Negative Mood, all showed strong factors loadings (see Table 10). For the latent variable Hormonal Sensitivity, both of the menstrual distress indicator variables showed strong loadings, while the acne and hirsutism indicator variables both showed weak factor loadings.

Maximum likelihood estimation was employed to estimate all models. The initial chi-square test of the hypothesized model was significant, χ^2 (83) = 221, 613, $p < .001$. Several goodness-of-fit indices were examined, and these suggested that the overall fit of the hypothesized model was good. The Incremental Index of Fit (IFI) and the Comparative Fit Index (CFI) both provided values of 0.95, which is believed to indicate a good-fitting model (Tabachnick & Fidell, 2001, p. 699). The value of the root mean square error of approximation (RMSEA) was .050, with a 90% confidence interval of .042 to .058, with the *p*-value equal to .492 (PCLOSE). An RMSEA value of .06 is often considered to be indicative of good fit, with values as high as .08 considered reasonable errors of approximation in the population (Byrne, 2010, p. 80). The *p*-value for the closeness of fit test was greater than .05 as recommended. Therefore, the various measures of model fit suggest that the hypothesized model fits the data well. See Table 11 for goodness-of-fit data for all models.

Table 10

Means and Standardized Factor Loadings of OC Side Effects, Eating Disorder Symptoms, Negative Mood, and Hormonal Sensitivity Indicator Variables at Time 1

Indicator Variable	Factor Loading
OC Side Effects	
Physical Side Effects Past Month	.78
Emotional Side Effects Past Month	.93
Sexual Side Effects Past Month	.71
Eating Disorder Symptoms	
Bulimia Score	.75
Drive for Thinness Score	.83
Body Dissatisfaction Score	.83
Negative Mood	
Depression Score	.86
Anxiety Score	.83
PANAS Negative Affect Score	.67
Hormonal Sensitivity	
Menstrual Distress Before Menses Score	.87
Menstrual Distress During Menses Score	.92
Acne Score	.12
Hirsutism Score	.13

In examining the standardized path coefficients among latent variables, the paths between Hormonal Sensitivity and OC Side Effects (p = .005), as well as Hormonal Sensitivity and Negative Mood (p = .004) were both significant. In addition, the paths between Negative Mood and Eating Disorder Symptoms and between BMI and Eating Disorder Symptoms were both significant (ps < .001, respectively). In contrast, the paths between mean 2D:4D and both Hormonal Sensitivity and Eating Disorders Symptoms were not significant. The path between BMI and Hormonal Sensitivity was also not significant. Finally, the paths between both Hormonal Sensitivity and Eating Disorder Symptoms, and OC Side Effects to Eating Disorder Symptoms were also not significant.

After examining the initial hypothesized model, post-hoc modifications were made in an attempt to improve the fit of the model. For model 2, the observed variable right 2D:4D and its paths to latent variables Hormonal Sensitivity and Eating Disorder Symptoms was removed, given that both paths were non-significant (p = .890 and p = .707, respectively). The non-significant path from BMI to Hormonal Sensitivity was also removed (p = .561). This improved the Akaike's Information Criterion (AIC; lower values indicate improved model fit) but did not provide substantial improvements in other fit indices (see Table 11). For Model 3, the non-significant path from OC Side Effects to Eating Disorder Symptoms (p = .118) was removed. With this change, the path between Hormonal Sensitivity and Eating Disorder Symptoms became significant (p = .035). Model fit indices remained similar to previous values indicating no improvement to the model after this alteration.

In Model 4, a path between Negative Mood and OC Side Effects was added, to see if this improved the fit of the model. This path was significant (p = .030). The lower

Table 11

Goodness-of-Fit Indices for Successive Structural Models

Model	$\chi^2(df)$	*p*	CFI	IFI	RMSEA	CI	PCLOSE	AIC
Time 1[a]						.042-		
1	221,613 (83)	<.001	.951	.952	.050	.058	.492	325,613
2	208,058 (72)	<.001	.952	.952	.053	.045-	.261	302,058
						.062		
3	210,648 (73)	<.001	.952	.951	.053	.045-	.263	302,648
						.061		
4	205,834 (72)	<.001	.953	.953	.053	.044-	.289	299,834
						.061		
5	205,842 (72)	<.001	.953	.953	.053	.044-	.289	299,842
						.061		
Time 2[b]						.055-		
4	146,567 (72)	<.001	.919	.922	.071	.088	.019	240,567
5	142,567 (72)	<.001	.923	.926	.069	.053-	.030	236,567
						.086		
Time 3[c]						.046-		
4	116,324 (72)	.001	.922	.927	.046	.094	.080	210,324
5	111,188 (72)	.002	.931	.935	.067	.041-	.134	205,188
						.090		

Note. CFI = comparative fit index; IFI = incremental fit index; RMSEA = root mean square error of approximation; CI = confidence interval; PCLOSE = *p* value for closeness of fit test; AIC = Akaike's information criterion.
[a]*N* = 671. [b]*N* = 204. [c]*N* = 124.

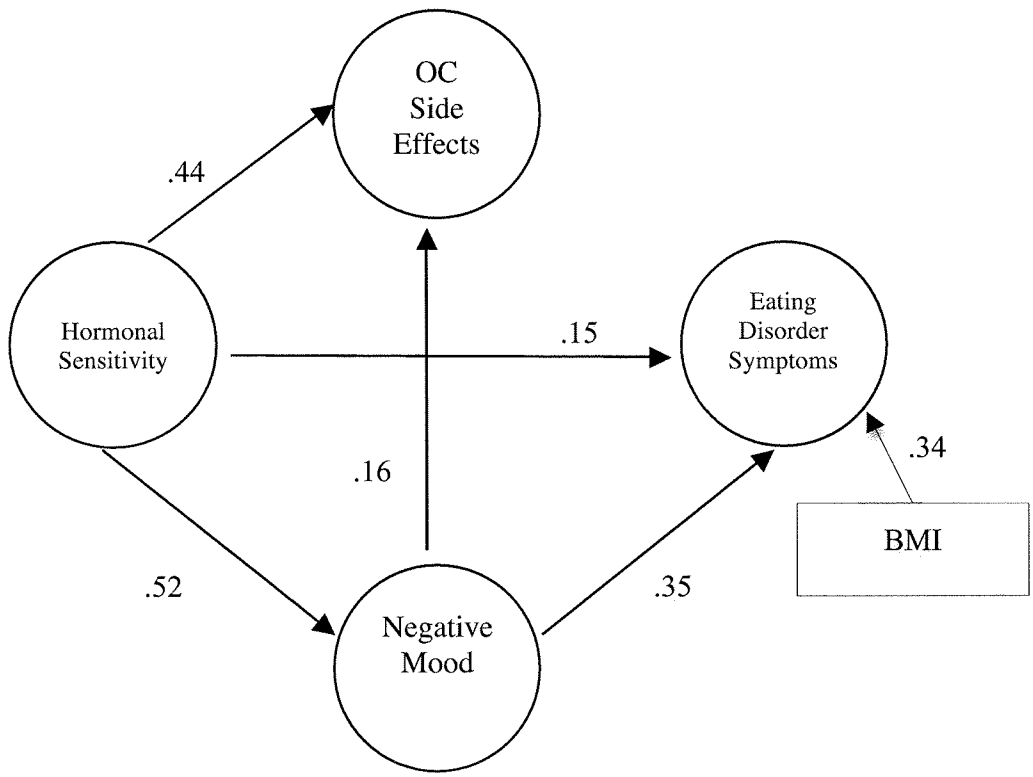

Figure 3. Structural model showing standardized path coefficients between latent variables for Model 4 at Time 1. The added path between Negative Mood and OC Side Effects was significant (p = .030). Fit indices (CFI, IFI, AIC) indicated improved model fit.

AIC and higher CFI and IFI suggested improved model fit with this path included. Model 4 suggested that greater Hormonal Sensitivity explained greater levels of OC Side Effects, Eating Disorder Symptoms, and Negative Mood (see Figure 3). Negative mood provided additional explanation of Eating Disorder Symptoms and OC Side Effects above and beyond Hormonal Sensitivity, such that greater Negative Mood predicted greater Eating Disorder Symptoms and greater OC Side Effects. With this model, squared multiple correlations indicated that Hormonal Sensitivity and Negative Mood together explained 30% of the variance in OC Side Effects. Hormonal Sensitivity, Negative Mood, and BMI together explained 31% of the variance in Eating Disorder Symptoms. Hormonal Sensitivity explained 27% of the variance in Negative Mood. One final model was run (Model 5, see Figure 4), to examine whether OC Side Effects was associated with Eating Disorder Symptoms when the direct path between Hormonal Sensitivity and Eating Disorder Symptoms was removed; that is, did Hormonal Sensitivity mediate the relationship between OC Side Effects and Eating Disorder Symptoms. That was, in fact, the case. When the path between Hormonal Sensitivity and Eating Disorder Symptoms was removed, OC Side Effects significantly explained Eating Disorder Symptoms (p = .005). Goodness-of-fit statistics suggest that Model 5 was comparable to Model 4, with similar values for CFI, IFI, RMSEA, and AIC. Squared multiple correlations were also very similar with the alterations to the model. The results indicated a mediation model such that the relationship between OC Side Effects and Eating Disorder Symptoms occurred due to the relationship between Hormonal Sensitivity and Eating Disorder Symptoms.

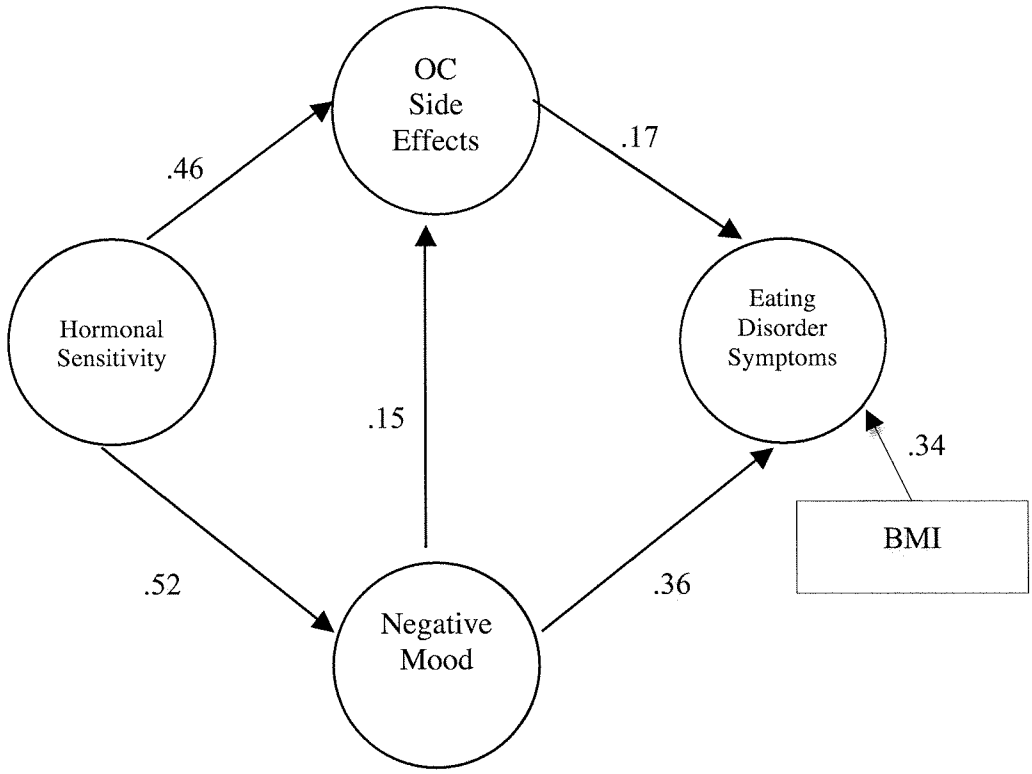

Figure 4. Structural model of standardized path coefficients between latent variables of Model 5 at Time 1. When the path between Hormonal Sensitivity and Eating Disorder Symptoms was removed the path between OC Side Effects and Eating Disorder Symptoms was significant (p = .005), suggesting mediation of the relationship between OC Side Effects and Eating Disorder Symptoms by Hormonal Sensitivity. Slight improvements in goodness-of-fit statistics were observed with this model.

Both Models 4 and 5 were examined for fit with the Time 2 sample (N = 204) to examine the stability of the model over time. In Model 4 the path between Hormonal Sensitivity and OC Side Effects, and Hormonal Sensitivity and Eating Disorder Symptoms were no longer significant (p = .124 and p = .543, respectively). Goodness-of-fit values were not within the ideal range for a good fitting model (see Table 11), but considering the lower sample size compared to the Time 1 sample, the results nonetheless suggested that the model stood up reasonably well over time. With Model 5, all paths were significant except the path between Hormonal Sensitivity and OC Side Effects (p = .119). The path between OC Side Effects and Eating Disorder Symptoms was significant (p = .041). Goodness-of-fit statistics were slightly improved for Model 5 at Time 2 compared to Model 4, suggesting that the inclusion of the path between OC Side Effects and Eating Disorder Symptoms is important to the model.

Models 4 and 5 were also examined using the data gathered at Time 3 (N = 122). In Model 4, paths between Hormonal Sensitivity and all other variables did not remain significant. Negative Mood continued to explain Eating Disorder Symptoms (p <.001) and OC Side Effects (p = .030), and BMI continued to significantly explain Eating Disorder Symptoms (p <.001). Model 5 at Time 3 had significant paths between Negative Mood and OC Side Effects (p = .041), Negative Mood and Eating Disorder Symptoms (p = .018), OC Side Effects and Eating Disorder Symptoms (p < .001), and BMI and Eating Disorder Symptoms (p = .003). The goodness-of-fit statistics indicated that Model 5 was superior to Model 4 at Time 3, suggesting the relationship between OC Side Effects and Eating Disorder Symptoms is important (similar to the findings at Time 2).

Overall, Models 4 and 5 at Time 1 held up well compared to the hypothesized model, with the exception of 2D:4D, which was not associated with Hormonal Sensitivity Scores. Another difference was that the paths between Hormonal Sensitivity and Eating Disorder Symptoms and OC Side Effects and Eating Disorder Symptoms; instead of both being significant as hypothesized, suggested a mediation model whereby Hormonal Sensitivity mediated the relationship between OC Side Effects and Eating Disorder Symptoms. The explanation of OC Side Effects, Eating Disorder Symptoms, and Negative mood by Hormonal Sensitivity did not hold up well over time when examining the model using follow-up data with substantially reduced sample sizes.

Hypothesis two. Severity of eating disorder symptoms will be related to the experience of OC side effects. Symptom scores on all three subscales of the Oral Contraceptive Side Effects Scale will explain higher scores on all three subscales of the EDI-3. Both current OC side effects (occurring in the past month, current users only) and the overall experience of OC side effects (in both current and previous users) will significantly explain eating disorder symptom scores.

Descriptive data for hypothesis two. The means and standard deviations for the eating disorder variables are reported in Table 12. The relative consistency of the scores over time was examined using Pearson correlations, presented in Table 13. For participants who completed all three questionnaires, repeated measures ANOVAs indicated no significant differences between scores at the three time points for Drive for Thinness (F (2, 168) = 2.541, p = .082), and Body Dissatisfaction (F (1.70, 137.84) = 2.947, p = .064). Results did indicate a significant difference between Bulimia scores across time (F (1.42, 120.33) = 7.379, p = .003). Post-hoc tests revealed that scores at

Table 12

Means and Standard Deviations[a] (SDs) for EDI-3 Subscales Across Time

	All Participants		
	Time 1	Time 2	Time 3
Subscale	(*N* = 603 - 612)	(*N* = 176 - 178)	(*N* = 99- 101)
Drive for Thinness	16.96 (10.03)	14.81 (8.87)	12.82 (7.91)
Body Dissatisfaction	23.83 (11.00)	22.19 (10.45)	22.46 (8.63)
Bulimia	8.85 (6.72)	8.02 (6.59)	10.39 (7.17)
	Participants Who Responded at All Three Time Points		
	Time 1	Time 2	Time 3
	(*N* = 96 - 98)	(*N* = 94 - 95)	(*N* = 88 – 91)
Drive For Thinness	14.00 (8.12)	13.79 (8.36)	13.13 (8.03)
Body Dissatisfaction	20.94 (9.92)	20.82 (9.98)	22.81 (8.39)
Bulimia	8.00 (6.76)	7.42 (5.93)	11.09 (7.26)*

Note. The upper portion of the table presents means from all participants at each time point. The lower portion of the table presents means from only those who provided responses to all three questionnaires.

[a]Means and SDs are presented using the adapted scoring method.

* Bulimia scores at Time 3 were significantly different than scores at Time 2, but not after controlling for BMI.

Table 13

Test-Retest Reliability of EDI-3 Subscales using Pearson Correlations

Subscale	Between Time 1 and Time 2	Between Time 2 and Time 3	Between Time 1 and Time 3
Drive for Thinness	.849**	.764**	.790**
N =	166	91	101
Body Dissatisfaction	.858**	.661**	.581**
N =	166	90	99
Bulimia	.813**	.528**	.618**
N =	169	89	104

Note. ** $p < .001$.

Time 3 were significantly higher than scores at Time 2 (p = .007). However, when the analysis was repeated controlling for change in BMI from Time 2 to Time 3 to account for possible increases in symptoms associated with weight gain, a significant difference between the scores was no longer present (F (1, 83) = 0.001, p = .971). Between Time 1 and Time 2 all subscales of the EDI-3 show correlations greater than .80, indicating good test-retest reliability. Correlations range between .528 and .764 for the various subscales between Time 2 and 3, and between .581 and .790 for the three subscales for the approximately one-year period between Time 1 and Time 3. The frequency of participants who reported at least one side effect, as well as the mean and standard deviations for the OC side effect subscale scores are found in Table 14.

Results for hypothesis two. As can be seen in Table 8, all three eating disorder symptom scores showed small positive correlations with all OC side effects scores for side effects experienced in the past month, with the exception of the relationship between sexual side effects and body dissatisfaction. For OC side effects experienced ever during OC use, similar but weaker relationships were found (see Table 9). Thus, women who report experiencing greater OC side effects within the past month also reported experiencing greater eating disorder symptoms. Similarly, women with a history of experiencing OC side effects also reported experiencing greater eating disorder symptoms.

A series of standard multiple regressions were performed to confirm that OC side effects significantly explain eating disorder symptoms. Three multiple regressions, each using one of the eating disorder symptom subscales as the criterion variable, were conducted. BMI was entered on the first step, then two variables indicating (yes or no)

Table 14

Frequency (Percent) Reporting at Least One OC Side Effect and Oral Contraceptive Subscale Score Means (SDs) at Times 1, 2, and 3

	Time 1	Time 2	Time 3
Subscale Scores	Frequency [Percent (%)] Reporting At Least One Side Effect		
Ever with Use			
Physical	194 (93.27)		
Emotional	117 (57.35)		
Sexual	96 (40.17)		
Past Month			
Physical	177 (70.80)	33 (82.50)	35 (77.80)
Emotional	127 (48.25)	44 (59.50)	28 (52.80)
Sexual	81 (29.24)	30 (40.50)	18 (33.30)
Subscale Scores		Mean (SD)	
Ever with Use			
Physical	11.74 (12.64)		
N =	206		
Emotional	10.44 (21.18)		
N =	203		
Sexual[a]	3.59 (7.21)		
N =	236		
Past Month			
Physical	7.75 (11.50)	6.48 (5.57)	5.87 (5.77)
N =	249	40	45
Emotional	7.83 (17.13)	6.46 (9.47)	5.72 (11.91)
N =	257	74	53
Sexual[a]	2.27 (5.71)	2.53 (5.15)	1.44 (2.92)
N =	276	74	54

Note. Data for OC side effects Ever During Use were collected at Time 1 only.
[a]Sexual side effect scores prior to transformation to dichotomous variables.

Table 15

Multiple Regressions Examining the Ability of OC Side Effect Scores to Explain Eating Disorder Scores at Time 1

Predictor	Bulimia			Body Dissatisfaction			Drive for Thinness		
	ΔR^2	β	sr^2	ΔR^2	β	sr^2	ΔR^2	β	sr^2
Past Month									
Step 1	.07***			.18***			.03*		
BMI		.27	.27***		.42	.42**		.17	.17*
Step 2	.02			.01			.02		
Hx of Anxiety		-.05	-.05		.01	.01		.06	.06
Hx of Dep.		.22	.21**		.10	.15		.11	.10
Step 3	.08***			.03*			.04*		
OC Physical		.21	.16*		.21	.17*		.08	.06
OC Emotional		.04	.03		-	.13		.09	.05
OC Sexual		.05	.04		.01	-.07		-.07	-.05
					.05				
Total R^2	.17			.22			.09		
F	6.96***			9.79***			3.38**		
df	6, 207			6, 207			6, 207		
Ever Use									
Step 1	.07***			.18			.03*		
BMI		.27	.27***		.42	.42***		.17	.17*
Step 2	.02			.01			.02		
Hx of Anxiety		-.04	-.04		.01	.01		.06	.06
Hx of Dep.		.15	.14		.10	.11		.11	.10
Step 3	.07**			.02			.02		
OC Physical		-.07	-.06		.15	.11		-.05	-.03
OC Emotional		.35	.23**		.02	.01		.21	.13
OC Sexual		.09	.08		.10	.09		.05	.04
Total R^2	.16			.21			.07		
F	5.02***			7.13***			2.05		
df	6, 160			6, 160			6, 160		

Note. * $p \leq .05$. ** $p < .01$. *** $p < .001$.

whether participants reported having been diagnosed with depression or an anxiety disorder and were experiencing symptoms at the time of the study were entered at step two. In the third step, the three OC side effect subscales for side effects experienced in the past month were entered. As hypothesized, the linear combination of the OC side effects significantly explained body dissatisfaction, drive for thinness, and bulimia scores over and above the variables entered in steps one and two ($ps < .05$; see Table 15 for details). On the third step, physical oral contraceptive side effects was a unique predictorof both bulimia and body dissatisfaction scores. For side effects experienced ever during use, the linear combination of OC side effects significantly explained scores on the bulimia subscale, but not scores on the body dissatisfaction or drive for thinness subscales. On the third step, emotional oral contraceptive side effects was a unique predictor of bulimia scores with this time frame.

Using the SPSS CANCORR macro, a canonical correlation was performed between the set of eating disorder symptom variables (body dissatisfaction, drive for thinness, bulimia at Time 1), and the set of OC side effects experienced in the past month (OC physical, emotional, and sexual side effects at Time 1). For all variables, greater scores indicated greater symptoms or side effects.

The first canonical correlation was .31 (12% overlapping variance), the second canonical correlation was .10 (1% overlapping variance), and the third canonical correlation was effectively zero. With all three canonical correlations included the canonical function was significant, $\chi^2 (9) = 20.93, p = .013$. Subsequent χ^2 tests were not statistically significant. Data on the first pair of canonical variates are found in Table 16, including correlations between the variables and canonical correlates, within-set variance

Table 16

Canonical Correlations, Standardized Canonical Coefficients, Percents of Variance and Redundancies between Eating Disorder and OC Side Effect Variables and their Corresponding Canonical Variates

Variables	First Canonical Variate	
	Correlation	*Coefficient*
Past Month (N = 240)		
Eating Disorders Set		
Bulimia	-.99	-1.07
Body Dissatisfaction	-.52	-.05
Drive for Thinness	-.49	.18
Percent of Variance	.50	
Redundancy	.05	
OC Side Effect Set		
Physical	-.97	-.75
Emotional	-.84	-.22
Sexual	-.67	-.13
Percent of Variance	.70	
Redundancy	.07	
Canonical Correlation	.31	
Ever During Use (N = 191)		
Eating Disorders Set		
Bulimia	-.85	-1.08
Body Dissatisfaction	-.10	.79
Drive for Thinness	-.40	-.39
Percent of Variance	.30	
Redundancy	.03	
OC Side Effect Set		
Physical	-.04	.99
Emotional	-.72	-1.48
Sexual	-.34	.09
Percent of Variance	.21	
Redundancy	.02	
Canonical Correlation	.30	

accounted for by the canonical variates (percent of variance), redundancies, and canonical correlations. Examining the first canonical variate, all variables in the eating disorder set were correlated with all variables in the OC side effects set (using a cut-off correlation of .3). Thus, the variate suggests that for current OC users, greater physical, emotional, and sexual side effects experienced in the past month are associated with higher current eating disorder symptoms, including body dissatisfaction, drive for thinness, and bulimia.

A second canonical correlation was performed substituting OC side effect subscale scores for side effects experienced ever during OC use, in place of those used only in the last month (see Table 16). The first canonical correlation was .30 (10% overlapping variance), the second canonical correlation was .20 (4% overlapping variance), and the third was close to zero. With all three canonical correlations included, the canonical function was significant, $\chi^2(9) = 19.81, p = .019$. The remaining χ^2 tests were not significant. From the eating disorder set, bulimia and drive for thinness were correlated with the first canonical variate. Among the OC side effect set, emotional and sexual side effects were associated with the first canonical variate. Therefore, for past and current OC users, higher emotional and sexual side effects experienced ever during OC use is associated with higher current drive for thinness and bulimia scores.

Hypothesis three. Levels of eating disorder symptoms will fluctuate with changes in OC status within an individual. Greater levels of eating disorder symptoms will occur during periods of OC use compared to OC nonuse.

Assumptions and preliminary analyses for hypothesis three. Twenty-six participants changed OC status during the study. Given the small number of

participants who changed OC status across the study, the possibilities for examining changes in eating disorder symptoms during periods of OC use and non-use was limited. To begin, EDI-3 scores for the three subscales were arranged so that participants had values for each subscale while they were on and off OCs. For participants with scores at three time points, scores from the closest two time points were used (for example, if a participant was on OCs at Time 1, on OCs at Time 2, and off OCs at Time 3, scores from Time 2 and 3 were used as they were closest in time). For the two participants who changed OC status twice across the study, the first of their changes was used (scores from Time 1 and Time 2). After scores were entered for the Bulimia, Drive for Thinness, and Body Dissatisfaction subscales for On and Off OCs (two variables for each EDI-3 subscale), the linearity and normality for new the variable was examined, and judged to be acceptable. A dichotomous variable was also created to reflect the order of being on and off OCs for each participant; those going from on to off OCs were called "stoppers", and those going from off to on were called "starters".

Participants who stopped OC usage during the study (i.e., previous users) may be different from particpants who started OCs during the study. For example, stoppers may be more sensitive to exogenous hormones, may have experienced more side effects, and may be different hormonally as a result of OC use (e.g., Panzer et al., 2006). Therefore, preliminary analyses to determine the appropriateness of examining OC stoppers and starter together were conducted. Independent *t*-tests were performed to compare change scores on each EDI-3 subscale between OC stoppers and starters. Change scores were created by taking the difference of the subscale scores on and off OC use for each participant (i.e., OC-on scores minus OC-off scores). While there were no differences

between change scores for stoppers and starters on the Drive for Thinness and Body Dissatisfaction subscales, there was a significant difference between stoppers and starters for their change in Bulimia subscale scores (see Table 17 for *t*-tests and mean change scores). Simply looking at the means indicated that women starting OCs showed an increase in Bulimia scores while the stoppers showed a decrease in symptoms, however only the latter was a significant change (see below). Due to the significant difference between stoppers and starters for Bulimia change scores and the possibility that the stopper group may involve the opposite of the "survivor effect", the two groups were examined both together and separately for other analyses. It should be noted that there were no significant differences between stoppers and starters with respect to age, BMI, depression and anxiety scores, or ratings of sexual orientation (see Table 17).

Results for hypothesis three. Repeated measures ANCOVAs were performed to compare each individual's Bulimia, Body Dissatisfaction, and Drive for Thinness scores while on and off OCs and when controlling for BMI (see Table 17). Note that that there were no significant differences in BMI for individuals comparing when on and off OCs. No significant findings were found for Body Dissatisfaction, Bulimia, or Drive for Thinness (examining both starters and stoppers together). Given the significant difference in Bulimia change scores for stoppers and starters, ANCOVAs were performed on these groups separately. For Bulimia scores, when examining starters and stoppers separately, no differences were found in OC stoppers. However, for OC starters, significant main effects were found for differences in Bulimia scores when comparing periods of OC use and non-use, controlling for BMI, $F\ (1, 8) = 21.21, p = .002$, observed power = .98.

Table 17

Descriptive Data and t-tests: Means and Standard Deviations for EDI-3 Subscale Change Scores for OC Stoppers and Starters

Comparison Variables	*M* (*SD*) Stoppers	*M* (*SD*) Starters	*t*	*df*	*p*
Bulimia[a]	-2.50 (6.18)	2.70 (3.62)	-2.069	24	.049
Drive for Thinness[a]	1.50 (3.81)	0.00 (7.89)	.463	24	.647
Body Dissatisfaction[a]	-0.69 (7.10)	0.60 (7.96)	-.365	24	.719
BMI	24.88 (6.79)	25.01 (4.90)	.052	22	.959
Age	23.71 (4.13)	20.43 (3.66)	-2.011	22	.057
Depression[b]	3.21 (0.87)	3.23 (0.97)	.061	21	.952
Anxiety[b]	0.53 (0.36)	0.61 (0.32)	.567	22	.577
Sexual Orientation[c]	3.36 (2.02)	3.38 (3.02)	.017	20	.987
	Mean (*SD*) On OCS	Mean (*SD*) Off OCs	*F*	*df*	*p*
BMI	25.01 (6.88)	25.87 (7.06)	3.058	25	.093
Bulimia	9.35 (6.32)	9.85 (7.73)	.121	24	.731
Bulimia (Stoppers)	9.81 (7.18)	12.31 (8.62)	.098	14	.759
Bulimia (Starters)	8.60 (4.90)	5.90 (3.76)	21.211	8	.002
Drive for Thinness	16.88 (10.05)	15.96 (9.04)	.127	24	.725
Body Dissatisfaction	24.27 (11.04)	24.46 (12.12)	2.705	24	.113

Note: [a]Mean EDI-3 subscale change scores between periods of OC use and non-use (OC on scores minus OC off scores) are reported for $n = 16$ stoppers and $n = 10$ starters. [b]Transformed Depression and Anxiety scores from the SCL-90-R. [c] Sexual orientation was rated using a 9-point likert scale from 1 (*only attracted to people of the opposite sex*) to 9 (*only attracted to people of the same sex*).

Following that, a one-way MANCOVA was conducted to determine the effect of OC status (never, current, or previous user) on the three dependent variables (bulimia, drive for thinness, and body dissatisfaction scales) at Time 1, with BMI as a covariate. A trend was found for differences between the OC groups on the dependent measures, Wilks' $\lambda = .98$, $F\ (6, 1070) = 1.985$, $p = .065$. An examination of the follow-up ANCOVAs found a significant difference for Drive for Thinness Scores between OC groups such that current users had higher Drive for Thinness scores compared to OC never users (see Table 18). There were no significant differences between OC groups for Bulimia scores or Body Dissatisfaction scores.

Hypothesis Four: In current OC users, Estrogenic Profile scores (indicating the severity of current OC side effects related to an excess of estrogen and a deficiency of progesterone and testosterone; see Table 2) will be positively correlated with scores on the Drive for Thinness subscale of the EDI-3, and negatively correlated with scores on the Bulimia subscale. Progestational/Androgenic Profile scores (indicating the severity of OC side effects related to a deficiency of estrogen and an excess of progesterone and testosterone; see Table 2) will be positively correlated with scores on the Bulimia scale of the EDI-3, and negatively correlated with scores on the Drive for Thinness scale.

Descriptive data and assumptions for hypothesis four. Estrogenic and progestational/androgenic profile scores were calculated using the OC side effect score variables (for side effects experienced by current users in the past month at Time 1) listed in Table 2. For each OC side effect included in the scale, a score of zero to three was entered. For example, the estrogenic profile score included the item increase in dizziness. Therefore, a participant could have a score of 0 indicating *no change* or *decrease* in

Table 18

Descriptive Data and ANCOVAs: Means and Standard Errors of EDI-3 Subscale Scores for OC Use Groups

EDI-3 Subscale Scores	*M (SE)* Never Users ($N = 145$)	*M (SE)* Current Users ($N = 270$)	*M (SE)* Previous Users ($N = 126$)	*F*	*df*	*p*
Bulimia	2.84 (0.08)	3.01 (0.06)	3.02 (0.09)	1.559	537	.211
Drive for Thinness	14.74 (0.82)**	17.94 (0.61)	17.14 (0.88)	4.944	537	.007
Body Dissatisfaction	22.29 (0.84)	24.44 (0.62)	24.72 (0.89)	2.706	537	.068

Note. ** $p < .001$

dizziness, or a score of 1 to 3 indicating *mild, moderate, or large* increases in dizziness, respectively. One exception was visual changes, which had response options of 1 or 0 (corresponding to *visual changes* or *no visual changes*, respectively). Profile scores were only calculated for participants with data for all items composing the scale, therefore scores for some current users are missing. Estrogenic profile scores were calculated for 292 participants, and scores ranged from 0 to 7 ($M = 0.75$, $SD = 1.32$). The estrogenic profile score was given a logarithmic transformation to achieve normality. The progestational/androgenic profile score was calculated for 270 participants, and scores ranged from 0 to 10 ($M = 1.36$, $SD = 1.87$). The progestational/androgenic profile score was also logarithmically transformed. No univariate outliers were found, as there were no z scores with an absolute value greater than 3.29 (Tabachnick & Fidell, 2001). The evaluation of assumptions for the EDI-3 subscale scores at Time 1 were described above.

Results for hypothesis four. Pearson product-moment correlations between the OC hormonal profile scores and eating disorder scores are shown in Table 19. Neither of the OC hormonal profile scores were correlated with BMI. The estrogenic and progestational/androgenic profile scores were significantly positively correlated with each other ($p < .001$). Scores on the bulimia subscale were positively correlated with the progestational/androgenic OC profile score as hypothesized ($p = .002$). Bulimia scores were not correlated with the estrogenic OC profile score, and the drive for thinness subscale scores were not significantly correlated with either OC profile score. A follow-up t-test was conducted to compare the bulimia subscale scores of women with low and high progestational/androgenic OC profile scores. High and low scoring groups were created using a mean split. The results indicated that women with high

Table 19

Correlations Between Hormonal OC Profile Scores and Eating Disorder Subscales at Time 1

	BMI	EST	P/A	BUL	DT
BMI	—	-.111	.090	.266**	.167**
EST	290	—	.453**	.112	.078
P/A	268	263	—	.187**	.112
BUL	602	288	267	—	.639**
DT	595	283	263	608	—

Note. Correlations are presented above the diagonal and sample sizes are presented under the diagonal. BMI = Body Mass Index; EST = Estrogenic Profile Score; P/A = Progestational/Androgenic Profile Score; BUL = Bulimia; DT = Drive for Thinness. Correlations were performed using transformed variables. Items on the Estrogenic Profile are dizziness, visual changes, leg cramps, heavy menstrual bleeding, increased breast size, and premenstrual negative mood. Items on the Progestational/Androgenic Profile are decreased menstrual bleeding, nervousness, hot flashes, fatigue, depression, increased appetite, acne, and aggression.

** $p < 0.01$

progestational/androgenic profile scores also had significantly higher bulimia scores (M = 3.71, SD = 1.29, n = 19) compared to women with low progestational/androgenic profile scores (M = 2.93, SD = 0.99, n = 249), t (266) = 3.19, p = .002.

To further explore the relationship between the progestational/androgenic profile scores and bulimia scores, a series of correlations between bulimia scores and the individual items that made up the profile score were examined. When controlling for BMI, bulimia scores were significantly correlated with the depression (r = .158, p = .011) and the appetite OC side effects (r = .184, p = .003). When controlling for both current Depression and Anxiety SCL-90-R scores, bulimia scores showed a trend towards a significant correlation with appetite (r = .123, p = .055). Therefore, when controlling for BMI and mood variables, the relationship between the progestational/androgenic profile scores and bulimia scores appears to be strongly related to the experience of increased appetite as an OC side effect. To ensure that the relationship between bulimia scores and progestational/androgenic OC Profile scores is not due entirely to appetite and negative mood, a progestational/androgenic OC profile score was calculated excluding both the appetite and depression items. This new profile score was significantly correlated with bulimia scores (r = .125, p = .039), and showed a trend towards significant correlation after controlling for BMI (r = .114, p = .062). With regard to the estrogenic OC profile scores, after controlling for BMI there were no significant correlations between any of the individual items and the EDI-3 subscales.

Part 2: Endogenous Gonadal Hormones and Eating Disorder Symptoms

Hypothesis five. Circulating estrogen, progesterone, and testosterone levels will be related to eating disorder symptoms, such that scores on the Drive for Thinness

subscale of the EDI-3 will be positively correlated with estradiol, but negatively correlated with progesterone and testosterone level, whereas scores on the Bulimia subscale of the EDI-3 will be negatively correlated with estradiol, and positively correlated with progesterone and testosterone. The levels of all three hormones as a group will significantly explain the total scores on the EDI-3.

Data screening and descriptive data for hypothesis five. Three participants were missing one value each from the EDI scale. To ensure that all analyses could be completed using all participants, the missing values were replaced with the group mean for that item (as per Tabachnick & Fidell, 2001, p. 62). The EDI-3 subscales were examined for the presence of outliers, as well as normality and linearity. All three subscales were reasonably normally distributed. Two outliers were identified on the Bulimia subscale, and these two scores were replaced with the next highest values. SCL-90-R Depression and Anxiety Scale scores were calculated for the lab session. Two participants were missing one value each from the anxiety scale, and the group mean value for the individual items were used as a replacement. The Depression Scale was given a square root transformation, and the Anxiety Scale was given a logarithmic transformation. Both scales were normally distributed following the transformations. One outlier was detected on the Depression Scale. This value was replaced by the next highest value. Measures of BMI taken in the lab were logarithmically transformed to reduce positive skewness. Two outliers were replaced with next highest values. Mean values of EDI-3 subscales, Depression and Anxiety scores, as well as BMI measurements for lab participants are found in Appendix O.

For participants who provided samples during the post-menses phase (n = 36), all but one provided samples during the planned range of 1 to 3 after the last day of menses. One participant provided a sample 4 days after the last day of menses, and so was excluded from analyses. Samples in the post-menses phase were provided on a mean of 2.03 (SD = 0.85) days after the last day of menses. For the mid-luteal phase (n = 16), 14 participants provided samples during days -5 to -9 of the cycle (5 to 9 days prior to the start of next menses). One participant provided a sample on day -2, and was excluded from analyses. One participant did not confirm the start of their next menses, however they indicated a total cycle length of 32 days, and reported that their sample was provided 26 days after the last day of their last menses. Therefore, it is likely that their sample falls within the planned mid-luteal range of days -5 to -9. Overall, mid-luteal samples were provided on a mean of 5.67 (SD = 1.76) days before the start of next menses.

Hormone values were examined in comparison to lower limits of detection for estradiol (0.8 pg/mL), progesterone (20 pg/mL), and testosterone (10 pg/ml). Values below lower limits of detection were excluded. Four values for estradiol were excluded, all from the post-menses phase. Thirty values for progesterone were excluded, with 26 of the ineligible values having been sampled in the post-menses phase. Two values were excluded for testosterone, one from each phase.

To examine the validity of the hormonal assays and the menstrual cycle day data, t-tests were used to examine differences between hormone values during the post-menses and mid-luteal phases. Significant differences were found between the hormone values in the two menstrual cycle phases for both progesterone and testosterone, but not estradiol. As would be expected based on published menstrual cycle phase norms (e.g., Alliende,

2002), progesterone values were significantly higher in the luteal phase, t (11.26) = 4.80, p = .001. While it has been argued that menstrual cycle phase does not need to be controlled for testosterone measurements given relatively small menstrual cycle effects (Dabbs & de La Rue, 1991), testosterone values in this study were higher in the post-menses phase, t (44.18) = -2.26, p = .029. Given the results of the t-tests, estradiol values for both phases were examined together in addition to separate examinations for each phase. Progesterone and testosterone values were examined separately by menstrual cycle phase. See Table 20 for means and standard deviations for all the hormone assays. The mean hormone levels are considered reasonably similar to those found in other published studies of women in the same age range (e.g., Griksiene & Ruksenas, 2011; Liening, Stanton, Saini, & Schultheiss, 2010).

After excluding ineligible hormone values (due to day of cycle and values below detectable limits) the measures of the estrogen, progesterone, and testosterone values were examined for normality and linearity. Estradiol values were given a logarithmic transformation to achieve a reasonably normal distribution. Following the transformation an examination of z-scores indicated that there were no outlying values for estradiol. For progesterone and testosterone, normality and linearity were examined separately by menstrual phase. For both phases, progesterone and testosterone values demonstrated appropriate distributions, and absence of outliers. Therefore, progesterone and testosterone values were not transformed.

Results for hypothesis five. Pearson correlations between hormone values and various laboratory measurements were conducted (see Table 21). Salivary estradiol (both phases combined) was significantly positively correlated with lab measures of BMI

Table 20

Means and Standard Deviations (Untransformed Values) for Hormone Salivary Assays of Estrogen, Progesterone, and Testosterone (pg/mL)

	M (*SD*)	Minimum	Maximum
Both Phases			
Estrogen (*N* = 46)	3.54 (2.18)	0.80	12.60
Post-Menses Phase			
Estrogen (*N* = 31)	3.50 (2.62)	0.80	12.60
Progesterone (*N* = 6)	25.83 (6.49)	20.00	38.00
Testosterone (*N* = 34)	33.07 (13.15)	17.31	70.88
Mid-Luteal Phase			
Estrogen (*N* = 15)	3.51 (0.78)	2.30	5.00
Progesterone (*N* = 11)	77.09 (34.33)	27.00	128.00
Testosterone (*N* = 14)	26.63 (6.52)	16.70	38.91

Table 21

Correlations between Salivary Hormone Levels and Laboratory Variables

	Age	Wake	BMI	WHR	Dep	Anx
Estradiol						
Both Phases (*N* = 46)	-.134	-.243	.313*	.407**	.120	.275
Post-Menses (*N = 31)*	-.1.53	-.191	.341	.453**	.137	.278
Mid-Luteal (*N = 15)*	-.012	-.027	.231	-.150	-.091	.210
Progesterone						
Post-Menses (*N = 6)*	-.423	.242	-.115	-.487	.808	.339
Mid-Luteal (*N = 11)*	-.220	-.209	-.270	.293	.052	-.288
Testosterone						
Post-Menses (*N = 34)*	-.163	.338	.238	-.072	.007	-.127
Mid-Luteal (*N = 14)*	-.234	.460	.156	.669	-.395	-.116

Note. Wake = Time between waking and provision of saliva sample; Dep = current Depression score; Anx = current Anxiety score; BMI = body mass index; WHR = waist to hip ratio [waist circumference (cm) / hip circumference (cm)].
* $p < .05$. ** $p \leq .01$.

(p = .034). Salivary estradiol also was significantly correlated with waist to hip ratio when examining both phases combined (p = .005) and the post-menses phase (p = .010). There were no other significant correlations between salivary hormone levels and participant age, time between waking and the laboratory session, BMI, waist to hip ratio, or Depression and Anxiety scores on the SCL-90-R.

Correlations were examined for all three gonadal hormones and EDI-3 subscale scores (see Table 22). There were no significant correlations between estradiol and any of the three subscale scores for the post-menses phase (including when controlling for waist to hip ratio which was done due to positive correlations between estradiol and these measures), the mid-luteal phase, or both phases combined (including when controlling for BMI and waist to hip ratio). For progesterone and testosterone, there were no significant correlations with any EDI-3 scores in the post-menses phase. There was a trend towards a positive correlation between Bulimia scores and progesterone levels during the mid-luteal phase (p = .078; see Figure 5). Testosterone was significantly positively correlated with Body Dissatisfaction scores during the mid-luteal phase (p = .020; see Figure 6).

To examine the explanation of EDI-3 scores by salivary hormone levels, hierarchical multiple regressions were performed using EDI-3 subscale scores as the dependent variables, and estradiol and testosterone levels as predictors. Progesterone levels were not included as predictor variables given the small number of available data points.

Hormone levels (estradiol and testosterone) did not significantly explain Bulimia scores (see Appendix P). However, exploratory analyses indicated that hormone levels

Table 22

Correlations between Salivary Hormone Levels and EDI-3 Subscales

	Drive for Thinness	Bulimia	Body Dissatisfaction	Total EDI-3 Score
Estradiol				
Both Phases ($N = 46$)[a]	.084	.006	.127	.083
	(-.111)	(-.184)	(-.061)	(-.149)
Post-Menses ($N = 31$)[b]	.071	.025	.143	.097
	(-.109)	(-.166)	(.073)	(-.075)
Mid-Luteal ($N = 15$)	-.018	-.340	-.218	-.232
Progesterone				
Post-Menses ($N = 6$)	-.118	.070	.711	.367
Mid-Luteal ($N = 11$)	.205	.553[t]	.258	.435
Testosterone				
Post-Menses ($N = 34$)	-.257	-.033	-.051	-.131
Mid-Luteal ($N = 14$)	.262	-.004	.612*	.278

Note. Total EDI-3 = sum of Drive for Thinness, Bulimia, and Body Dissatisfaction scores. Partial correlations are displayed in brackets.
[a] For both phases partial correlations were performed to control for BMI and waist to hip ratio. [b] For the post-menses phase partial correlations were performed to control for waist to hip ratio.
[t] $p < .08$. * $p < .05$.

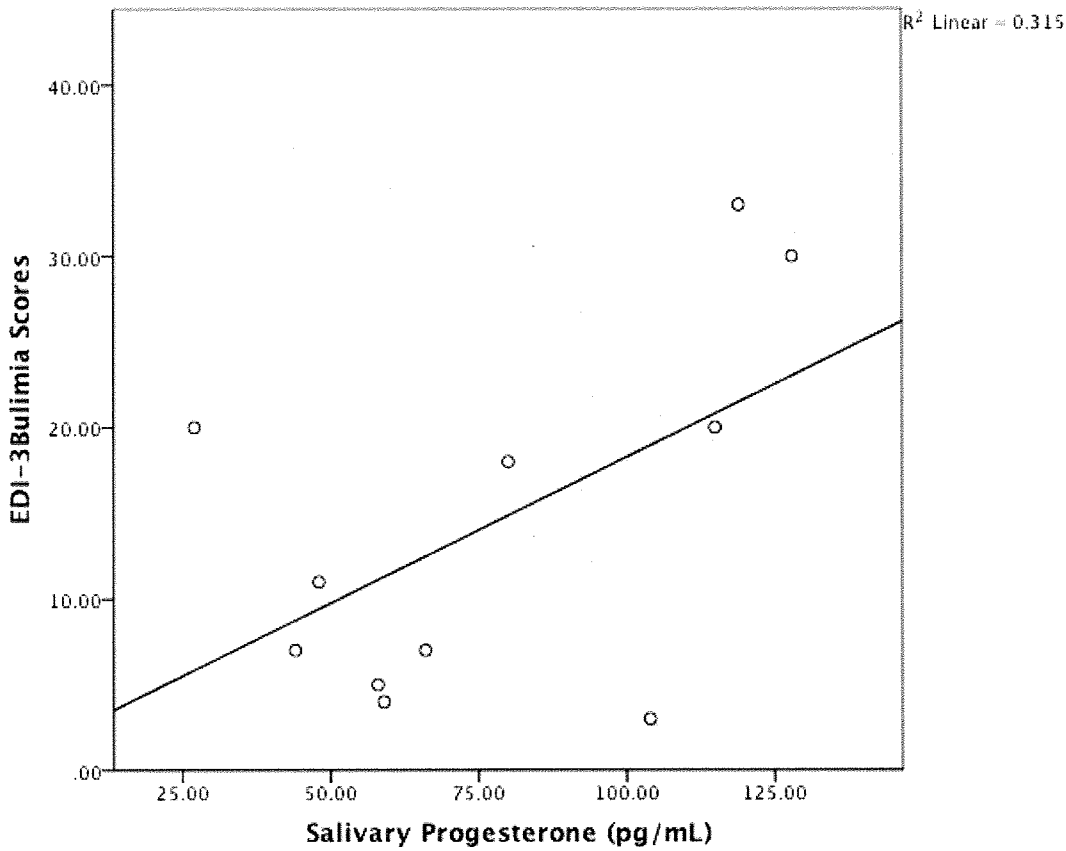

Figure 5. Scatterplot illustrating the trend towards a positive correlation between EDI-3 Bulimia scores and salivary progesterone levels during the mid-luteal phase ($r = .553$, $p = .078$, $N = 11$).

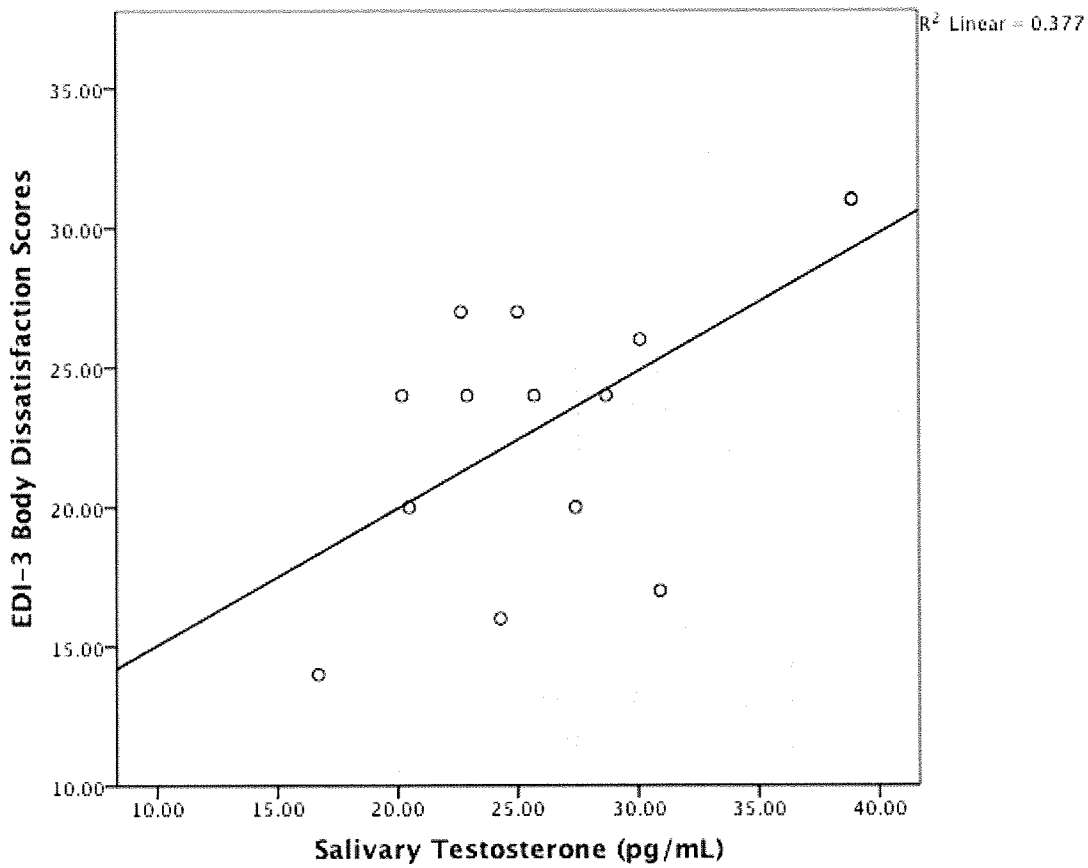

Figure 6. Scatterplot illustrating significant positive correlation between EDI-3 Body Dissatisfaction scores and salivary testosterone levels during the mid-luteal phase (r = .612, p = .020, N = 14).

did significantly explain Drive for Thinness during the post-menses phase (with added predictors described below), and Body Dissatisfaction scores in the mid-luteal phase (see Table 23). Hormone levels were not significantly associated with Body Dissatisfaction scores in the post-menses phase (see Appendix P).

For Drive for Thinness scores in the post-menses phase, the linear combination of estradiol and testosterone levels did not initially provide significant explanation of scores (p = .109). However, after controlling BMI and waist to hip ratio in step 1, hormone levels showed a trend towards a significant association with Drive for Thinness above and beyond BMI and waist to hip ratio (p = .054). With all variables entered (p = .019), 37% (26% adjusted) of the variance in Drive for Thinness was accounted for, and testosterone level was a unique predictor or of Drive for Thinness. In a final regression, Depression and Anxiety scores were entered in step 2 (after BMI and waist-to-hip ratio) to rule out the possibility that the relationship between hormones and Drive for Thinness was not simply due to elevated negative affect. These mood scores did not significantly add to the explanation of Drive for Thinness (p = .079). In step 3, after controlling for BMI, waist to hip ratio, Depression, and Anxiety; estradiol and testosterone levels together significantly explained Drive for Thinness scores (p = .022). Overall, these six variables together accounted for 53% (41% adjusted) of the variance in Drive for Thinness during the post-menses phase. Testosterone levels emerged as a unique predictor in the final model, above and beyond the other five variables (p = .010). With the limitation of there being a small sample size (N = 14), an identical set of regressions were calculated for Body Dissatisfaction during the mid-luteal phase (right

Table 23

Multiple Regressions Examining the Explanation of Drive for Thinness and Body Dissatisfaction Scores by Salivary Estradiol and Testosterone Levels

Predictors	Drive for Thinness (Post-Menses Phase, $N = 31$)		Body Dissatisfaction (Mid-Luteal Phase, $N = 14$)	
	ΔR^2	β	ΔR^2	β
Step 1	.15		.47*	
Salivary Estradiol		.12		-.31
Salivary Testosterone		-.37		.68*
Total R^2	.15		.47*	
F	2.408		4.775	
df	2, 27		2, 13	
Step 1	.20[t]		.21	
BMI		.23		.12
Waist/Hip Ratio		.32		.44
Step 2	.17[t]		.52*	
Salivary Estradiol		-.11		-.29
Salivary Testosterone		-.41*		.73**
Total R^2	.37*		.73**	
F	3.597		6.027	
df	4, 29		4, 13	
Step 1	.20[t]		.21	
BMI		.28		.12
Waist/Hip Ratio		.32		.44
Step 2	.15		.20	
Depression Score		.29		-.14
Anxiety Score		.15		-.34
Step 3	.19*		.50***	
Salivary Estradiol		-.16		-.26
Salivary Testosterone		-.41**		.86***
Total R^2	.53**		.91**	
F	4.352		11.59	
df	6, 29		6, 13	

[t] $p < .06$. * $p < .05$. ** $p \leq .01$. *** $p \leq .001$.

column of Table 23). The linear combination of the estradiol and testosterone variables significantly explained Body Dissatisfaction scores (p = .032) and accounted for 46% (37% adjusted) of the variance in scores. Testosterone scores emerged as a unique predictor (p = .012). In the second regression, BMI and waist to hip ratio were added in step 1 (p = .270). In step 2, the hormonal variables added significantly to the explanation of Body Dissatisfaction (p = .008), and accounted for an additional 52% of the variance in scores. In the final model, BMI and waist-to-hip ratio were entered in step 1, and Depression and Anxiety scores in step 2. In step 3, estradiol and testosterone levels provided additional explanation of Body Dissatisfaction above and beyond the other variables (p = .001), accounting for 91% (83% adjusted) of the variance in Body Dissatisfaction scores. With all variables entered in the model, Depression scores (p =.038), Anxiety scores (p = .008), and testosterone levels (p < .001) all emerged as unique predictors of Body Dissatisfaction in the mid-luteal phase.

Visual examination of the beta weights for estradiol and testosterone levels in the above regressions (see Table 23 top panel) show that the beta weight for estradiol is negative while testosterone is positive. Therefore, another series of regressions were conducted for Drive for Thinness (post-menses phase) and Body Dissatisfaction (mid-luteal phase) to examine whether the ratio of estradiol to testosterone (salivary estradiol level divided by salivary testosterone level) explains level of eating disorder symptoms. The ratio of estradiol to testosterone was not significantly associated with Drive for Thinness (see Table 24). However, the ratio of estradiol to testosterone was a significant unique predictor of Body Dissatisfaction in the mid-luteal phase (p = .019), even after controlling for BMI, waist-to-hip ratio, Depression, and Anxiety scores (p = .038).

Table 24

Multiple Regressions Examining the Explanation of Drive for Thinness and Body Dissatisfaction Scores by the Ratio of Salivary Estradiol to Testosterone Levels

Predictors	Drive for Thinness (Post-Menses Phase, $N = 31$)		Body Dissatisfaction (Mid-Luteal Phase, $N = 14$)	
	ΔR^2	β	ΔR^2	β
Step 1	.03		.38*	
E/T		.18		-.62
Total R^2	.03		.38*	
F	.965		7.319	
Df	1, 29		1, 13	
Step 1	.20[t]		.21	
BMI		.23		.11
Waist/Hip Ratio		.31		.44
Step 2	.00		.38*	
E/T		.02		-.62*
Total R^2	.20		.59*	
F	2.154		4.857	
Df	3, 29		3, 13	
Step 1	.20[t]		.21	
BMI		.17		.19
Waist/Hip Ratio		.26		.34
Step 2	.15		.20	
Depression Score		.29		.36
Anxiety Score		.15		-.46
Step 3	.00		.26*	
E/T		-.04		-.62*
Total R^2	.35[t]		.67	
F	2.556		3.201	
Df	5, 29		5, 13	

Note: E/T = ratio of salivary estradiol levels to salivary testosterone levels

[t] $p < .06$. * $p < .05$. ** $p \leq .01$. *** $p \leq .001$.

Hypothesis six. The hormonal sensitivity score will moderate the relationship between gonadal hormone levels (estrogen, progesterone, and testosterone) and eating disorder symptoms (total and subscale scores on the EDI-3).

Data screening and assumptions for hypothesis six. The hormonal sensitivity score was calculated as described above, using the menstrual distress, acne, and hirsutism scores. A total of 29 participants who provided saliva samples in the post-menses phase also had scores for hormonal sensitivity. Hormonal sensitivity scores for these participants ranged from 4.55 to 24.73 with a mean of 14.59 (SD = 5.71). Hormone levels and hormonal sensitivity scores were mean-centered by subtracting individual scores by the group mean. Mean-centering variables is recommended for regressions involving interaction terms (Tabachnick & Fidell, 2001, p.151).

Results for hypothesis six. Stepwise multiple regressions were used to examine whether the hormonal sensitivity score acts as a moderator of the relationship between gonadal hormone levels and eating disorder symptom scores. Given the concern of small sample size, regressions were only examined for estradiol and testosterone in the post-menses phase. Total scores on the three EDI-3 subscales were each used as the dependent variable. Individual hormone levels as measured by salivary assay were entered in the first step, and hormonal sensitivity scores were entered in the second step. A product term (measured hormone level x hormonal sensitivity score) was entered in the third step.

The results of the hierarchical multiple regressions are found in Table 25. Results for estradiol are examined first. For Drive for Thinness, none of the three individual steps provided significant increases in the explanation of Drive for Thinness (p = .778, p = .907, and p = .135, respectively), and the overall model was not significant (p = .488).

Table 25

Multiple Regressions Examining the Moderation Effect of Hormonal Sensitivity on the Explanation of EDI-3 Subscale Scores by Salivary Hormone Levels in the Post-Menses Phase

Predictors	Drive for Thinness		Bulimia		Body Dissatisfaction	
	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.00		.00		.05	
Estradiol		-.06		.05		.24
Step 2	.00		.08		.02	
Horm. Sens.		.03		.28		.07
Step 3	.11		.21*		.04	
E x Horm. Sens.		.36		.49*		.23
Total R^2	.11		.28		.12	
F	0.840		2.631		0.913	
Df	3, 23		3, 23		3, 23	
Step 1	.07		.00		.00	
Testosterone		-.26		-.02		.30
Step 2	.20*		.34**		.13	
Horm. Sens.		.50*		.64**		.39
Step 3	.04		.02		.06	
T x Horm. Sens.		-.22		-.15		.10
Total R^2	.31*		.35*		.20	
F	3.378		4.180		1.890	
Df	2, 26		3, 26		3, 26	

Note. E = estradiol; T = testosterone; Horm. Sens. = hormonal sensitivity. $N = 25$ for the top panel and $N = 28$ for the bottom panel.
* $p < .05$. ** $p < .01$.

For Body Dissatisfaction scores, none of the individual steps resulted in significant increases in the explanation of the dependent variable (p = .274, p = .478, p = .333, respectively). The overall model with all three variables included was not significant (p = .453).

When examining Bulimia scores, estradiol levels and hormonal sensitivity scores did not add significantly to the model (p = .829 and p = .203, respectively). However, in the final step the product term (estradiol x hormonal sensitivity) did significantly explain Bulimia scores above and beyond estradiol levels and hormonal sensitivity scores (p = .027). This suggests that in the post-menses phase, hormonal sensitivity scores may moderate the relationship between estradiol levels and Bulimia scores as hypothesized. With this moderator in the model there was an increase in the explanation of variance in Bulimia scores by 21%. The overall model was not significant (p = .078). In step 3 with all variables included, the product term emerged as a unique predictor of Bulimia scores (p = .027). In addition, a Pearson correlation examining the relationship between the product term and Bulimia scores showed a trend towards significance (r = .319, p = .055, n = 37).

For testosterone, in step 1 measured hormone levels were not significantly associated with Drive for Thinness scores (p = .191). However, hormonal sensitivity scores did provide a significant increase in the explanation of Drive for Thinness scores in step 2 (p = .016). Step 3 containing the product term was not significant (p = .287), however the entire model did significantly explain Drive for Thinness scores (p = .036) and did account for 31% of the variance in scores (22% adjusted). Hormonal sensitivity was a unique predictor in the final step of the regression (p = .013). For Bulimia scores,

neither step 1 (p = .925) nor step 3 (p = .443) was significant. Step 2 containing hormonal sensitivity scores provided significant explanation of Bulimia scores after controlling for measured testosterone levels (p = .002). The overall model was significant (p = .017) and explained 35% (27% adjusted) of the variance in Bulimia scores. Hormonal sensitivity was a unique predictor (p = .002) above and beyond the other variables. In the final model examining explanation of Body Dissatisfaction scores, none of the steps in the regression were significant (p = .334, p = .092, p = .337, respectively). The overall model with all three variables was also not significant (p = .207).

Overall, the results supported hormonal sensitivity acting as a moderator between estradiol levels and Bulimia scores in the post-menses phase of the cycle. After controlling for testosterone levels in post-menses phase women, hormonal sensitivity was a significant and unique predictor of both Drive for Thinness and Bulimia scores.

Discussion

The current study explored the relationships between gonadal hormones and eating disorder symptoms in non-clinical samples of women. This relationship was examined in two ways: first by assessing the association between eating disorder symptoms and both OC use and side effects, and second by observing eating disorder symptoms in relation to measures of circulating gonadal hormones. The concept of hormonal sensitivity was also explored, and examined with respect to both OC use and circulating hormone levels and their relation to eating disorder symptomatology. One goal of the study was to determine whether direct or indirect effects were primarily responsible for an association between OC use and eating disorder symptoms, or whether the relationship was due primarily to hormonal sensitivity. A second goal was to

determine whether circulating hormones were correlated with measures of eating disorder symptoms.

As hypothesized, the findings of the current study did support a relationship between eating disorder symptoms and both OC use and side effects. Greater OC side effects were associated with greater eating disorder symptoms, and greater hormonal sensitivity explained higher scores on the OC side effect, eating disorder, and mood measures. Although based on a small sample, greater Bulimia scores were found in women when they started OCs during the study. A cross-sectional examination also found higher Drive for Thinness scores in OC users compared to non-users. Thus, support was found both for hormonal sensitivity in explaning eating disorder symptoms, as well as direct/indirect effects of OCs in explaining eating disorder symptoms. Preliminary support was also found for the explanation of eating disorder scores by circulating hormone levels. During the mid-luteal phase, testosterone levels showed a significant positive correlation with Body Dissatisfaction scores, and progesterone levels showed a trend towards significant positive correlation with Bulimia scores. During the post-menses phase, preliminary analyses indicated that estradiol and testosterone, together with BMI and mood/anxiety measures, explained Drive for Thinness and Body Dissatisfaction scores. While many of the results are preliminary, this is the first study to prospectively examine associations between OC use and eating disorder symptoms in non-clinical participants, the first to examine hormonal sensitivity and eating disorder symptoms, and the first to examine the relationship between circulating levels of estradiol, progesterone, and testosterone and eating disorder symptoms in a non-clinical population.

The Relationship Between OC Use and Eating Disorder Symptoms (Study Part 1)

Hypothesis one. Hypothesis One proposed a model suggesting relationships between latent variables (Hormonal Sensitivity, OC Side Effects, Negative Mood, and Eating Disorder Symptoms), as well as measures of mean 2D:4D as an observed variable (see Figure 1). BMI was also added as an observed variable. It was hypothesized that the overall fit of the model would be significant at all three time points. The model was examined using structural equation modeling, and post-hoc modifications were made to in an attempt to improve the fit of the hypothesized model. The measurement model showed that indicator variables all loaded strongly on the latent constructs, with the exception of the acne and hirsutism variables that loaded weakly on the latent variable Hormonal Sensitivity. Acne and hirsutism may have shown weak factor loadings given the infrequency of the items. Alternately, it is possible that they showed weak factor loadings because they are likely more strongly related to androgen hormonal sensitivity, while sensitivity to estrogen and progesterone may have been more pertinent to the current model. Nevertheless, acne and hirsutism were retained in the model given the theoretical importance of including measures of presumed androgen sensitivity and examining their relationship to eating disorder symptoms.

Goodness-of-fit indices for the initial model were good, and in support of the hypothesized model. Several of the hypothesized paths were significant, however there was not support for the inclusion of 2D:4D as a predictor of Hormonal Sensitivity or Eating Disorder Symptoms. Post-hoc modifications were made, and four successive models were examined to attempt to improve the fit of the model and better understand the relationship between the variables of interest. The final two models indicated that

Hormonal Sensitivity significantly explained OC Side Effects, Eating Disorder Symptoms, and Negative Mood. Negative Mood provided additional explanation of both OC Side Effects and Eating Disorder Symptoms. In addition, a mediation model was revealed that suggested Hormonal Sensitivity mediated the relationship between OC Side Effects and Eating Disorder Symptoms. The final models did not stand up well at Times 2 and 3, however the sample sizes were much reduced and likely did not provide the required power to determine significant relationships between variables should they have present.

The results of the SEM indicated that greater Hormonal Sensitivity significantly explained greater OC side effects, eating disorder symptoms, and negative mood. The association between hormonal sensitivity and OC side effects is supported by findings in other studies (e.g., Bancroft et al., 1997; Joffe, Cohen, & Harlow, 2003). The current association remained after accounting for current negative mood (depression and anxiety). This strengthens the hypothesis that the connection between PMS symptoms and OC side effects is not due simply to elevated negative mood, and may in fact reflect a vulnerability to physical, emotional, and sexual changes as a result of hormonal changes. Hormonal sensitivity and negative mood together accounted for nearly a third of the variance in OC side effects, which is significant considering the homogeneity within the sample of respondents (e.g., age, length of time using OCs, OC formulations). The results suggest that women who experience greater emotional and physical distress associated with the menstrual cycle are more likely to also experience changes in functioning (i.e., side effects) with OC use.

The SEM also indicated that hormonal sensitivity significantly explained level of eating disorder symptoms, while simultaneously controlling for BMI and negative mood. This result strengthens the hypothesis that sensitivity to endogenous hormones and endogenous hormonal changes are related to disordered eating behaviours. A number of studies have been conducted examining the relationship between circulating hormone levels and eating disorder symptoms. However, to our knowledge, ours is the first study to attempt to define and measure endogenous hormonal sensitivity as it relates to eating disorder symptoms.

Another important finding from the SEM was that hormonal sensitivity mediated the relationship between OC side effects and ED symptoms. With both latent variables in the model (hormonal sensitivity and OC side effects), only hormonal sensitivity showed a significant association with of eating disorder symptom scores. When hormonal sensitivity was removed, OC side effects showed significant explanation of ED symptoms. This demonstrates a strong link between PMS symptoms and OC side effects, and suggests that both may be indicators of sensitivity to gonadal hormone levels. Given that PMS symptoms (the primary component of the hormonal sensitivity latent variable) accounted for the relationship between OC side effects and ED symptoms, this indicates that PMS symptoms may be a much stronger indicator of hormonal sensitivity compared to OC side effects. Alternately, given the smaller sample size associated with the OC side effect latent variable in the SEM (because only a portion of the entire sample were current OC users), this may have limited the strength of OC side effects in model. Similarly, while women were exposed to presumably comparable changes in endogenous hormones across the cycle, women were exposed to a variety of OC formulations and

exogenous hormone doses. This diversity in the exposure to exogenous hormones may had led OC side effects to be a less sensitive measure of hormonal sensitivity than PMS symptoms. Therefore, at this time it is unclear whether hormonal sensitivity associated with PMS symptoms accounts in large part for the occurrence of OC side effects, or whether these two sets of experiences represent related but distinct types of hormonal sensitivity that may both increase a woman's predisposition to eating disorder symptomatology.

In contrast to the findings of previous studies (i.e., Klump et al., 2006; Oinonen & Bird, 2012; Smith, Hawkeswood, & Joiner, 2010), the current study did not find support for a relationship between 2D:4D, a presumed indicator of prenatal testosterone, and hormonal sensitivity or eating disorder symptoms within the SEM analyses. However, the SEM included participants that were heterogeneous with respect to variables such as OC status (current, previous, or never user), age of menarche, ethnicity, sexual orientation and sociosexuality. As all of these variables have been previously found to be associated with 2D:4D (see Grimbos, Dawood, Burriss, Zucker, & Puts, 2010; Manning, Churchill, & Peters, 2007; Matchock, 2008, Oinonen, Jarva, & Mazmanian, 2008; Oinonen, Teatero, & Mazmanian, 2011), the heterogeneity may have obscured relationships between the variables of interest. An additional factor that may have led to heterogeneity in measurements and reduced the likelihood of significant findings is that three different research assistants completed the 2D:4D measurements for the study. Nevertheless, the present findings do not support a link between 2D:4D and eating disorder symptoms in a non-clinical sample of women.

In sum, several of the hypothesized relationships between key variables were supported. As hypothesized, hormonal sensitivity did significantly explain OC side effects and eating disorder symptoms, even after controlling for BMI and current negative mood. Therefore, women who experience greater menstrual and premenstrual distress (both physical and emotional), may be at greater risk of eating disorder symptoms (i.e., drive for thinness, bulimia symptoms, body dissatisfaction) and changes in functioning with OC use. The results did not indicate a relationship between 2D:4D and either hormonal sensitivity or eating disorder symptoms. With respect to the overall goals of the study, the results of the SEM analyses provided support for the possibility that both OC side effects and eating disorder symptoms are related as both are more likely when a woman has a predisposition to hormonal sensitivity.

Hypothesis two. Hypothesis Two further examined the relationship between severity of eating disorder symptoms and the experience of OC side effects. It was hypothesized that elevated scores on all three OC Side Effects subscales would explain higher scores on all three subscales of the EDI-3, both for symptoms occurring in the past month rated by current OC users and symptoms ever during OC use rated by current and previous users. Preliminary positive correlations provided support for the hypothesis, and indicated that women who reported greater OC side effects in the past month also reported greater eating disorder symptoms, except for a lack of relationship between OC sexual side effects and Body Dissatisfaction scores. As would be expected, similar but weaker relationships were found for past history of OC side effects and eating disorder symptoms. Multiple regressions provided additional support for hypothesis two, as the

linear combination of OC Side Effects in the past month significantly explained scores on all three EDI-3 subscales, over and above BMI and a history of depression or anxiety.

Results of the canonical correlations were also in support of hypothesis two. Findings indicated that for current OC users, greater physical, emotional, and sexual side effects experienced in the past month were associated with higher current eating disorder symptom scores, including body dissatisfaction, drive for thinness, and bulimia. For current and past OC users, a history of greater emotional and sexual OC side effects explained greater current drive for thinness and bulimia scores. Overall, the findings from all three types of analyses supported a relationship between both current and history of OC side effects and higher eating disorder symptoms.

Given the evidence of an association between eating disorder symptoms and circulating endogenous hormones (e.g., Monteleone et al., 2001), it is plausible that the changes in endogenous hormones that accompany OC use may affect women's level of eating disorder symptoms. OC users who experience side effects likely do so as a result of changing hormone levels and hormonal sensitivity to those changes. Therefore, OC use may lead to altered endogenous hormone levels, OC side effects, and changes in the level of eating disorder symptoms. Only one previous study has examined body dissatisfaction and drive for thinness in a non-clinical group of OC ever users (Bird & Oinonen, 2011). The results indicated that women with a history of negative OC side effects experienced greater body dissatisfaction and eating dysfunction compared to women with no such history. A greater number of reported OC side effects explained increased eating disorder symptoms, even after controlling for current negative mood symptoms, such as depression, and physical symptoms, such as weight gain and

swelling. The current study further examined this hypothesized relationship between eating disorder symptoms and OC side effects.

Results of the current study were consistent with the findings of Bird and Oinonen (2011). Current OC side effects showed small positive correlations with the various eating disorder symptom scales, with the exception of the lack of a relationship between sexual side effects and Body Dissatisfaction scores. The lack of relationship between body dissatisfaction and OC sexual side effects is unclear at this time, but may be due to less of a relationship between body dissatisfaction and gonadal hormones and hormonal sensitivity. Similar but weaker relationships were found for overall history of OC side effects and current eating disorder symptoms. Current OC side effects also significantly explained body dissatisfaction, drive for thinness, and bulimia scores over and above BMI and history of depression and anxiety. Thus, the results from the current study replicate our previous finding of a relationship between the experience of both OC side effects and eating disorder symptoms independent of BMI and negative mood.

With respect to the weaker relationship in between side effect history and ED symptoms when compared to the relationship between current OC side effects and ED symptoms, this may reflect poorer recall of past OC side effects. However, this pattern could also suggest that high hormonal sensitivity is causing both current OC side effects and current eating disorder symptoms in the current users while the past users would only be currently experiencing the disordered eating attitudes and behaviours. Additional factors could include a direct effect of changing or absolute hormone levels on eating disorder symptoms.

Kiesner (2009) reported that changes in gonadal hormones have tissue-specific effects that are observable by asking about physical symptoms, and that physical symptoms across the cycle may be indices of reactivity to hormones. In the multiple regressions conducted in the present study for current OC users, physical OC side effects emerged as a unique predictor of both Bulimia and Body Dissatisfaction scores (see Table 15). An examination of the results of the canonical correlations appear to show a similar strong relationship between Bulimia scores and OC physical side effects in current OC users (see Table 16). Both sets of symptoms may be indicative of a reaction to absolute or changing hormone levels. Conversely, when examining similar relationships for OC ever users, mood rather than physical side effects emerged as a unique predictor. OC emotional side effects were unique predictors of Bulimia scores, and canonical correlations appeared strongest for Bulimia and OC mood side effects. Therefore, when examining a history of OC side effects that may be associated with current bulimic-type symptoms, emotional/cognitive symptoms appear to be most pertinent.

Further examination of the canonical correlations indicated that for current OC users, greater OC side effects (physical, emotional, and sexual) were associated with higher scores on all three eating disorder scales. Therefore, rather than particular OC side effects being associated with specific ED symptoms, it appears that women experienced both an increase in a wide variety of OC side effects and in all three eating disorder symptoms (drive for thinness, bulimic symptoms, and body dissatisfaction). While some canonical correlations were stronger than others, for current OC users all three types of side effects were related to eating disorder symptoms. This may be due to the

individualized nature of women's responses to OCs. As noted previously, women's plasma levels and the bioavailability of gonadal hormones vary significantly after oral administration (see Fotherby, 1996). Furthermore, there are large number of different OC preparations, including various doses of ethinyl estradiol and several types and doses of progestins, used by participants in the current study. Therefore, the highly individualized nature of responses to exogenous hormone administration combined with heterogeneity of OC formulations and dosage patterns may lead to a wide variety of side effect profiles that were difficult to distinguish in this study. Further study examining side effects during use of a single OC formulation in a large group of women may allow for the determination of different side effect profiles, and perhaps individual side effects that are most related to eating disorder symptoms.

Overall, the findings supported hypothesis two. Greater eating disorder symptoms were related to a greater experience of OC side effects, both for current OC side effects and history of OC side effects. The relationship between current OC side effects and eating disorder symptoms was stronger than was the relationship between history of OC side effects and eating disorder symptoms, indicating that beyond shared hormonal sensitivity, a direct effect of changing or absolute hormone levels on eating disorder symptoms may occur. The canonical correlations indicated relationships between all three OC SE scales, and all three eating disorder symptom scales, and thus particular patterns of relationships did not emerge. However, when examining unique predictors of eating disorder symptom scores as well as the strength of the canonical correlations, it appeared that greater physical OC side effects were associated with higher Bulimia scores

for current OC users. Conversely, greater emotional OC side effects appeared to be more strongly related to Bulimia scores in OC ever users.

Hypothesis three. Hypothesis Three proposed that levels of eating disorder symptoms would fluctuate with changes in OC status within an individual, and that greater levels of ED symptoms would occur during periods of OC use compared to nonuse. Unfortunately, only 26 participants changed OC status during the course of the study limiting the analyses that could be performed as well as the power to test this hypothesis. However, repeated measures ANCOVAs were performed comparing individual's EDI-3 subscale scores while on and off OCs and controlling for BMI. Changes in Bulimia scores for women who were stoppers versus starters were significantly different and analyses for these groups were therefore done separately. Results indicated that women who started OCs over the course of the study had significantly higher Bulimia scores after starting OCs compared to before OC use. A one-way MANCOVA was then conducted comparing EDI-3 scores between OC status groups (never, current, and previous OC users), with BMI as a covariate. A trend emerged suggesting group differences in EDI- 3 scores based on OC status. A follow-up ANCOVA found a significant difference between OC groups on the Drive for Thinness scale, such that current OC users had higher scores compared to OC never users. The results provide support for the hypothesis that women would have higher Drive for Thinness scores while using OCs.

With regard to changes in Bulimia scores associated with starting OC use, decreases in Bulimia scores might have been more expected, given that testosterone levels are often found to be positively correlated with bulimic symptoms (e.g., Naessen

et al., 2006), and OC use is associated with a decrease in testosterone (e.g., Greco et al., 2007). However, our finding is consistent with previous studies involving community or non-patient samples, rather than samples of women diagnosed with BN. Specifically, Naessen and colleagues (2007) found that OC use decreased the frequency of compensatory behaviours as well as ratings of hunger and craving for sweets and fat in women diagnosed with BN. Conversely, the control group exhibited increased cravings for fat after OC treatment, as well as a significantly decreased meal-related CCK response (suggesting decreased satiety after eating). Increased food cravings and decreased post-meal satiety suggests a greater propensity towards bulimic symptoms, rather than the decrease in symptoms experienced by the clinical group. Similarly, McVay (2011) found increased hunger ratings in OC users compared to non-users. The findings of the current study are consistent with these results, and suggest that non-clinical participants may experience increases in bulimic symptoms after starting OC use.

With regard to circulating hormones, symptoms of BN (i.e., bingeing and purging) are most often discussed in relation to androgen levels. However, Klump and colleagues (2008) did find an association between circulating estradiol levels and binge eating in a community sample of women. Lower levels of estradiol were associated with higher levels of binge eating. Therefore, it is possible that the finding of greater Bulimia scores in university student women who start OCs may be related to the significant decrease in circulating endogenous estradiol that occurs with OC use (e.g., Greco et al., 2007). It is unlikely that weight gain associated with starting OC use is responsible for the increase in Bulimia scores, as there were no significant differences in BMI between

the two time points. Overall, this preliminary evidence suggests that in non-clinical samples, women who start OCs may experience an increase in bulimic symptoms.

As previously noted, significant differences in Bulimia scores were only noted for participants who went from OC nonusers to OC users (i.e., Starters). This suggests that there were no significant changes in bulimia symptoms for participants who went from OC users to nonusers (i.e., Stoppers). Further research should be conducted to determine whether OC use may be associated with longer-lasting changes in ED symptoms that persist beyond OC discontinuation. Some studies provide evidence that certain effects of OCs may not be reversible. For example, Panzer and colleagues (2006) found that after six months of OC discontinuation women still had significantly higher-than-average SHBG levels. Thus, stoppers may not show a reversal of the "starter effect" if OCs have specific long-term or permanent changes on hormone levels or hormonal sensitivity. However, the small sample sizes in these analyses make the findings very preliminary and any explanations are only speculative.

An additional preliminary finding was that when examining between-subjects comparisons of the ED symptom scores of current, previous, and never OC users, current OC users had significantly higher Drive for Thinness scores after controlling for BMI. Thus, it is possible that hormonal factors related to OC use may increase restricting-type ED symptoms and negative body image in some women.

While not the result of a repeated measures design, the finding of greater Drive for Thinness scores in OC users is conceptually similar to the finding that participants had significant increases in Bulimia scores after starting OCs. Both findings involve comparisons of ED symptoms during periods of OC use and nonuse. In terms of

hormonal explanations for these findings, recall that OC use most often results in lowered levels of E, P, and T (Greco et al., 2007). Increased appetite and bulimia-type symptoms may be related to lowered levels of E (e.g., Klump et al., 2008). Decreases in levels of P, P metabolites, and T are consistent with decreased appetite and binge symptoms and therefore increased restricting-type symptoms (e.g., Klump et al., 2008, Naessen et al., 2006). Therefore, the multiple hormones that are affected in a variety of ways as a result of OC use makes it especially difficult to predict how individuals or groups of women may react. One important factor in understanding the seemingly contradictory findings is that these results do not take into consideration the level of each hormone in relation to the others. Therefore, overall patterns and ratios of gonadal hormones may be more important than hormone levels. Indeed, the ratio of estradiol to testosterone was found to explain Body Dissatisfaction scores in the current study.

In addition, while most women respond to OCs in a characteristic fashion (e.g., lowered hormone levels), some women may respond differently. For example, some women who use OCs experience significant rises in estradiol during their cycle (e.g., van Heusden & Fauser, 1999). Therefore, the findings may reflect diverse hormonal responses to OCs rather than one typical pattern. An alternate explanation for why OC use is associated with increases in both bulimic-type and restricting-type symptoms is that in non-clinical populations OC use may result in hormonal changes that enhance a general eating disordered factor (discussed in further detail below).

It is also possible that premorbid differences between OC users and non-users may have lead to the finding of greater eating disorder symptoms in OC users in the between-subject design. Therefore, a series of exploratory *t*-tests were conducted to

search for differences between OC users and non-users at Time 1 (see Appendix Q; see Appendix A for specific wording of all items). With respect to consumption of media, users and non-users were not different in the number of reported hours of television/movies viewed per week, or number of magazines (including fashion magazines) read per month. This suggests exposure to media messages and images about body shape and weight are likely similar between these groups. Importantly, current ratings of depression and anxiety symptoms (SCL-90-R) were also not significantly different between the OC groups. Average number of alcoholic drinks, frequency of binge drinking, and number of cigarettes per day were also similar in OC users and non-users. OC users did report having a greater number of sexual partners in the last year. In terms of relationship status, Pearson chi-square tests suggested that OC non-users were less likely to be single or casually dating and more likely to have a steady partner (living apart), while OC users showed the reverse pattern. No differences were noted with respect to ratings of sexual orientation. OC users were more likely to indicate that "sex without love is OK" compared to non-users, and that they have more frequent thoughts about sex compared to non-users.

The findings of greater number of sexual partners and less restrictive sexual attitudes in OC users was also found in a comparison study of OC users and non-users by Bancroft, Sherwin, Alexander, Davidson, and Walker (1991). Similarly, Oinonen, Jarva, and Mazmanian (2008) reported less restrictive sexual attitudes in OC user compared to non-users. It is not clear how these differences in sexual behaviour and attitudes may relate to eating disorder symptoms. Research from clinical samples of women with eating disorders suggest loss of libido and decreased sexual behaviour are associated with

diagnoses of eating disorders (e.g., Pinheiro et al., 2010). Therefore, if OC users have greater eating disorder symptoms we might expect them to have lower ratings of sexual behaviour and more restricted attitudes. However, there is less research available on the links between sexuality and eating disorder symptoms in the non-clinical population to indicate whether this effect is present in healthy women without the effects of malnutrition. Nevertheless, a recent five-study paper provides indirect evidence suggesting a small effect size link between high prenatal androgen exposure and unrestricted sociosexual behavior (Oinonen, Teatero, & Mazmanian, 2011). Further research should be conducted to clarify whether pre-existing differences in sexual behaviours and attitudes in OC users may somehow account for differences in eating disorder symptoms (e.g., possibly as another indicator of hormonal sensitivity or prenatal hormone exposure), or whether these two phenomena are separate and unrelated.

In addition, further studies examining eating disorder symptoms in larger groups of women as they start and stop OCs, will assist in clarifying these initial findings of greater eating disorder symptoms in OC users and an increase in Bulimia scores in OC starters. Such studies should control for OC formulation, BMI, mood, and hormonal variables. However, these preliminary findings are important, as they suggest that in addition to an association between greater OC side effects and increased eating disorder symptoms, greater eating disorder symptoms may also be associated with periods of OC use compared to non-use. This is the first study to compare eating disorder symptoms across OC groups, and the first study to examine changes in eating disorder symptoms associated with both starting and stopping OC use.

Hypothesis four. For Hypothesis Four, the types of OC side effects women experienced were examined and profile scores were created to indicate severity of OC side effects related to an excess of estrogen and a deficiency of progesterone and testosterone (Estrogenic Profile scores), and side effects related to an excess of progesterone and testosterone and deficiency of estrogen (Progestational/Androgenic Profile scores). It was hypothesized that Drive for Thinness scores would be positively correlated with Estrogenic Profile scores and negatively correlated with Bulimia scores, and Progestational/Androgenic Profile scores would be negatively correlated with Drive for Thinness scores and positively correlated with Bulimia scores. Support was found for the hypothesized relationship between the Progestational/Androgenic Profile scores and Bulimia scores, as these were positively correlated. In addition, a follow-up *t*-test comparing women with low and high Progestational/Androgenic profile scores found that women with high profile scores also had significantly higher Bulimia scores. The hypotheses for Estrogenic Profile scores and Drive for Thinness scores were not supported.

The Progestational/Androgenic (P/A) Profile score was positively correlated with Bulimia scores, and women with high scores on this profile had significantly higher Bulimia scores compared to women with low profile scores. The physical and emotional experiences captured by the P/A Profile score were chosen based on the literature (i.e., Dickey, 2000; Nelson, 2007) to be reflective of increased progesterone and androgen levels, and low estrogen levels. Both high T and high P have been found to be correlated with increased BN symptoms (e.g., Cotrufo et al., 2000; Naessen et al., 2006). The positive association between Bulimia scores and the P/A Profile score lends construct

validity to this group of symptoms as representing a profile of high P and T. This may be particularly useful in future studies where measures of circulating hormones are not feasible.

Further examination of the relationship between P/A Profile and Bulimia scores suggested that when controlling for BMI and mood variables, the relationship between the two measures appears to be strongly related to increased appetite. This is consistent with the findings of increased cravings for fat and decreased meal-related CCK response (likely leading to decreased satiety following a meal) in non-clinical women starting OCs (Naessen et al., 2007). A study by McVay and colleagues (2011) also found increased hunger in OC users, both in the week prior to the pill-free period and during the pill-free period. One small study suggests no differences in caloric intake between OC users and non-users (Tucci et al., 2010), however the increase in appetite may be sufficient to increase bulimic thinking (e.g., feeling guilty after eating, thinking about bingeing, thinking about vomiting to lose weight, worrying about overeating) as is measured by the Bulimia scale of the EDI-3. Furthermore, while overall caloric intake may not differ between OC users and non-users, OC users may still engage in disordered patterns of eating behaviour such as bingeing/overeating then restricting or engaging in other compensatory behaviours (e.g., purging, over-exercising, laxative use). Therefore, an examination of the link between P/A Profile and Bulimia scores suggests that increased appetite in response to OC use may lead to greater disordered thinking and eating behaviour. This also suggests that women who experience altered appetite with OC use may also be more susceptible to symptoms of BN.

However, while the relationship between OC P/A Profile and Bulimia scores appears to be strongly related to appetite, increased appetite does not completely explain the connection between the two constructs. P/A Profile and Bulimia scores continued to be significantly correlated after removing both the appetite and depression items when calculating the P/A Profile score (and was a trend after controlling for BMI). Therefore, beyond appetite and depressed mood, the reporting of greater progestational and androgenic OC side effects (e.g., decreased menstrual bleeding, fatigue, hot flashes, and acne) is related to reporting greater bulimic symptoms in women.

In contrast to the P/A profile scores, the Estrogenic OC Profile scores derived were not related to any eating disorder symptom scores. Furthermore, after controlling for BMI none of the individual items significantly correlated with any of the eating disorder symptom scores. This may suggest that estrogen is less predictive of eating disorder symptomatology compared to progesterone and testosterone. This interpretation would be somewhat consistent with our findings for hormone levels in hypothesis five. Alternately, estrogenic symptoms may have not been correctly identified in the literature, or may be more diffuse or non-specific compared to P/A symptoms. Certainly estradiol has wide-ranging impacts on a variety of substances (i.e., 5-HT, CCK, NPY, etc.), which may lead to a variety of possible side effects, adding to difficulty in measuring its effects.

In sum, the Progestational/Androgenic OC Profile score developed for this study was significantly positively correlated with Bulimia scores, supporting a relationship between Bulimia symptoms and physical/emotional OC side effects that are believed to reflect elevated progesterone and testosterone activity. OC-related appetite increase appears to be an important P/A side effect related to increased Bulimia scores. These

results also add further support to the hypothesis that in certain women, OC use may result in elevated eating disorder symptoms due to alterations in gonadal hormone levels or sensitivity to gonadal hormones. Ours appears to be the only study that has attempted to generate profiles relating specific physical and emotional OC side effects to gonadal hormone levels and to examine the relationship of these profiles to disordered eating attitudes and behaviours.

The Relationship Between Endogenous Gonadal Hormones and Eating Disorder Symptoms (Study Part 2)

Hypothesis five. Hypothesis five proposed that circulating estrogen, progesterone, and testosterone levels would be related to eating disorder symptoms, such that scores on the Drive for Thinness subscale of the EDI-3 would be positively correlated with estradiol, but negatively correlated with progesterone and testosterone level, whereas scores on the Bulimia subscale of the EDI-3 would be negatively correlated with estradiol, and positively correlated with progesterone and testosterone. Together, the levels of all three hormones as a group were expected to significantly explain the total scores on the EDI-3.

Estradiol showed positive correlations with BMI and waist to hip ratio, but did not show significant correlations with any EDI-3 scores during either menstrual cycle phase. Previous findings with regard to the correlation between estradiol and BMI in healthy premenopausal women are inconsistent, but overall research tends to suggest a lack of relationship (see review by Key, Allen, Verkasalo, & Banks, 2001). One previous study that examined waist to hip ratio and gonadal hormones in healthy premenopausal women found no relationship (Tworoger et al., 2006). However, another study found that

women having a higher waist to hip ratio (> .80) had higher salivary estradiol levels across the menstrual cycle (Emaus et al., 2007). Progesterone levels during the mid-luteal phase showed a trend towards significant positive correlation with Bulimia scores. Testosterone levels showed a significant positive correlation with Body Dissatisfaction scores during the mid-luteal phase. Preliminary findings from the multiple regressions indicated that after controlling for BMI, waist to hip ratio, current Depression scores, and current Anxiety scores, estradiol and testosterone levels significantly explained Drive for Thinness scores during the post-menses phase. Testosterone emerged as a unique inverse predictor above and beyond the other variables in the model. In a similar regression explaining Body Dissatisfaction scores in the post-menses phase, estradiol and testosterone levels significantly explained a substantial amount of the variance in scores, after controlling for BMI, waist to hip ratio, Depression scores, and Anxiety scores. Finally, the ratio of estradiol to testosterone emerged as a unique predictor of Body Dissatisfaction scores in the mid-luteal phase, even after controlling for BMI, waist to hip ratio, Depression scores, and Anxiety scores.

Overall, findings from the correlations between circulating hormone levels and EDI-3 subscale scores were not robust, but did provide some support for the hypotheses. Preliminary findings from regressions using both estradiol and testosterone levels (and the ratio of estradiol to testosterone) strongly explained Drive for Thinness and Body Dissatisfaction and therefore supported the hypothesis that circulating hormone levels would together explain eating disorder symptoms.

As previously indicated, the positive correlations between circulating progesterone levels and Bulimia scores found during the mid-luteal phase are consistent

with the literature. The menstrual cycle literature has noted increases in bulimic symptoms during the latter half of the cycle, including the mid-luteal phase when progesterone levels are peaking and estrogen levels are moderately high, and the premenstrual phase when both estrogen and progesterone levels are falling. While studies examining estrogen and testosterone are more common, two studies have also found correlations between progesterone and increases in binge eating in both clinical and non-clinical samples (Edler, Lipson, & Keel, 2007; Klump et al., 2008). The current study provides additional support for this relationship, and adds to the literature in that it is one of the few studies to examine this relationship in a non-clinical sample. In addition, the Bulimia scale of the EDI-3 focuses on a tendency to think about and engage in bingeing and purging, as well as eating in response to emotional upset. The scale is strongly focused on the cognitive aspects of Bulimia symptoms, as opposed to many studies that focus exclusively on the occurrence of binge and purge behaviour. This indicates that increases in progesterone, in addition to being related to increases in actual bingeing and compensatory behaviours, may also be associated with milder and/or sub-clinical symptoms.

In addition to the associations found between hormones and Bulimia scores in the mid-luteal phase, there were also hormone level findings for Body Dissatisfaction scores. Testosterone levels were significantly positively correlated with Body Dissatisfaction scores in the mid-luteal phase of the cycle. One of the few studies to examine body dissatisfaction in relation to gonadal hormones found greater body image dissatisfaction and greater dissatisfaction with physical appearance in the premenstrual (late-luteal) phase (Altabe & Thompson, 1990). Menstrual cycle findings are generally associated

with progesterone and estradiol, rather than testosterone. It may be that changes in the ratio of testosterone to progesterone and estradiol across the cycle (e.g., lower testosterone relative to progesterone and estradiol in the mid-luteal phase) results in changes in body dissatisfaction. In addition, higher testosterone levels in women may be associated with differences in body shape where such women experience greater body dissatisfaction due to societal preferences for body types associated with low testosterone. Research does suggest that PCOS (associated with elevated androgen levels) is related to greater accumulation of fat in the upper body, known as android fat distribution, in both lean and obese women with PCOS (Cosar et al., 2008). Similarly, there is evidence that women with higher testosterone levels also have higher waist-to-hip ratios compared to non-affected women. Furthermore, women with PCOS experience higher levels of body dissatisfaction compared to women without PCOS (Himelein & Thatcher, 2006). The results of the preliminary regressions provide support for a link between testosterone levels and Body Dissatisfaction scores in the post-menses phase as well. After controlling for several variables (including BMI, waist to hip ratio, and current Depression and Anxiety scores) estradiol and testosterone levels significantly explained Body Dissatisfaction scores. Both mood variables and testosterone levels emerged as unique predictors in the model. Similar to the simple correlations, higher testosterone was associated with increased Body Dissatisfaction scores. Given the small sample size however, these results require replication in future studies.

Taken as a whole, the results provide evidence that elevated testosterone levels are associated with poor body image in both the post-menses and mid-luteal phases of the cycle (i.e., when estradiol and progesterone levels are both high and low). It should be

noted that hormone levels explained of Body Dissatisfaction scores, even after controlling for current mood and BMI. Body dissatisfaction is a risk factor and strong predictor of eating disorder symptomatology (Jacobi et al., 2004; Tylka, 2004), and therefore it is important to understand its relationship to hormonal factors.

A preliminary regression similar to the one described above found that estradiol and testosterone levels (after controlling for BMI, waist to hip ratio, Depression and Anxiety scores) significantly explained Drive for Thinness scores. Testosterone levels were the only variable that emerged as a unique predictor. In contrast to the findings for Body Dissatisfaction, low testosterone levels were associated with high Drive for Thinness. In the literature, low testosterone was associated with higher depression, anxiety, and EDI-2 subscale scores in women with AN (Miller et al., 2007). A double-blind, placebo-controlled follow-up study found that treatment of women with AN with testosterone significantly improved mood and cognitive functioning (Miller, Grieco, & Klibanski, 2008). While there is some evidence that low testosterone levels are related to poorer functioning (greater negative mood and cognitive symptoms) in women with AN, our study appears to be the first to examine testosterone levels and restricting symptoms in non-clinical samples of women. Given that higher Drive for Thinness was associated with lower testosterone, this may fit with our finding of higher Drive for Thinness scores in OC users compared to non-users, considering the significant decrease in circulating testosterone that is typically associated with OC use (Greco et al., 2007).

While significant findings were noted for circulating levels of both progesterone and testosterone, no significant findings emerged for estradiol levels. This may be due to technical difficulties associated with estradiol assays, as some have suggested that

salivary estradiol levels in women are too low to be reliably measured by assays (e.g., Shirtcliff et al., 2000). This may be particularly true in the low estradiol post-menses phase. [However, Klump and colleagues (2006) did find an association between estradiol and disordered eating in this phase of the cycle]. In addition, the small sample size in this study and small range of estradiol levels (compared to the larger range of levels for progesterone and testosterone) may have limited the ability to detect associations between estradiol levels and eating disorder symptoms. Alternately, it is possible that, as suggested by the data, estradiol is not associated with ED symptoms in the non-clinical range.

Hypothesis six. Hypothesis Six proposed that hormonal sensitivity would moderate the relationship between gonadal hormone levels and EDI-3 subscale scores. Following a series of multiple regressions, hormonal sensitivity emerged as a moderator of the relationship between estradiol levels and Bulimia scores in the post-menses phase. After controlling for testosterone levels in the post-menses phase women, hormonal sensitivity was a significant and unique predictor of Drive for Thinness and Bulimia scores. Therefore, some support was found for this hypothesis, as hormonal sensitivity moderated the relationship between estradiol levels and Bulimia scores, but no other evidence was found when examining other combinations of hormones and eating disorder symptoms.

In the current study, ED symptom scores were explained by hormonal sensitivity, and to a lesser degree measured hormone levels. The general lack of findings for the interaction effect may suggest that the relationship between absolute hormone levels and ED symptoms may be similar for women who are high and women who are low in

hormonal sensitivity. Hormonal sensitivity may be more relevant in times of changing or fluctuating hormone levels, for example across the menstrual cycle or during puberty, rather than the method used here where we examined associations between symptoms and the level of one specific hormone at one point in time. Alternately, small sample size may have limited the power available to detect an effect.

OC Side Effects and Eating Disorder Symptoms.

Overall, the hypotheses regarding the ability of OC side effects to explain eating disorder symptoms were supported. In current users, current OC side effects was significantly associated with EDI-3 subscale scores above and beyond BMI and history of negative mood. The canonical correlations indicated a general association between all three EDI subscales and all three types of OC side effects. However, physical side effects did emerge as most associated Bulimia scores in current users, and mood side effects were most associated with Bulimia scores in ever users. Women who started OC use during the study reported greater bulimic symptoms when on OCs compared to off OCs. The literature, as well as findings from the current study, suggest that this may be related to increases in appetite and food cravings, and decreases in post-meal satiety. The results further indicated that this increased level of Bulimic symptoms may persist beyond discontinuation of OCs. A comparison of eating disorder symptoms across OC groups indicated possible higher Drive for Thinness in current OC users compared to never users. This indicates that in the non-clinical population, rather than seeing distinct profiles of ED symptoms related to particular hormonal profiles, there may be a general increase in eating disorder symptoms associated with OC use. The highly individualized

nature of response to OCs and the wide variety of OC drugs available may contribute to the difficulty of pinpointing particular symptom/side effect profiles.

As discussed previously, beyond providing additional support for a connection between OC use, OC side effects, and greater eating disorder symptoms, one of the main goals of the current study was to attempt to clarify whether the relationship between OC side effects and eating disorder symptoms occurred due to a) a direct effect of altered gonadal hormonal levels as a result of OC use on eating disorder symptoms, b) an indirect effect of particular OC side effects (e.g., low mood or weight gain) leading to increased eating disorder symptoms, and/or c) that both hormonal contraceptive side effects and eating disorder symptoms reflect a predisposition to hormonal sensitivity. The results of the various analyses provide further understanding of these three options.

With regard to a direct effect of altered endogenous or exogenous hormone levels on eating disorder symptoms, there is some support. The relationship between OC side effects and eating disorder symptoms was stronger when examining ratings of current as opposed to history of OC side effects. This finding may be due to poor recall of historical OC side effects in previous users, however it may also reflect a stronger connection because of a direct effect of altered gonadal hormones on eating disorder symptoms. Further evidence for a direct effect was that current OC users had greater Drive for Thinness scores compared to non-users, after controlling for BMI. There were no pre-existing differences between OC users and non-users with respect to ratings of depression or anxiety symptoms, suggesting that mood/anxiety differences between the two groups were not responsible for the increase in symptoms.

Furthermore, the regressions examining the explanation of EDI-3 scores appear to rule out indirect effects due to mood/anxiety or BMI. At this time it is unclear whether the increase in appetite associated with OC use and greater Bulimia scores represents an indirect or direct effect. Greater appetite may be part of increased bulimic symptomatology, and thus reflect a direct effect of gonadal hormones on eating disorder symptoms (perhaps indicating altered levels of gonadal hormones in brain areas related to eating behaviour). Alternately, OC use may cause an increase in appetite, which then dysregulates eating behaviour (increase in food consumption and possible response of greater compensatory behaviours) or thoughts about eating, ultimately resulting in greater Bulimia scores. Further research will assist in clarifying which pathway occurs. Overall, there is evidence for both direct and indirect effects of OCs on ED symptoms, however the evidence for direct effects does appear to be stronger at this time.

With respect to a hormonal sensitivity causing a predisposition to both OC side effects and eating disorder symptoms, the results of the study are also supportive of this relationship. First, the results of the SEM clearly demonstrated explanation of both OC side effects and eating disorder symptoms by hormonal sensitivity, even after controlling for negative mood and BMI. In addition, as discussed above, the relationship between OC side effects and eating disorder symptoms was stronger when examining ratings of current as opposed to history of OC side effects. This finding suggests that two pathways may be present when examining the connection between OC use and eating disorder symptoms: 1) women with a history of OC side effects report higher eating disorder symptoms because they are more hormonally sensitive [weaker effect], and 2) current

users report greater eating disorder symptoms because of direct (or indirect) effects of gonadal hormone changes on eating thoughts and behaviours [stronger effect].

A General Eating Disorder Factor

The literature tends to suggest that from a hormonal perspective, restricting-type and bulimic-type ED symptoms may have opposing hormonal profiles (i.e., restricting symptoms associated with high estrogen and low androgens, and vice versa for bulimic symptoms; e.g., Klump et al., 2008; Edler et al., 2007). The hypotheses for the current study reflected this concept of opposing hormonal profiles for restricting and bulimic-type symptoms. However, the present results suggest instead that, in this particular sample (non-clinical, university-aged women), all three eating disorder symptoms (Drive for Thinness, Bulimia, Body Dissatisfaction), were positively correlated and did not show consistent differential relationships to various hormonal profiles. This raises the possibility that a general eating disorder factor exists, and that OC use, OC side effects, and perimenstrual symptoms may increase risk or vulnerability to this general eating disorder factor.

While the bingeing and restricting types of eating disordered behaviour may be more distinguished in a clinical population, a general factor related to an increased tendency to restrict, binge, and purge, and have elevated body dissatisfaction may be prevalent in the general population. Support for this hypothesis comes from the strong positive correlations between the EDI-3 subscales in this study (see Tables 8 and 9), in addition to the canonical correlations, which indicated that for current OC users, greater OC side effects were associated with higher scores on all three eating disorder scales. Therefore, it is possible that as a result of changes in endogenous hormones associated

with OC use, women experienced both an increase in a wide variety of OC side effects and eating disorder symptoms.

In fact, the EDI-3 includes a composite scale (Eating Disorder Risk Composite [EDRC]) that is composed of the summed *T* scores for the Drive for Thinness, Bulimia, and Body Dissatisfaction subscales (Garner, 2004). Factor-analytic research on the original EDI supported the combination of these scales in non-clinical samples, with the overall score reflecting the level of eating concerns (Welch, Hall, & Walkey, 1988). A recent examination of the factor structure of the EDI-3 using a large sample of Danish non-clinical females aged 18 to 30, supported a model including a risk component comprised of elevations on the Drive for Thinness, Bulimia, and Body Dissatisfaction subscales (Clausen, Rosenvinge, Friborg, & Rokkedal, 2011). All three subscales showed strong, positive loadings on the eating disorder risk factor. Therefore, the findings of the current study (greater scores on all three EDI-3 subscales in women reporting OC side effects) are consistent with the theoretical underpinnings of the EDI-3 as well as factor analytic research.

In Klump and colleagues' (2006) study that found a link between higher circulating estradiol levels and greater disordered eating, they utilized a composite score from the MEBS that included measures of body dissatisfaction, weight preoccupation, binge eating, and compensatory behaviours. Greater scores on the composite were described as indicating greater levels of disordered eating. Therefore, hormonal differences within the non-clinical population may reflect a general tendency towards disordered eating. A review of the specific items of the EDI-3 subscales used indicates that they examine cognitive and emotional experiences that are related to eating disorders

as well as some items examining behaviours, rather than measuring exclusively disordered eating behaviours (e.g., frequency of restricting, bingeing, compensatory behaviours). The Drive for Thinness subscale is said to be predictive of the development of BN in college students (Garner, 2004), rather than being strictly related to restricting behaviours and an anorexic-type profile. Similarly, the Bulimia subscale can be elevated in women with both AN-B/P (Anorexia nervosa – binge/purge subtype) and BN. Therefore it is common for women to experience elevations on both subscales, and thus these particular measures may not cleanly associate with the anorexic-type and bulimic-type hormonal profiles seen within the literature on clinical populations. It is hoped that future research can assist in clarifying which hormonal changes may result in increasing this general eating disorder risk.

Hormonal Sensitivity

The current study examined the concept of hormonal sensitivity, as represented by menstrual distress, and the androgenic symptoms of acne and hirsutism. Previous studies have indicated that a portion of women are particularly sensitive or reactive to fluctuating hormone levels (for example, across the menstrual cycle, during pregnancy, or the postpartum period). Women who are hormonally sensitive (often identified as having a history of PMS or PMDD) are believed to show differences in hormonal variables compared to women without such sensitivity (e.g., Bancroft, 1993). Results of the present analyses found that hormonal sensitivity was associated with increased OC side effects, negative mood, and eating disorder symptoms. The connection between hormonal sensitivity scores and OC side effect ratings was significant after controlling for negative mood, and supports a vulnerability of hormonally sensitive women to various physical

and emotional effects as a result of hormone change. Hormonal sensitivity was also associated with eating disorder symptoms while controlling for BMI and negative mood, further supporting a connection between hormonal functioning and eating disorder symptomatology in a non-clinical sample. OC side effects were associated with eating disorder symptoms, but only when hormonal sensitivity was controlled, indicating a mediation model. Hormonal sensitivity did not mediate the relationship between circulating hormone levels and eating disorder symptoms (aside from a trend indicating a possible mediation role between estradiol and bulimia scores), suggesting that hormonal sensitivity may be more relevant to changing rather than absolute hormone levels.

A small body of research has examined the challenging concept of hormonal sensitivity. In women with PMS and PMDD, emotional symptoms (e.g., depressed mood, anxiety) fluctuate across the menstrual cycle, strongly suggesting an impact of gonadal hormones on emotional symptoms, however researchers rarely find significant differences in levels of circulating hormones between women with and without PMS/PMDD (see review by Rubinow, Schmidt, & Roca, 1998). A number of studies have suggested that women with PMS or PMDD are differentially sensitive to the effects of gonadal hormones, and that associations with emotional, physical, or sexual symptoms (e.g., negative mood, food cravings) are only found during periods of hormone fluctuation in women with a history of PMS/PMDD (see Dye & Blundell, 1997; Rubinow, Schmidt, & Roca, 1998). Given the evidence and conceptualization of hormonal sensitivity in the literature, the current study utilized measures of menstrual and pre-menstrual physical and mood changes (MDQ scores before and during menses) as a way of measuring hormonal sensitivity.

Bancroft (1993) highlights that hormonally sensitive women are susceptible to experiencing symptoms when faced with changing or fluctuating hormones (e.g., daily/weekly changes associated with OC use, menstrual cycle). This reactivity or sensitivity to hormones may be due to tissue-specific hormonal effects, in particular differences in tissue responses (e.g., hormone cascades), and localized changes in brain activity associated with hormonal changes (see Kiesner, 2010). Kiesner further posits that physical symptoms are likely the markers of these tissue-specific effects and localized brain changes in hormonally sensitivity women. To examine this possibility in the current study, correlations between individual MDQ items (for seven days prior to menses) and eating disorder symptoms, while controlling for reported pre-menstrual weight gain and mood/anxiety symptoms (see Appendix R). Significant positive correlations between Bulimia and Drive for Thinness scores and various physical symptoms were noted, including headaches, swelling, fatigue, and skin blemishes. These physical experiences provide further evidence that certain women show reactivity to hormonal changes in various tissues or brain regions during the premenstrual period. This reactivity in particular tissues or brain areas may also lead to changes in eating thoughts and behaviours. Perhaps even more importantly, these particular physical symptoms may be useful indicators of women with an increased risk of eating disorders.

In addition to the physical symptoms mentioned, premenstrual appetite increase was significantly positively correlated with both Bulimia and Drive for Thinness scores, after controlling for weight gain and mood/anxiety. Bulimia scores were also significantly correlated with premenstrual food cravings. This is consistent with the finding of OC-related increased appetite being positively related to Bulimia scores.

Considering Kiesner's theory, women who are hormonally sensitivity and endorse greater premenstrual symptoms may experience greater eating disorder symptoms because of greater reactivity to hormonal changes in brain areas associated with hunger, satiety, and eating behaviours (e.g., ventromedial and paraventricular nuclei of the hypothalamus, central nucleus of the amygdala; see Eckel & Geary, 2001; Thammacharoen et al., 2008).

Overall, the results of the study provide further support for the concept of hormonal sensitivity, and its relationship to the experience of negative mood, OC side effects, and eating disorder symptoms. Hormonally sensitive women may be more vulnerable to changes in functioning across the menstrual cycle, including mood, physical experiences, and eating disorder symptoms. Furthermore, these experiences may be related to a reactivity of brain and peripheral tissues to changing gonadal hormone levels. This is one of the few studies to attempt to further explore and measure hormonal sensitivity. In addition, the current study appears to be the first to link hormonal sensitivity with the experience of OC side effects and eating disorder symptoms.

Strengths and Limitations

The current study has a number of strengths, as well as some weaknesses that must be acknowledged. The strengths and weaknesses of this study are outlined and discussed below. One possible limitation of the findings of this study is that response bias may play a role in the relationship between OC side effects and eating disorder symptoms. Such responses biases may include a tendency to endorse a large number of negative experiences or symptoms, or a general tendency to endorse any experience/symptom, whether positive or negative. With respect to a possible negative response bias, it should be noted that the OC Side Effects Scale included both positive

and negative items, and that the response options provided went in both directions (i.e., *increase* and *decrease*), which should minimize a general propensity to over-endorse experiences. More importantly, the OCSES was scored such that both positive and negative side effects were included in the subscale scores. For example, increases in stable mood or decreases in menstrual cramps would both increase the score of the relevant side effect scale. Both pleasant and unpleasant side effects are important as it is likely that they both reflect hormonal changes (Oinonen & Mazmanian, 2002). Therefore, elevated OC side effect scores do not necessarily reflect endorsement of solely negative side effects. If the relationship between OC side effects and eating disorder symptoms was only due to a greater tendency to endorse symptoms/side effects, one would expect similar correlations for both current OC users and ever OC users. However, the strength of the correlations is greatest in current OC users, supporting the association between hormonal changes as a result of OC use and increases in eating disorder symptoms.

The present study has a number of strengths within the design and measures utilized. With respect to the participant sample, a non-clinical (primarily student) group was recruited, rather than a clinical sample. Advancement of the body of research on sub-clinical eating disorder symptomatology is important, given that these symptoms are not uncommon in young women, put women at risk for full-blown eating disorders, and cause significant distress and impairment in many women on a daily basis. However, a drawback of the current study is that, given the large number of participants, current eating disorder status could not be confirmed by more rigorous methods such as clinical interview and medical examinations. Presence of past or current eating disorders was

self-reported by participants. Therefore, it is possible that some women may have failed to disclose diagnoses, or were suffering from clinically diagnosable eating disorders that had not yet been diagnosed. Given the anonymity of the questionnaires and the relative rarity of clinical-level eating disorders in the general population, it is unlikely that a large number of women with current diagnosable eating disorders were present in the sample. Research looking specifically at hormonal aspects of eating disorder symptoms in community samples shows substantial differences from findings in clinical populations. Therefore, it is of great importance that research in both populations progress.

Another important aspect of the sample is that it was restricted to women of a particular age range (18 to 30 years) thus creating a reasonably uniform sample with respect to hormonal functioning. After age 30, shifts in hormonal functioning (including changes in average progesterone levels, menstrual cycle length and regularity, and fertility) occur that may potentially result in differences in hormonal variables examined (see review by Hampson & Young, 2008, p. 67). Use of a non-clinical sample is important with respect to hormonal functioning as well, because severe restricting and binge-purge behaviour is known to impact functioning of the HPG and HPA axes. Therefore, the findings from the current study are much less likely to be confounded by changes in hormonal functioning that are typically associated with nutritional deficits (Treasure & Murphy, 2005, p. 91).

An additional strength of the current sample was the large number of participants who responded to the online questionnaire. Unfortunately, however, the number of participants dropped across time, and fewer respondents were available for the second and third follow-up questionnaires. While analyses did not indicate any differences

between those who did and did not respond to follow-up questionnaires at 6 months and 1 year later, it is possible that participants with certain characteristics were more likely to respond than others. The same concern is relevant to those who agreed to participate in the laboratory session. These women may have been more conscientious, for example, that those who did not volunteer. While personality variables were not measured in this study and so could not be examined, participants who took part in the laboratory session were similar to the full sample with respect to BMI as well as mood and anxiety ratings. Lab participants did differ from the full sample in that they were slightly younger, and had lower total EDI-3 scores. Given the inconsistencies in recruiting strategies, for example, not all women were invited to participate in the lab session due to time constraints and selection variables (described in the *Procedures* section), any differences between lab participants and non-participants may not necessarily be related to participants' tendency to volunteer. However, lower Total EDI-3 scores in the lab participants suggests that women with higher eating disorder symptoms may have avoided participating because of the required body measurements (e.g., weight, hip and waist circumference). The impact of lower EDI-3 scores in lab participants is not known, however a restricted range of scores may have lessened the likelihood of finding associations between eating disorder symptom and other measures.

Another factor regarding recruitment for the study is that course bonus points were provided for participation, as well as entry into draws for gifts cards and an iPod. These incentives may have expanded the group of women willing to volunteer their time. An additional weakness worth noting is that most of the participants were university

students, and therefore not necessarily representative of the general population of women within that age group.

An additional aspect related to recruitment and study participation was that the Women's Health Across Time questionnaire was administered online. Once again, this is an additional factor that may have influenced the characteristics of the women who volunteered to participate in the study. Given that the bulk of respondents were university students, it is unlikely that computer and internet access was an impediment to many, if any, potential participants. Free computers and internet access are available for use across the university campus for those students who may not have independent access to such technology. A large number of studies currently utilize online questionnaires, and therefore it is something that students are likely familiar with. With respect to access to the questionnaire, an online version as opposed to a paper-and-pencil version likely served to increase access to the study, as participants were able to access the study from home (or anywhere), and complete it on their own time without needing to pick-up or drop-off a hard copy.

With respect to the laboratory portion of the study, the small number of saliva samples collected was a weakness. Recruitment and organization of laboratory sessions was challenging given the requirements prior to providing a saliva sample (e.g., early morning sessions, not eating or brushing one's teeth), and the necessity of booking sessions during particular days of the menstrual cycle. A larger number of saliva samples would have provided more power for the analyses, possibly allowing for stronger relationships between hormones and eating disorder symptoms to emerge. Another possible weakness of the salivary hormone level analyses was the unexpected failure of

the freezer where a portion of the samples were stored. The samples were moved to another freezer, but may have suffered some defrosting prior to the transfer. According to the laboratory where the samples were processed, defrosting and refreezing is a part of the usual processing of samples, and it was not believed that incident would have impacted the integrity of the samples. *T*-tests indicated no differences in salivary hormone values when samples that may have been thawed were compared to those that were not. Therefore, while the freezer failure may be a weakness of the study the results suggest that the samples were not affected.

A number of other strengths are found within the design of the study. This is one of the few studies that has attempted to contribute to the small body of research on hormonal sensitivity. It is the one of the few studies that has attempted to define and measure hormonal sensitivity, and the only known study that has examined the hormonal sensitivity variable in relation to eating disorder symptoms. An additional asset of this study comes from the collection of a wide variety of hormonal data, including the use of self-report questionnaires, anthropometric measures, and measures that reflect both activational (i.e., salivary hormone assays) and organizational effects of hormones (i.e., 2D:4D). The use of a prospective repeated measures design for the questionnaire was also a strength, as it allowed variables to be examined within individual women across a one year period. While the repetition of measures was certainly a strength, within the current study the most important hypothesis regarding change over time was with respect to alterations in symptoms related to OC use status. Unfortunately, only a small number of women (i.e., 26) changed their OC use status across the 12 months of the study. This limited the ability to use this data as planned.

Future Studies

The results of the current study have raised a number of questions and possibilities for future study. With respect to OC side effects, the present study illuminated the difficulty related to examining women during periods of OC use and nonuse. While a large number of participants used OCs, only a small number changed OC status during this one year study. Therefore, a more successful approach may be to recruit women planning to start OCs for the first time and measure important variables before and after use. This would ensure a strong repeated-measures design, and would allow for the measurement of OC side effects shortly after starting OC use, when side effects are most often present. Furthermore, this design would eliminate any concern regarding pre-existing differences between current OC users and OC never users (i.e., differences in sexual attitudes and behaviours). Ideally, recruiting women who will be using one single OC preparation may allow for the identification of side effect profiles most relevant to eating disorder symptomatology. Additional research should be aimed at discovering whether changes in eating disorder symptoms persist after discontinuation of OCs.

The current study also indicated the importance of including measures of hormonal sensitivity when studying the relationships between OC side effects and eating disorder symptoms. Key physical symptoms during the pre-menstrual period linking hormonal sensitivity and eating disorder symptoms were identified (e.g., headaches, swelling, fatigue, appetite increase), and these could be further explored as indicators of increased eating disorder risk. In addition, imaging studies may provide insight into the plasticity of important brain regions across the menstrual cycle, in particular areas that

may be related to hunger/satiety and food intake. Given that many women begin taking OCs to treat menstrual-cycle related difficulties (e.g., irregular cycles, menstrual cramps, heavy menstrual bleeding), an additional area of study may be to determine whether clusters of PMS symptoms may predict a positive or negative response to OCs, or which types of OCs may be best tolerated by women with menstrual distress. Another factor to examine in relationship to hormonal sensitivity is negative mood. This study's SEM analyses indicated that hormonal sensitivity explained negative mood, including ratings of depression and anxiety. Depression and anxiety are significant psychiatric problems in both clinical and non-clinical populations, and therefore further exploration of possible risk or exacerbating factors is clearly important.

Future studies should attempt to replicate the relationship between the proposed Progestational/Androgenic Profile score and eating disorder symptoms. It will be interesting to examine whether this profile score (in particular increased appetite) is predictive of other hormonal experiences and strict measures of disordered eating behaviours (i.e., frequency of bingeing and purging). If possible, clarification of direct or indirect effects of OC use on eating disorder symptoms will be important. Specifically, examining whether increased appetite associated with OC use is a precursor to elevated eating disorder symptoms, or whether increased appetite ratings are a part of the eating disorder symptomatology itself. Compared to the Progestational/Androgenic Profile score, the Estrogenic Profile score was less successful, and therefore further studies may explore additional physical and emotional experiences that may together be predictive of eating disorder symptoms and other hormonally-based experiences. Studies that examine these profile scores in conjunction with measures of circulating hormone levels may be

most useful. With respect to circulating hormones and eating disorder symptoms, the preliminary findings for relationships between eating disorder symptoms and circulating levels of progesterone and testosterone should be replicated with larger non-clinical samples. It may be useful to include alternate measures of eating disorder symptoms in place of or in addition to the EDI-3, with the goal of further understanding the impact of gonadal hormones on eating disorder behaviour (e.g., restricting, compensatory behaviours), rather than a focus on emotional/cognitive eating disorder symptoms.

Considering the study as a whole, there was stronger support for Bulimia scores versus Drive for Thinness scores in showing a relationship with hormonal factors. Therefore, further research exploring whether bulimic-type symptoms show a stronger hormonal basis compared to restricting-type symptoms may be warranted. Similarly, stronger support was found for progesterone and testosterone levels and associated OC side effects when compared to estradiol. Further studies focused on understanding effects of progesterone and testosterone on eating disorder symptoms may therefore be important.

Conclusions

The present study examined the relationship between eating disorder symptoms and hormonal variables in a non-clinical sample of university-aged females. The results informed a model whereby: a) hormonal sensitivity increases the risk of OC side effects and eating disorder symptoms, and b) direct (and possibly indirect) effects of OC use increase the risk of eating disorder symptoms in OC users compared to non-users. Increased appetite, either as a side effect of OC use or associated with hormonal changes across the cycle, was associated with higher eating disorder symptoms. This may reflect

sensitivity to hormonal changes in brain regions related to satiety and eating behaviours. All three gonadal hormones examined (estradiol, progesterone, and testosterone) showed relationships with eating disorder symptoms, either through correlations or regressions. These particular findings did not necessarily fit with hypotheses based on the current literature, therefore emphasizing the need to further study the relationships between circulating gonadal hormones and eating disorders in non-clinical populations. Considering the results as a whole, this study provides additional support for a role of gonadal hormones in eating disorder symptoms. Further studies will be important to replicate and extend these findings, given that this is the first study to examine many of these constructs and hypotheses. Nonetheless, the results suggest that women who are hormonally sensitive and/or use OCs may be at greater risk of eating disorder symptoms. Women may also be at greater risk of eating disorder symptoms at times of hormonal fluctuations, in particular if hormonal changes result in increases in appetite. Finally, women with greater than average levels of circulating progesterone and testosterone may also be more vulnerable to increased eating disorder symptoms. Looking at the greater picture of advances in women's health, it is hoped that this study has contributed in two main ways: first, in gaining a better understanding of changes and side effects associated with OC use to assist women and health care practitioners in making important decisions about hormonal contraception, with the ultimate goal of reducing OC discontinuation and failure rates; second, in contributing information regarding biological risk factors for eating disorders, an essential part of developing methods for the prevention and treatment of eating disorders.

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Appendix A

WOMEN'S HEALTH ISSUES ACROSS TIME QUESTIONNAIRE

Please provide your contact information so we can contact you for the follow-up surveys and to book laboratory sessions.
First name: _____
Email (that you check regularly):_____
Phone number:_____

PARTICIPANT CODE

Please follow these instructions and the example to create your Participant Code. This will help us track you as you complete the various portions of the study. Answer the questions in order, and place the responses one-by-one in the box below. Your 7 letter and number responses will create your 7-digit Participant Code. You do not need to remember this code because we will ask you these questions on each occasion that you participate in the study.

1. What is the second letter of your first name? ___
   ex: Jane
2. On what day of the month you were born? (i.e., from 01 to 31) ___
   ex: June 09
3. What is the first letter of your last name? ___
   ex: Doe
4. In what month were you born? (i.e., from 01 to 12) ___
   ex: 06 (June)
5. What is the third letter of the city where you were born? ___
   ex: Sudbury

   Example code: J09D06D
   Place your 5 responses (7 numbers/letters) in order here: _____

Today's Date (DD/MM/YY): _____

Are you currently a student at Lakehead University?

___ yes
___ no

If yes, please provide the following information if you are eligible to receive bonus points for participating in this study (we will delete this information after you have received your bonus points):

Full name:_____
Course (eg., PSYC 1100 YE): _____
Instructor:_____

Student number:_____

1. Please check the box(es) that best describe your ethnic origins. (Check all that apply

- ☐ North American (Canada, United States, Mexico)
- ☐ Aboriginal (Native Canadian, Native American, Metis, Inuit)
- ☐ Eastern European (Hungary, Poland, Russian, Ukraine)
- ☐ Western European (Austria, Germany, Switzerland, France, Netherlands)
- ☐ Southern European (Spain, Portugal, Italy, Greece, Croatia, Yugoslavia)
- ☐ Northern European (Finland, Denmark, Norway, Sweden)
- ☐ British (Scotland, Ireland, England, Wales)
- ☐ Central American/Caribbean (Nicaragua, Costa Rica, Jamaica)
- ☐ South American (Brazil, Peru, Chile, Venezuela)
- ☐ North African (Egypt, Libya, Algeria)
- ☐ South African (Zambia, Botswana, South Africa)
- ☐ East African (Kenya, Ethiopia, Somalia)
- ☐ West African (Mauritania, Senegal, Cote D'Ivoire)
- ☐ Central African (Democratic Republic of the Congo, Uganda, Central African Republic)
- ☐ Central Asian (Kazakhstan, Tajikistan, Uzbekistan)
- ☐ East Asian (People's Republic of China, Hong Kong, Japan, North Korea, South Korea, Taiwa
- ☐ South Asian (Afghanistan, Bangladesh, India, Pakistan Sri Lanka)
- ☐ Southeast Asian (Cambodia, Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam)
- ☐ West Asian (Armenia, Iraq, Israel, Lebanon, Saudi Arabia)
- ☐ Oceanic (Australia, New Zealand, Papua New Guinea, Samoa)
- ☐ Other/Unsure (Please Specify):_____

2.Please check the box or boxes that best describe you:

- ☐ White
- ☐ Aboriginal (First Nations, Metis, Inuit)
- ☐ Black
- ☐ Asian
- ☐ Southeast Asian
- ☐ Latin American
- ☐ Arab
- ☐ Hispanic/Latino
- ☐ Other (Please Specify):_____

EDUCATION

3. What was the highest grade in elementary school you completed: ____

4. What was the highest grade in high school you completed: ____

5. How many years of college/trade school have you completed? ____

6. How many years of undergraduate university have you completed? ____

7. How many years of graduate university have you completed? ____

MEDIA USE

8. Please estimate the total number of hours you spend watching programs, movies, and videos per week (including viewing on the television, internet/computer, and movie theatre): _____ hours

9. Please estimate the number of hours per week the television is on in your home: _____ hours

10. How many magazines you do usually read in one month? _____

Of those, how many are fashion/beauty magazines? _____
How many are fitness/health magazines? _____

11. Have you ever talked to anyone by telephone?

___ yes
___ no

EMOTIONS AND MENTAL HEALTH

12. Have you ever been diagnosed with or treated for any of the following disorders? If yes, please choose the response that best reflects the current status of that disorder.

no
yes, symptoms are no longer present
yes, symptoms are currently reduced but still present
yes, symptoms are currently present

	No	Yes – Symptoms no longer present	Yes- Symptoms present but reduced	Yes- Symptoms currently present
a) Anxiety Disorder (including Panic, Phobias, General Anxiety, Post-Traumatic Stress Disorder, Obsessive-Compulsive Disorder)	0	1	2	3
b) Depression (including Post-partum and Seasonal depression)	0	1	2	3
c) Bipolar/Manic Depressive Disorder	0	1	2	3
d) Anorexia Nervosa	0	1	2	3
e) Bulimia Nervosa	0	1	2	3
f) Binge Eating Disorder	0	1	2	3
g) Pre-Menstrual Dysphoric Disorder	0	1	2	3
h) Polycystic Ovarian Syndrome (PCOS)	0	1	2	3

13. This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent to which you have felt this way today. Use the following scale to record your answers.

1	2	3	4	5
very slightly/not at all	a little	moderately	quite a bit	extremely

____ interested
____ distressed
____ excited
____ upset
____ strong
____ guilty
____ scared
____ hostile
____ enthusiastic
____ proud
____ irritable
____ alert
____ ashamed
____ inspired
____ nervous
____ determined
____ attentive
____ jittery
____ active
____ afraid

14. Below is a list of problems that people sometimes have. Please read each one carefully, and check the box that best describes HOW MUCH THAT PROBLEM HAS DISTRESSED OR BOTHERED YOU DURING THE PAST 7 DAYS INCLUDING TODAY.

	Not At All	A Little Bit	Moderately	Quite A Bit	Extremely
1. Nervousness or shakiness inside	0	1	2	3	4
2. Loss of sexual interest or pleasure	0	1	2	3	4
3. Feeling low in energy or slowed down	0	1	2	3	4
4. Thoughts of ending your life	0	1	2	3	4
5. Trembling	0	1	2	3	4
6. Crying easily	0	1	2	3	4
7. Feelings of being trapped or caught	0	1	2	3	4
8. Suddenly scared for no reason	0	1	2	3	4
9. Blaming yourself for things	0	1	2	3	4
10. Feelings lonely	0	1	2	3	4
11. Feeling blue	0	1	2	3	4
12. Worrying too much about things	0	1	2	3	4
13. Feeling no interest in things	0	1	2	3	4

14. Feeling fearful	0	1	2	3	4
15. Heart pounding or racing	0	1	2	3	4
16. Feeling hopeless about the future	0	1	2	3	4
17. Feeling tense or keyed up	0	1	2	3	4
18. Feeling everything is an effort	0	1	2	3	4
19. Spells of terror or panic	0	1	2	3	4
20. Feeling so restless you couldn't sit still	0	1	2	3	4
21. Feelings of worthlessness	0	1	2	3	4
22. The feeling that something bad is going to happen to you	0	1	2	3	4
23. Thoughts and images of a frightening nature	0	1	2	3	4

EATING AND BODY IMAGE

15. The following items ask about your attitudes, feelings, and behaviour. Some of the items relate to food or eating. Other items ask about your feelings about yourself. For each item, decide if the item is true about you ALWAYS (A), USUALLY (U), OFTEN (O), SOMETIMES (S), RARELY(R) or NEVER (N). Respond to all of the items, making sure that you choose the rating that is true about you.

ALWAYS USUALLY OFTEN SOMETIMES RARELY NEVER

		Always	Usually	Often	Sometimes	Rarely	Never
1.	I eat sweets and carbohydrates without feeling nervous.	A	U	O	S	R	N
2.	I think that my stomach is too big.	A	U	O	S	R	N
3.	I eat when I am upset.	A	U	O	S	R	N
4.	I stuff myself with food.	A	U	O	S	R	N
5.	I think about dieting.	A	U	O	S	R	N
6.	I think that my thighs are too large.	A	U	O	S	R	N
7.	I feel extremely guilty after overeating.	A	U	O	S	R	N
8.	I think that my stomach is just the right size.	A	U	O	S	R	N
9.	I am terrified of gaining weight.	A	U	O	S	R	N
10.	I feel satisfied with the shape of my body.	A	U	O	S	R	N
11.	I exaggerate or magnify the importance of weight.	A	U	O	S	R	N

12.	I have gone on eating binges where I felt that I could not stop.	A	U	O	S	R	N
13.	I like the shape of my buttocks.	A	U	O	S	R	N
14.	I am preoccupied with the desire to be thinner.	A	U	O	S	R	N
15.	I think about bingeing (overeating).	A	U	O	S	R	N
16.	I think my hips are too big.	A	U	O	S	R	N
17.	I feel bloated after eating a normal meal.	A	U	O	S	R	N
18.	I eat moderately in front of others and stuff myself when they're gone.	A	U	O	S	R	N
19.	If I gain a pound I worry that I will keep gaining.	A	U	O	S	R	N
20.	I have the thought of trying to vomit to lose weight.	A	U	O	S	R	N
21.	I think that my thighs are just the right size.	A	U	O	S	R	N
22.	I think that my buttocks are too large.	A	U	O	S	R	N
23.	I eat or drink in secrecy.	A	U	O	S	R	N
24.	I think that my hips are just the right size.	A	U	O	S	R	N
25.	When I am upset, I worry that I will start eating.	A	U	O	S	R	N
26.	Being with someone who is eating often makes me hungry.	A	U	O	S	R	N
27.	When I crave something, I know I won't be able to stop eating once I start.	A	U	O	S	R	N
28.	If I eat what I am craving, I often lose control and eat too much.	A	U	O	S	R	N
29.	I hate it when I give in to cravings.	A	U	O	S	R	N
30.	Food cravings invariably make me think of ways to get what I want to eat.	A	U	O	S	R	N
31.	I feel like I have food on my mind all the time.	A	U	O	S	R	N
32.	I often feel guilty for craving certain foods.	A	U	O	S	R	N
33.	I find myself preoccupied with food.	A	U	O	S	R	N
34.	I eat to feel better.	A	U	O	S	R	N
35.	Sometimes, eating makes things seem just perfect.	A	U	O	S	R	N
36.	Thinking about my favorite foods makes my mouth water.	A	U	O	S	R	N

37.	I crave foods when my stomach is empty.	A	U	O	S	R	N
38.	I feel as if my body asks me for certain foods.	A	U	O	S	R	N
39.	I get so hungry that my stomach seems like a bottomless pit.	A	U	O	S	R	N
40.	Eating what I crave makes me feel better.	A	U	O	S	R	N
41.	When I satisfy a craving I feel less depressed.	A	U	O	S	R	N
42.	When I eat what I am craving I feel guilty about myself.	A	U	O	S	R	N
43.	Whenever I have cravings, I find myself making plans to eat.	A	U	O	S	R	N
44.	Eating calms me down.	A	U	O	S	R	N
45.	I crave foods when I feel bored, angry, or sad.	A	U	O	S	R	N
46.	I feel less anxious after I eat.	A	U	O	S	R	N
47.	If I get what I am craving I cannot stop myself from eating it.	A	U	O	S	R	N
48.	When I crave certain foods, I usually try to eat them as soon as I can.	A	U	O	S	R	N
49.	When I eat what I crave I feel great.	A	U	O	S	R	N
50.	I have no will power to resist my food cravings.	A	U	O	S	R	N
51.	Once I start eating, I have trouble stopping.	A	U	O	S	R	N
52.	I can't stop thinking about eating no matter how hard I try.	A	U	O	S	R	N
53.	I spend a lot of time thinking about whatever it is I will eat next.	A	U	O	S	R	N
54.	If I give into a food craving, all control is lost.	A	U	O	S	R	N
55.	When I'm stressed out, I crave food.	A	U	O	S	R	N
56.	I daydream about food.	A	U	O	S	R	N
57.	Whenever I have a food craving, I keep on thinking about eating until I actually eat the food.	A	U	O	S	R	N
58.	If I am craving something, thoughts of eating it consume me.	A	U	O	S	R	N
59.	My emotions often make me want to eat.	A	U	O	S	R	N
60.	Whenever I go to a buffet I end up eating more than what I needed.	A	U	O	S	R	N
61.	It is hard for me to resist the	A	U	O	S	R	N

	temptation to eat appetizing foods that are in my reach.						
62.	When I am with someone who is overeating, I usually overeat too.	A	U	O	S	R	N
63.	When I eat food, I feel comforted.	A	U	O	S	R	N
64.	I crave foods when I am upset.	A	U	O	S	R	N
65.	Things with sugar in them taste sweet to me.	A	U	O	S	R	N

REPRODUCTION

16. a) Have you ever been pregnant? (Only say YES if you were 100% sure)
YES NO

b) If yes, how many times have you been pregnant? _____

c) How many children have you given birth to? _____

d) Are you currently pregnant? (Circle your answer)
YES NO MAYBE

e) Are you currently breastfeeding/nursing? (Circle your answer)
YES NO A LITTLE

BODY AND PHYSICAL HEALTH

17. Height: ____ (feet & inches) or ____ (cm)

18. Weight: ____ (pounds) or ____ (kg)

19. Bra cup size (e.g., AA, A, B, C, D, DD) ____

20. Please check any of the following mental or physical health problems with which you have been diagnosed.

___ asthma
___ anemia
___ hypothyroidism (underactive thyroid)
___ hyperthyroidism (overactive thyroid)
___ allergies
___ diabetes
___ irritable bowel syndrome (IBS)
___ endometriosis

21. Please list any additional mental or physical health not covered above:

_____

22. Please list any medications you are currently taking:

___ none List: _____

23. As a teenager and young adult, how did your acne/pimples compare to your same-age peers? Only consider times when you were not using hormonal birth control (i.e., birth control pill or injections).
I had _____ acne compared to most girls/women my age (check the best response).

___ significantly less (1)
___ slightly less (2)
___ about the same (3)
___ slightly more (4)
___ significantly more (5)

24. In the most recent one-month period when you were not using hormonal birth control, your acne can be best described as:

___ absent – no acne at all (0)
___ mild – less than 15 blackheads AND less than 15 pimples (1)
___ moderate – more than 15 blackheads OR more than 15 pimples AND less than 5 lesions/cysts (2)
___ severe – more than 5 lesions/cysts (3)

25. Are you currently taking medication to treat acne?

___ no
___ yes – birth control pill
___ yes – other type of medication

26. It is common for women to have hair growth on various parts of their bodies. Please rate the amount of terminal hair on each of the following body parts by *circling the category that best describes you when you are NOT using hormonal birth control.* Terminal hairs are thick, pigmented hairs, like those found on the head, armpits, and pubic area (as opposed to the thin, non-pigmented "peach fuzz" hair that covers the body). If you remove hair, please provide the rating that bests describes your hair growth prior to hair removal.

Upper Lip	None.
	A few hairs at the outer ends of the lip.
	A small moustache at the outer ends of the lip.
	A moustache extending halfway from the outer ends of the lip.
	A moustache extending to across the entire lip.
Chin	None.
	A few scattered hairs.
	Scattered hairs in small groups.
	Complete cover, light hair growth.
	Complete cover, heavy growth.
Chest	None.
	Hairs around the nipple/areola.
	Hairs around the nipple/areola and some in the middle of the chest.
	Hairs across the chest, covering about three quarters of the chest.

	Hairs across the chest, covering the entire chest.
Upper Back	None.
	A few scattered hairs.
	More than a few hairs, but still scattered.
	Complete cover, light hair growth.
	Complete cover, heavy growth.
Lower Back	None.
	A small tuft of hair just below the small of the back.
	A small tuft of hair below the small of the back that extends horizontally across the lower back.
	Hairs covering about three quarters of the lower back.
	Hairs completely covering the lower back.
Upper Abdomen (Above Navel)	None.
	A few hairs around the middle.
	More hairs, still around the middle.
	The upper abdomen is half covered.
	The upper abdomen is completely covered.
Lower Abdomen (Below Navel)	None.
	A few hairs around the middle.
	A stripe of hair down the middle.
	A thicker stripe (band) down the middle.
	An inverted V-shaped growth.
Upper Arm (Above Elbow)	None.
	Sparse growth on less than a quarter of the arm.
	More than sparse growth, but incomplete cover of the arm.
	Complete cover, light hair growth.
	Complete cover, heavy hair growth.
Forearm (Below Elbow)	None.
	Complete cover of the top of the arm, light growth.
	Complete cover of the top of the arm, moderate growth.
	Complete cover of the top of the arm, heavy growth.
	Complete cover of the top of the arm, very heavy growth.
Thigh	None.
	Complete cover of the top of the thigh, light growth.
	Complete cover of the top of the thigh, moderate growth.
	Complete cover of the top of the thigh, heavy growth.
	Complete cover of the top of the thigh, very heavy growth.
Leg	None.
	Complete cover of the top of the leg, light growth.
	Complete cover of the top of the leg, moderate growth.
	Complete cover of the top of the leg, heavy growth.
	Complete cover of the top of the leg, very heavy growth.

27. Please check the appropriate box to indicate if you have any hair between the 1st and 2nd knuckle on each of your fingers. You may need to examine your fingers from different angles if your hair is light-coloured or short.

Left hand:	**Right hand:**
Index finger ☐ yes ☐ no	Index finger ☐ yes ☐ no
Middle finger ☐ yes ☐ no	Middle finger ☐ yes ☐ no
Ring finger ☐ yes ☐ no	Ring finger ☐ yes ☐ no
Little (pinky) finger ☐ yes ☐ no	Little (pinky) finger ☐ yes ☐ no

28. Please indicate if you have ever had hair on your head:

___ yes
___ no

29. What is your current natural hair colour? _____

30. What was your natural hair colour as a young child? _____

31. Do any of your immediate biological family members have natural red hair?

___ yes
___ no

32. Please answer this question, NOT INCLUDING any time spent pregnant, receiving birth control pills or injections, after menopause, or after having both ovaries or the uterus surgically removed:

a) Between the ages of 16 and 40, about how long was your average menstrual cycle (time from first day of one period to the first day of the next period)?

___ < 25 days
___ 25-34 days
___ 35-60 days
___ more than 60 days
___ totally variable

b) During your menstruating years (not including during pregnancy) did you have a tendency to grow dark, coarse hair on your (choose all that apply):

___ upper lip ___ chin ___breasts
___ chest between the breasts ___back
___belly ___ upper arms ___ upper thighs

c) Were you ever obese or overweight between the ages of 16 and 30?

___ yes
___ no

d) Between the ages of 16 and 40 have you ever noticed a milky discharge from your nipples (not including during pregnancy, childbirth, or breastfeeding)?

___ yes
___ no

33. Below is a list of emotional, sexual, and physical experiences that people sometimes have. For each of these experiences, choose the rating that best reflects your experience over the past month:

	Not at All	Mild	Moderate	Strong	Severe/Extreme	Not Applicable
1) Bloating/swelling	0	1	2	3	4	
2) Dizziness/faintness	0	1	2	3	4	
3) Amount of menstrual bleeding (period)	0	1	2	3	4	
4) Painful/tender breasts	0	1	2	3	4	
5) Nausea/vomiting	0	1	2	3	4	
6) Headaches	0	1	2	3	4	
7) Weight gain	0	1	2	3	4	
8) Weight loss	0	1	2	3	4	
9) Breast size increase	0	1	2	3	4	
10) Breast size decrease	0	1	2	3	4	
11) Breakthrough bleeding/spotting (bleeding between periods)	0	1	2	3	4	
12) Migraines	0	1	2	3	4	
13) Facial hair growth	0	1	2	3	4	
14) Tiredness/fatigue	0	1	2	3	4	
15) Acne/pimples	0	1	2	3	4	
16) Facial skin discolouration/dark blotches on face (melasma)	0	1	2	3	4	
17) Leg cramps	0	1	2	3	4	
18) Vaginal dryness	0	1	2	3	4	
19) Sleeping less than usual	0	1	2	3	4	
20) Sleeping more than usual	0	1	2	3	4	
21) Disrupted sleep	0	1	2	3	4	
22) Difficulty falling asleep	0	1	2	3	4	
23) Feeling tired/unrefreshed after a full night's sleep	0	1	2	3	4	
24) Clumsiness	0	1	2	3	4	
25) Diarrhea	0	1	2	3	4	
26) Constipation	0	1	2	3	4	
27) Frequent urination	0	1	2	3	4	
28) Hot flashes/cold sweats	0	1	2	3	4	
29) Food cravings	0	1	2	3	4	
30) Appetite increase	0	1	2	3	4	
31) Appetite decrease	0	1	2	3	4	
32) PMS symptoms						
33) Increased food intake (eating)	0	1	2	3	4	
34) Decreased food intake (eating)	0	1	2	3	4	

35) Memory problems	0	1	2	3	4	
36) Problems concentrating	0	1	2	3	4	
36) Impulsive	0	1	2	3	4	
37) Self-conscious	0	1	2	3	4	
38) Affectionate	0	1	2	3	4	
39) Sociable	0	1	2	3	4	
40) Lonely	0	1	2	3	4	
41) Active	0	1	2	3	4	
42) Short-tempered	0	1	2	3	4	
43) Not feeling like myself	0	1	2	3	4	
44) Frustrated	0	1	2	3	4	
45) Irritable	0	1	2	3	4	
46) Jealous	0	1	2	3	4	
47) Optimistic	0	1	2	3	4	
48) Sense of well-being	0	1	2	3	4	
49) Depressed	0	1	2	3	4	
50) Moody	0	1	2	3	4	
51) Unmotivated	0	1	2	3	4	
52) Pessimistic	0	1	2	3	4	
53) Content/happy	0	1	2	3	4	
54) Elated	0	1	2	3	4	
55) Sad	0	1	2	3	4	
56) Feeling inferior	0	1	2	3	4	
57) Stable mood	0	1	2	3	4	
58) Sensitive to criticism	0	1	2	3	4	
59) Calm	0	1	2	3	4	
60) Critical of self	0	1	2	3	4	
61) Critical of others	0	1	2	3	4	
62) In control of life	0	1	2	3	4	
63) Aggressive feelings	0	1	2	3	4	
64) Capable	0	1	2	3	4	
65) Thoughts of suicide	0	1	2	3	4	
66) Trusting of romantic partner	0	1	2	3	4	
67) Confident	0	1	2	3	4	
68) Focused	0	1	2	3	4	
69) Nervous	0	1	2	3	4	
70) Excited about the future	0	1	2	3	4	
71) Worried	0	1	2	3	4	
72) Determined	0	1	2	3	4	
73) Crying	0	1	2	3	4	
74) Concerned about body shape/size	0	1	2	3	4	
75) Pain/discomfort during sex	0	1	2	3	4	N/A
76) Enjoyment of sex	0	1	2	3	4	N/A
77) Vaginal lubrication	0	1	2	3	4	
78) Feeling sexually attractive	0	1	2	3	4	
79) Ability to become sexually aroused (with a partner)	0	1	2	3	4	N/A

80) Ability to become sexually aroused (alone)	0	1	2	3	4	N/A

81) Please circle the category that best corresponds to your self-esteem over the past month:

Extremely Low	Moderately Low	Mildly Low	Mildly High	Moderately High	Extremely High
0	1	2	3	4	5

For the following items, please choose the category which best reflects how often you have had each experience <u>in the past month.</u>

	Never	1-2 times per month	1 time per week	2-3 times per week	4-5 times per week	6-7 times per week	More than once a day
82) Desire for sex with others	0	1	2	3	4	5	6
83) Desire to masturbate	0	1	2	3	4	5	6
84) Frequency of masturbation	0	1	2	3	4	5	6

85) How frequently do you have <u>thoughts</u> that cause you to become sexually aroused?

___ never
___ once a month or less
___ a few times a month
___ once a week
___ 2 – 3 times per week
___ 4 – 5 times per week
___ every day or almost every day
___ 2-3 times per day
___ 4 or more times per day

86) How frequently are you able to orgasm when desired (both with and without a partner)?

___ always
___ usually
___ often
___ sometimes
___ rarely
___ never
___ I don't care about having orgasms
___ this does not apply to me

87) When with a partner, what percent of the time do you (as opposed to your partner) initiate sexual activity?

___ 0 to 20% of the time
___ 20 to 40% of the time
___ 40 to 60% of the time
___ 60 to 80% of the time
___ 80 to 100% of the time
___ this does not apply to me

88) Do you try to get at least some sleep every night?

___ yes
___ no

MENSTRUATION

34. What is the average length of your menstrual cycle right now (how many days are there from the first day of one period to the day before the first day of your next period)? Most people range between 25 and 35 days. Women on standard birth control pills have a 28-day cycle. _____ days

35. What is your average length of your menstrual period/bleeding when you are not taking hormonal contraceptives (birth control pill, injections)? In other words, how many days does your period last? Most people's periods last between 1 and 10 days. _____ days

36. Using the calendars below as a reference, please indicate the FIRST day of your LAST menstrual period (i.e., the day your last period started). Please also indicate the day that you believe your next menstrual period will start (i.e., the day when you expect your next period). If you are not sure, please make your best guess.

October						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

November						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

December						
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

37. The FIRST day of your LAST period was: _____

38. How confident are you that the above day was the first day of your last period?

0%		25%		50%		75%		100%
0	1	2	3	4	5	6	7	8

39. The day your NEXT period will start is: _____

40. How confident are you that the above day will be day that your next period will start?

0%		25%		50%		75%		100%
0	1	2	3	4	5	6	7	8

41. Which statement best describes your menstrual cycle when you are not taking hormonal contraceptives (ie. Birth control pill, vaginal ring, Depo Provera injection)?

___ I never have my period.
___ My period is irregular – I only get my period about 1 – 4 times a year.
___ My period is irregular – I get my period about 5 – 9 times a year.
___ I usually get my period every month, but it is irregular and I cannot predict when it will start.
___ I usually get my period within four or five days of when I expect it.
___ I usually get my period within two or three days of when I expect it.
___ My period is like clockwork and the same number of days elapse between periods each month.

42. How old were you when you first started menstruating (started your period)?
_____years old

43. The list below shows common symptoms and feelings associated with menstruation. For each item, choose the category that best describes your overall experience WHEN NOT USING HORMONAL CONTRACEPTIVES (birth control pill, patch, ring, injection). For each item, decide whether you have "no experience or symptom", or whether your experience is "mild", "moderate", "strong", or "severe". If none of the categories exactly describes your experience, choose the one that most closely matches what you feel. Be sure to rate every item. Only rate symptoms as present if you believe they are associated with your menstrual cycle.

No experience of symptom	Present, mild	Present, moderate	Present, strong	Present, severe
0	1	2	3	4

	7 days before menstrual flow (period)	*During* menstrual flow (period)
Muscle stiffness	0 1 2 3 4	0 1 2 3 4
Weight gain	0 1 2 3 4	0 1 2 3 4
Dizziness, faintness	0 1 2 3 4	0 1 2 3 4
Loneliness	0 1 2 3 4	0 1 2 3 4
Headaches	0 1 2 3 4	0 1 2 3 4
Skin blemish or disorder	0 1 2 3 4	0 1 2 3 4
Cold sweats	0 1 2 3 4	0 1 2 3 4
Anxiety	0 1 2 3 4	0 1 2 3 4
Mood swings	0 1 2 3 4	0 1 2 3 4
Cramps	0 1 2 3 4	0 1 2 3 4
Painful or tender breasts	0 1 2 3 4	0 1 2 3 4
Nausea, vomiting	0 1 2 3 4	0 1 2 3 4
Crying	0 1 2 3 4	0 1 2 3 4
Backache	0 1 2 3 4	0 1 2 3 4
Swelling (breasts, abdomen)	0 1 2 3 4	0 1 2 3 4
Hot flashes	0 1 2 3 4	0 1 2 3 4
Irritability	0 1 2 3 4	0 1 2 3 4
Tension	0 1 2 3 4	0 1 2 3 4
Fatigue	0 1 2 3 4	0 1 2 3 4
Feeling sad or blue	0 1 2 3 4	0 1 2 3 4
General aches and pains	0 1 2 3 4	0 1 2 3 4
Restlessness	0 1 2 3 4	0 1 2 3 4
Insomnia	0 1 2 3 4	0 1 2 3 4
Poor school or work performance	0 1 2 3 4	0 1 2 3 4
Affectionate	0 1 2 3 4	0 1 2 3 4
Feelings of suffocation	0 1 2 3 4	0 1 2 3 4
Forgetfulness	0 1 2 3 4	0 1 2 3 4
Take naps, stay in bed	0 1 2 3 4	0 1 2 3 4
Orderliness	0 1 2 3 4	0 1 2 3 4
Chest pains	0 1 2 3 4	0 1 2 3 4
Confusion	0 1 2 3 4	0 1 2 3 4
Poor judgement	0 1 2 3 4	0 1 2 3 4
Stay at home	0 1 2 3 4	0 1 2 3 4
Excitement	0 1 2 3 4	0 1 2 3 4
Ringing in the ears	0 1 2 3 4	0 1 2 3 4
Difficulty concentrating	0 1 2 3 4	0 1 2 3 4
Avoid social activities	0 1 2 3 4	0 1 2 3 4
Feelings of well-being	0 1 2 3 4	0 1 2 3 4
Heart pounding	0 1 2 3 4	0 1 2 3 4
Distractible	0 1 2 3 4	0 1 2 3 4

Decreased efficiency	0 1 2 3 4	0 1 2 3 4
Bursts of energy, activity	0 1 2 3 4	0 1 2 3 4
Numbness, tingling	0 1 2 3 4	0 1 2 3 4
Minor accidents	0 1 2 3 4	0 1 2 3 4
Blind spots, fuzzy vision	0 1 2 3 4	0 1 2 3 4
Poor motor coordination	0 1 2 3 4	0 1 2 3 4
Increased appetite	0 1 2 3 4	0 1 2 3 4
Crave specific foods	0 1 2 3 4	0 1 2 3 4

44. How would you say your experience of menstrual symptoms IN THE PAST MONTH compares to your overall experience of symptoms as rated above?

___ my symptoms in the past month were less severe than what I rated above
___ my symptoms in the past month were similar to what I rated above
___ my symptoms in the past month were more severe than what I rated above

45. When not using hormonal contraceptives (ie., birth control pill, patch, ring, injection)....

a) Has one or more symptoms associated with your menstrual cycle (such as those above) caused a reduction of productivity or inefficiency at work, school, or home?

No	Yes - Mild	Yes - Moderate	Yes – Severe
0	1	2	3

b) If yes, how frequently does this occur?

Rarely	A few times a year	About half the time	Most cycles	Every cycle
1	2	3	4	5

c) Has one or more symptoms associated with your menstrual cycle interfered with hobbies or social activities?

No	Yes - Mild	Yes - Moderate	Yes – Severe
0	1	2	3

d) If yes, how frequently does this occur?

Rarely	A few times a year	About half the time	Most cycles	Every cycle
1	2	3	4	5

e) Has one or more symptoms associated with your menstrual cycle interfered with your relationships with others?

No	Yes - Mild	Yes - Moderate	Yes – Severe
0	1	2	3

f) If yes, how frequently does this occur?

Rarely	A few times a year	About half the time	Most cycles	Every cycle
1	2	3	4	5

CONTRACEPTION

46. Which category best describes your use of oral contraceptives (the birth control pill)?

___ I've never used the birth control pill
___ I'm currently using the birth control pill
___ I'm not currently using the birth control but I have in the past

47. Which category best describes your use of hormonal contraceptives other than the birth control pill? Examples of hormonal contraceptives are injectable contraceptives (Depo Provera, Lunelle), the vaginal ring (NuvaRing), the contraceptive patch (Evra), contraceptive implants (Norplant), and hormonal IUDs (Mirena).

___ I've never used a non-pill hormonal contraceptive
___ I'm currently using a non-pill hormonal contraceptive
___ I'm not currently using a non-pill hormonal contraceptive but I have in the past

48. Some women who use oral contraceptives (birth control pills) experience side effects. Side effects are changes in physical, emotional, and sexual functioning that can be either *positive* or *negative*. We would like to learn about any changes that you have experienced due to oral contraceptives.

Please read the following list of side effects and choose either NO, YES, or MAYBE to indicate whether you have experienced a change in the item as a result of using oral contraceptives

a) in the past month (current users only)
b) ever, during the entire time of oral contraceptive use (current and past users)

If you have noticed any of these changes in yourself, only check YES or MAYBE if your experience is due to oral contraceptive use and reflects a change from when you did not use oral contraceptives.

If you choose YES or MAYBE, please indicate the amount and direction of change as compared to when you did not use oral contraceptives:

A	B	C	D	E	F
Large Decrease	Moderate Decrease	Mild Decrease	Mild Increase	Moderate Increase	Large Increase

Change In:	a) Past Month		b) Ever During Use	
	No Yes Maybe	*Change*	*No Yes Maybe*	*Change*
1) Bloating/swelling	N Y M	A B C D E F	N Y M	A B C D E F
2) Dizziness/faintness	N Y M	A B C D E F	N Y M	A B C D E F
3) Amount of menstrual bleeding (period)	N Y M	A B C D E F	N Y M	A B C D E F
4) Painful/tender breasts	N Y M	A B C D E F	N Y M	A B C D E F
5) Nausea/vomiting	N Y M	A B C D E F	N Y M	A B C D E F
6) Headaches	N Y M	A B C D E F	N Y M	A B C D E F
7) Weight	N Y M	A B C D E F	N Y M	A B C D E F
8) Breast size	N Y M	A B C D E F	N Y M	A B C D E F
9) Breakthrough bleeding/spotting (bleeding between periods)	N Y M	A B C D E F	N Y M	A B C D E F
10) Migraines	N Y M	A B C D E F	N Y M	A B C D E F
11) Facial hair growth	N Y M	A B C D E F	N Y M	A B C D E F
12) Tiredness/fatigue	N Y M	A B C D E F	N Y M	A B C D E F
13) Acne/pimples	N Y M	A B C D E F	N Y M	A B C D E F
14) Facial skin discolouration /dark blotches on face (melasma)	N Y M	A B C D E F	N Y M	A B C D E F
15) Leg cramps	N Y M	A B C D E F	N Y M	A B C D E F
16) Vaginal dryness	N Y M	A B C D E F	N Y M	A B C D E F
17) Amount of sleep	N Y M	A B C D E F	N Y M	A B C D E F
18) Disrupted sleep	N Y M	A B C D E F	N Y M	A B C D E F
19) Difficulty falling asleep	N Y M	A B C D E F	N Y M	A B C D E F
20) Feeling tired/unrefreshed after a full night's sleep	N Y M	A B C D E F	N Y M	A B C D E F
21) Clumsiness	N Y M	A B C D E F	N Y M	A B C D E F
22) Diarrhea	N Y M	A B C D E F	N Y M	A B C D E F
23) Constipation	N Y M	A B C D E F	N Y M	A B C D E F
24) Frequency of urination	N Y M	A B C D E F	N Y M	A B C D E F
25) Hot flashes/cold sweats	N Y M	A B C D E F	N Y M	A B C D E F
26) Food cravings	N Y M	A B C D E F	N Y M	A B C D E F
27) Appetite	N Y M	A B C D E F	N Y M	A B C D E F
28) Food intake (eating)	N Y M	A B C D E F	N Y M	A B C D E F
29) PMS symptoms	N Y M	A B C D E F	N Y M	A B C D E F
30) Memory problems	N Y M	A B C D E F	N Y M	A B C D E F
31) Problems concentrating	N Y M	A B C D E F	N Y M	A B C D E F
32) Impulsivity	N Y M	A B C D E F	N Y M	A B C D E F
33) Feeling self-conscious	N Y M	A B C D E F	N Y M	A B C D E F
34) Affectionate	N Y M	A B C D E F	N Y M	A B C D E F
35) Feeling sociable	N Y M	A B C D E F	N Y M	A B C D E F
36) Loneliness	N Y M	A B C D E F	N Y M	A B C D E F
37) Feeling active	N Y M	A B C D E F	N Y M	A B C D E F
38) Short-tempered	N Y M	A B C D E F	N Y M	A B C D E F
39) Not feeling like myself	N Y M	A B C D E F	N Y M	A B C D E F

40) Frustration	N Y M	A B C D E F	N Y M	A B C D E F
41) Irritability	N Y M	A B C D E F	N Y M	A B C D E F
42) Jealousy	N Y M	A B C D E F	N Y M	A B C D E F
43) Optimism	N Y M	A B C D E F	N Y M	A B C D E F
44) Sense of well-being	N Y M	A B C D E F	N Y M	A B C D E F
45) Depression	N Y M	A B C D E F	N Y M	A B C D E F
46) Moodiness	N Y M	A B C D E F	N Y M	A B C D E F
47) Feeling unmotivated	N Y M	A B C D E F	N Y M	A B C D E F
48) Pessimistic	N Y M	A B C D E F	N Y M	A B C D E F
49) Contentment/happiness	N Y M	A B C D E F	N Y M	A B C D E F
50) Elation	N Y M	A B C D E F	N Y M	A B C D E F
51) Sadness	N Y M	A B C D E F	N Y M	A B C D E F
52) Feelings of inferiority	N Y M	A B C D E F	N Y M	A B C D E F
53) Stable mood	N Y M	A B C D E F	N Y M	A B C D E F
54) Sensitivity to criticism	N Y M	A B C D E F	N Y M	A B C D E F
55) Calmness	N Y M	A B C D E F	N Y M	A B C D E F
56) Critical of self	N Y M	A B C D E F	N Y M	A B C D E F
57) Critical of others	N Y M	A B C D E F	N Y M	A B C D E F
58) In control of life	N Y M	A B C D E F	N Y M	A B C D E F
59) Aggressive feelings	N Y M	A B C D E F	N Y M	A B C D E F
60) Feeling capable	N Y M	A B C D E F	N Y M	A B C D E F
61) Thoughts of suicide	N Y M	A B C D E F	N Y M	A B C D E F
62) Trust in romantic partner	N Y M	A B C D E F	N Y M	A B C D E F
63) Confidence	N Y M	A B C D E F	N Y M	A B C D E F
64) Focus	N Y M	A B C D E F	N Y M	A B C D E F
65) Nervousness	N Y M	A B C D E F	N Y M	A B C D E F
66) Feeling excited about the future	N Y M	A B C D E F	N Y M	A B C D E F
67) Worrying	N Y M	A B C D E F	N Y M	A B C D E F
68) Determination	N Y M	A B C D E F	N Y M	A B C D E F
69) Crying	N Y M	A B C D E F	N Y M	A B C D E F
70) Concern about body shape/size	N Y M	A B C D E F	N Y M	A B C D E F
71) Self-esteem	N Y M	A B C D E F	N Y M	A B C D E F
72) Pain/discomfort during sex	N Y M	A B C D E F	N Y M	A B C D E F
73) Sexual enjoyment	N Y M	A B C D E F	N Y M	A B C D E F
74) Vaginal lubrication	N Y M	A B C D E F	N Y M	A B C D E F
75) Feeling sexually attractive	N Y M	A B C D E F	N Y M	A B C D E F
76) Ability to become sexually aroused (with partner)	N Y M	A B C D E F	N Y M	A B C D E F
77) Ability to become sexually aroused (alone)	N Y M	A B C D E F	N Y M	A B C D E F
78) Desire for sex with others	N Y M	A B C D E F	N Y M	A B C D E F
79) Desire to masturbate	N Y M	A B C D E F	N Y M	A B C D E F
80) Frequency of masturbation	N Y M	A B C D E F	N Y M	A B C D E F
81) Sexual thoughts	N Y M	A B C D E F	N Y M	A B C D E F
82) Ability to orgasm	N Y M	A B C D E F	N Y M	A B C D E F
83) Initiation of sexual activity	N Y M	A B C D E F	N Y M	A B C D E F

49. Have you ever experienced any of the following with oral contraceptive use:

___ change in body shape
___ hives/allergic reaction
___ difficulty with contact lenses
___ vision changes
___ susceptibility to infection

50. Please list any additional side effects you have experienced while using oral contraceptives:

If you are currently using oral contraceptives (birth control pills), please answer the following questions:

51. What brand of oral contraceptive are you currently taking (please check)?

Alesse	___	Ortho-Cept	___
Brevicon 0.5/35	___	Ortho 7/7/7	___
Brevicon 1/35	___	Ortho 10/11	___
Cyclen	___	Synphasic	___
Demulen 30	___	Tri-Cyclen	___
Seasonale	___	Tri-Cyclen Lo	___
Loestrin 20	___	Triphasil	___
Loestrin 24 Fe	___	Loestrin 30	
Marvelon	___	Triquilar	___
MinEstrin	___	Demulen 50	___
Min-Ovral	___	Norlestin 1/50	___
Norinyl	___	Ovral	___
Ortho 1/35	___	Ortho-Novum 1/50	___
Ortho 0.5/35	___	Diane 35	___
Yasmin	___	Linessa	___
Femcon FE	___	Micronor	___
Mircette	___	Nordette/Levora	___
Portia	___	Seasonique	___
Select	___	Yaz	___

Other (Please Specify): _____

52. How long have you been using your current brand of oral contraceptive?

____ years ____ months

53. How long in total you used any oral contraceptive?

____ years ____ months

54. If you are <u>not currently</u> using a hormonal contraceptive (e.g., birth control pill, injection) but <u>have in the past</u>, how long has it been since you stopped using the hormonal contraceptive?
____ years ____ months

55. How did you choose the brand of oral contraceptive you are currently taking?
___ Doctor recommended it (but I don't know why)
___ Doctor recommended because of side effects I had with another brand
___ Doctor recommended because of symptoms I had before taking the pill (ie., acne, PMS)
___ I requested this brand because I know other people who take it
___ I requested this brand because of advertisements
___ I requested this brand after researching brands of birth control pill
___ I requested this brand because of affordability (low price)
___ Other (Specify:)_____

56.
a) Which option best describes how you take your oral contraceptive pills:
___ I always take my pill within the same 2-hour window every day
___ I usually take my pill within the same 2-hour window every day
___ I take my pill within the same 2-hour window about half the time
___ I usually take my pill at different times of the day
b) Which option best describes how you take your oral contraceptive pills:
___ I never miss a pill
___ I rarely miss a pill, maybe once or twice a year
___ Every few months or so I miss a pill
___ I usually miss a pill every month
___ I usually miss more than one pill every month

c) Which option best describes how you take your oral contraceptive pills:
___ I usually take my pill in the early morning
___ I usually take my pill in the late morning
___ I usually take my pill in the early afternoon
___ I usually take my pill in the late afternoon
___ I usually take my pill in the early evening
___ I usually take my pill in the late evening
___ I usually take my pill at no fixed time

57. If you miss a pill, how/when do you take it?
___ As soon as I remember
___ I take it with the next regularly scheduled pill (I take two at once)
___ I don't take it at all

58. What phase of your oral contraceptives are you currently in?
___ Week 1 of active pills

___ Week 2 of active pills
___ Week 3 of active pills
___ Pill-free/Inactive/Sugar pill week (when most women have their period)
___ I take my pills continuously so I don't get my period

59. Why are you currently taking oral contraceptives (check all that apply)?

___ Birth control
___ For cycle regularity
___ To treat acne
___ I am taking another medication that can cause birth defects
___ Due to a hormonal medical condition (Specify):_____
___ Other (Specify:)_____

60. Please check all brands of oral contraceptives you have used:

Alesse	____	Ortho-Cept	____
Brevicon 0.5/35	____	Ortho 7/7/7	____
Brevicon 1/35	____	Ortho 10/11	____
Cyclen	____	Synphasic	____
Demulen 30	____	Tri-Cyclen	____
Seasonale	____	Tri-Cyclen Lo	____
Loestrin 20	____	Triphasil	____
Loestrin 24 Fe	____	Loestrin 30	
Marvelon	____	Triquilar	____
MinEstrin	____	Demulen 50	____
Min-Ovral	____	Norlestin 1/50	____
Norinyl	____	Ovral	____
Ortho 1/35	____	Ortho-Novum 1/50	____
Ortho 0.5/35	____	Diane 35	____
Yasmin	____	Linessa	____
Femcon FE	____	Micronor	____
Mircette	____	Nordette/Levora	____
Portia	____	Seasonique	____
Select	____	Yaz	____

Other (Please Specify): _____
Can't recall _____

61. Indicate the reason(s) why you changed brands of oral contraceptive (Check all that apply):

___ Bothered by side effects
___ Brand was discontinued/hard to get
___ Switched to a less expensive brand
___ Switched to a brand that is supposed to have positive effects (i.e., less acne, lighter periods)

___ I stopped using oral contraceptives and was prescribed a new brand when I started again
___ Other (Specify): _____

62. At what age did you first start using oral contraceptives?
___ years

63. If you have every stopped using a brand of oral contraceptive, please indicate why you stopped (Check all that apply).
____ I had physical side effects that bothered me
____ I had mood side effects that bothered me
____ I had sexual side effects that bothered me
____ I didn't feel like myself
____ I felt like I was pregnant
____ My sexual relationship ended
____ I was in a long distance relationship
____ I didn't want to be using hormones for an extended period
____ I wanted to become pregnant
____ I had an allergic reaction to my oral contraceptive
____ I switched to another type of hormonal contraceptive
____ Oral contraceptives conflicted with another medication I was taking
____ I found them too hard to use/too much work
____ Oral contraceptives were too expensive
____ My partner/family disagreed with my use of oral contraceptives
____ My doctor recommended I stop taking oral contraceptives
____ Other (Specify):_____

64. If you have ever taken oral contraceptives, please choose the best response from the options below.

a) I believe that oral contraceptives have affected my mood and emotions...

Very Negatively	Slightly Negatively	In No Way at All	Slightly Positively	Very Positively
-2	-1	0	1	2

b) I believe that oral contraceptives have affected my physical health...

Very Negatively	Slightly Negatively	In No Way at All	Slightly Positively	Very Positively
-2	-1	0	1	2

c) I believe that oral contraceptives have affected my sexual functioning (e.g., arousal, sex drive)...

Very Negatively	Slightly Negatively	In No Way at All	Slightly Positively	Very Positively
-2	-1	0	1	2

65. If you are <u>currently</u> taking a hormonal contraceptive other than the oral contraceptive pill, please indicate which type:

___ Injectable contraceptive (Depo Provera, Lunelle)
___ Contraceptive patch (Ortho Evra)
___ Vaginal ring (NuvaRing)
___ Hormonal implants (Norplant)
___ Hormonal IUD (Mirena)
___ Other (Specify): _____

66. Please indicate ANY hormonal contraceptives you have EVER used:

___ Injectable contraceptive (Depo Provera, Lunelle)
___ Contraceptive patch (Ortho Evra)
___ Vaginal ring (NuvaRing)
___ Hormonal implants (Norplant)
___ Hormonal IUD (Mirena)
___ Other (Specify): _____

67. Please describe any physical, emotional, and sexual side effects you experienced while taking hormonal contraceptives other than the oral contraceptive pill:

_____

68. Has anyone in your biological family (e.g., mother, sister) experienced side effects when using oral contraceptives?

___ I don't know
___ no
___ yes

<u>CURRENT DRUG AND ALCOHOL USE</u>

For all questions, please choose the option that BEST reflects your answer for the period of the LAST 3 MONTHS.

Within the past 3 months...

69. How often did you consume alcohol?

___ never (0)
___ once or twice a month or less (1)
___ once or twice a week (2)
___ three to four times a week (3)
___ almost every day (4)

70. What is the average number of drinks you had in the last 3 months, when/if you drank?

One drink equal 12 ounces of beer (standard bottle/can), 4 ounces of wine (half a standard wine glass), or 1 ounce of liquor (standard shot glass).

___ drinks

71. In the last 3 three months, how often did you wake up in the morning with a "hangover" due to alcohol use the previous night?

___ never (0)
___ one to three times a month or less (1)
___ four to eight times a month (2)
___ twelve to eight times a month (3)
___ most mornings (4)

72. In the last 3 months, how many times have you consumed so much alcohol that you vomited?

___ never (0)
___ one to three (1)
___ four to seven (2)
___ eight to twelve (3)
___ more than twelve (4)

73. In the last 3 months, how often did you skip meals when you consumed alcohol?

___ never (0)
___ 25% of the time or less (1)
___ about 50% of the time (2)
___ about 75% of the time (3)
___ almost every time I drink (4)

74. In the last 3 months, how often have you typically used cannabis (i.e., marijuana, pot, weed, hash, oil)?

___ never (0)
___ once or twice a month or less (1)
___ once or twice a week (2)
___ three to four times a week (3)
___ almost every day (4)

75. In the last 3 months, how often have you typically used recreational/illegal drugs <u>other than marijuana or hash,</u> (e.g., cocaine, ecstasy, mushrooms), or used prescription drugs for recreational purposes?

___ never
___ once or twice a month or less
___ once or twice a week
___ three to four times a week
___ almost every day

76. During the past 30 days, how many times have you consumed <u>5 or more drinks on one occasion</u>? _____ times

77. Choose the option that best describes your cigarette smoking status:

___ never smoked
___ previous smoker

___ previous casual/social smoker
___ current smoker
___ current casual/social smoker

78. How many cigarettes on average do you smoke per day? _____

79. For how many years have you smoked cigarettes? _____ years

80. In the last 3 months, please indicate the average number of each type of caffeinated beverage you consumed in a day:

1 beverage = 12 oz beverages (e.g., medium Tim Hortons, tall Starbucks, 375 mL can of pop/soda)

___ coffee
___ tea
___ hot chocolate/flavoured cappuccino
___ pop/soda
___ iced tea
___ caffeinated energy drink
___ other (Specify):_____

81. Compared to other people, how sensitive do you think you are to the effects of caffeine (please circle one)?

0	1	2	3	4	5	6
Not sensitive at all			Average sensitivity			Extremely sensitive

RELATIONSHIPS AND SEX

82. Check the box that best describes your current relationship status:

___ married or living with steady partner
___ steady partner but living apart
___ more than one partner
___ casually dating
___ no partner (single)
___ other (Specify):_____

83. If you are currently in a steady relationship, how long have you and your partner be together
(in years and months)?

_____ years and _____ months

84. Please answer all of the following questions honestly.

a) With how many different partners have you had sex (sexual intercourse) within the past year? _____

b) How many different partners do you foresee yourself having sex with during the next five years? (Please give a *specific, realistic* estimate) _____

c) With how many different partners have you had sex on *one and **only one*** occasion?

_____

d) How often do (did) you fantasize about having sex with someone other than your current (most recent) dating partner? (Circle one. **If you have not been in a dating relationship then leave this question blank**.)

1. Never
2. Once every two or three months
3. Once a month
4. Once every two weeks
5. Once a week
6. A few times each week
7. Nearly every day
8. At least once a day

e) Sex without love is OK.

I Strongly Disagree								I Strongly Agree
1	2	3	4	5	6	7	8	9

f) I can imagine myself being comfortable and enjoying "casual" sex with different partners.

I Strongly Disagree								I Strongly Agree
1	2	3	4	5	6	7	8	9

g) I would have to be closely attached to someone (both emotionally and psychologically) before I could feel comfortable and fully enjoy having sex with him/her.

I Strongly Disagree								I Strongly Agree
1	2	3	4	5	6	7	8	9

h) How frequently do you think about sex?

Virtually Never								Almost all of the time
1	2	3	4	5	6	7	8	9

i) During the past year, with how many <u>different</u> partners have you had any kind of physical sexual contact (e.g., kissing, sexual touching, oral sex, intercourse)?_____

85. Rate your sexual orientation on the following scale:

I am only attracted to people of the opposite sex			I am equally attracted to people of both sexes			I am only attracted to people of the same sex as me		
1	2	3	4	5	6	7	8	9

Appendix B

Experiences Scale Items, Subscales, and Alternate Scoring

Subscale	Items
Physical	Bloating/swelling
	Dizziness/faintness
	Amount of menstrual bleeding (period)[1]
	Painful/tender breasts
	Nausea/vomiting
	Headaches
	Weight loss[2]
	Breast size increase[2]
	Breast size decrease[2]
	Breakthrough bleeding/spotting (bleeding between periods)
	Migraines
	Facial hair growth
	Tiredness/fatigue
	Acne/pimples
	Facial skin discolouration/dark blotches on face (melasma)
	Leg cramps
	Vaginal dryness
	Sleeping less than usual
	Sleeping more than usual
	Disrupted sleep

Physical con't	Difficulty falling asleep
	Feeling tired/unrefreshed after a full night's sleep
	Clumsiness
	Diarrhea
	Constipation
	Frequent urination
	Hot flashes/cold sweats
	Food cravings
	Appetite increase
	Appetite decrease[2]
	PMS symptoms
	Increased food intake (eating)
	Decreased food intake (eating)[2]
Emotional/Cognitive	Memory problems
	Problems concentrating
	Impulsive
	Self-conscious
	Affectionate*
	Sociable*
	Lonely
	Active*
	Short-tempered
	Not feeling like myself

Emotional/Cognitive	Frustrated
con't	Irritable
	Jealous
	Optimistic*
	Sense of well-being*
	Depressed
	Moody
	Unmotivated
	Pessimistic
	Content/happy*
	Elated*
	Sad
	Feeling inferior
	Stable mood*
	Sensitive to Criticism
	Calm*
	Critical of self
	Critical of others
	In control of life*
	Aggressive feelings
	Capable*
	Thoughts of suicide
	Trusting of romantic partner*

Emotional/Cognitive con't	Confident
	Focused*
	Nervous
	Excited about the future*
	Worried
	Determined*
	Crying
	Concerned about body shape/size
	Self-esteem[3]
Sexuality/Libido	Pain/discomfort during sex
	Enjoyment of sex*
	Vaginal lubrication*
	Feeling sexually attractive*
	Ability to become sexually aroused (with partner)*
	Ability to become sexually aroused (alone)*
	Desire for sex with others[4]
	Desire to masturbate[4]
	Frequency of masturbation[4]
	Sexual thoughts[5]
	Ability to orgasm[6]
	Initiation of sexual activity[6]

* Indicates a reverse-scored item

Note: 1. Menstrual bleeding period: Responses of *mild*, *moderate*, and *strong* were scored as 0, as they indicated a regular experience with the menstrual cycle. Responses of *Not at All* and *Severe/Extreme* were scored as 1, as they indicate irregular cycles or very heavy menses.

2. These items were not scored, as they are difficult to categorize as either negative or positive, but will be examined separately.

3. Responses to Self-esteem (item 80) were be scored as follows: *Extremely Low (-3), Moderately Low (-2), Mildly Low (-1), Mildly High (1), Moderately High (2), Extremely High (3).*

4. Responses to these items were scored as follows: *Never (0), 1-2 times per month (1), 1 time per week (2), 2-3 times per week (3), 4-5 times per week (4), 6-7 times per week (5), More than once a day (6).*

5. Responses to this item were scored as follows: *Never (0), Once a month (1), A few times a month (3), Once a week (4), 2-3 times per week (5), 4-5 times per week (6), every day or almost every day (7), 2-3 times per day (8), 4 or more times per day (9).*

6. Responses to these times will be score as follows: *Never/I don't care about having orgasms (0), Rarely (1), Sometimes (2), Often (3), Usually (4), Always (5).*

Appendix C

LABORATORY QUESTIONNAIRE

Today' Date:_____

Participant code:

Please follow these instructions and the example to create your Participant Code. This will help us track you as you complete the various portions of the study. Answer the questions in order, and place the responses one-by-one in the box below. Your 5 letter and number responses will create your 7-digit Participant Code. You do not need to remember this code because we will ask you these questions on each occasion that you participate in the study.

1. What is the second letter of your first name? ____
   ex: Jane
2. On what day of the month you were born? (i.e., from 01 to 31) ____
   ex: June 09th
3. What is the first letter of your last name? ____
   ex: Doe
4. In what month were you born? (i.e., from 01 to 12) ____
   ex: 06 (June)
5. What is the third letter of the city where you were born? ____
   ex: Sudbury

   Example code: J09D06D
   Place your 5 responses (7 letters/numbers) in order here: _____

1. How many hours of sleep did you get last night? _____ hours

2. What time did you wake up this morning? _____ hours

3. This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now, that is, at the present moment. Use the following scale to record your answers.

1	2	3	4	5
very slightly/not at all	a little	moderately	quite a bit	extremely

____ interested ____ irritable

____ distressed	____ alert
____ excited	____ ashamed
____ upset	____ inspired
____ strong	____ nervous
____ guilty	____ determined
____ scared	____ attentive
____ hostile	____ jittery
____ enthusiastic	____ active
____ proud	____ afraid

4. Below is a list of problems that people sometimes have. Please read each one carefully, and circle the letter that best describes HOW MUCH THAT PROBLEM HAS DISTRESSED OR BOTHERED YOU DURING THE PAST 7 DAYS INCLUDING TODAY.

	Not At All	A Little Bit	Moderately	Quite A Bit	Extremely
1. Nervousness or shakiness inside	0	1	2	3	4
2. Loss of sexual interest or pleasure	0	1	2	3	4
3. Feeling low in energy or slowed down	0	1	2	3	4
4. Thoughts of ending your life	0	1	2	3	4
5. Trembling	0	1	2	3	4
6. Crying easily	0	1	2	3	4
7. Feelings of being trapped or caught	0	1	2	3	4
8. Suddenly scared for no reason	0	1	2	3	4
9. Blaming yourself for things	0	1	2	3	4
10. Feeling lonely	0	1	2	3	4
11. Feeling blue	0	1	2	3	4
12. Worrying too much about things	0	1	2	3	4
13. Feeling no interest in things	0	1	2	3	4
14. Feeling fearful	0	1	2	3	4
15. Heart pounding or racing	0	1	2	3	4
16. Feeling hopeless about the future	0	1	2	3	4
17. Feeling tense or keyed up	0	1	2	3	4
18. Feeling everything is an effort	0	1	2	3	4
19. Spells of terror or panic	0	1	2	3	4
20. Feeling so restless you couldn't sit still	0	1	2	3	4
21. Feelings of worthlessness	0	1	2	3	4
22. The feeling that something bad	0	1	2	3	4

is going to happen to you					
23. Thoughts and images of a frightening nature	0	1	2	3	4

5. Please indicate the extent to which you agree with each of the following statements <u>right now, at this very moment</u>. Choose from the following options:

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	I have an intense desire to eat [one or more specific foods].	SD	D	N	A	SA
2.	Eating [one or more specific foods] would make things seem just perfect.	SD	D	N	A	SA
3.	If I ate something, I wouldn't feel so sluggish and lethargic.	SD	D	N	A	SA
4.	If I had [one or more specific foods], I could not stop eating it.	SD	D	N	A	SA
5.	I am hungry.	SD	D	N	A	SA
6.	I'm craving [one or more specific foods].	SD	D	N	A	SA
7.	If I were to eat what I am craving, I am sure my mood would improve.	SD	D	N	A	SA
8.	Satisfying my craving would make me feel less grouchy and irritable.	SD	D	N	A	SA
9.	My desire to eat [one or more specific foods] seems overpowering.	SD	D	N	A	SA
10.	If I ate right now, my stomach wouldn't feel as empty.	SD	D	N	A	SA
11.	I have an urge for [one or more specific foods].	SD	D	N	A	SA
12.	Eating [one or more specific foods) would feel wonderful.	SD	D	N	A	SA
13.	I would feel more alert if I could satisfy my craving.	SD	D	N	A	SA
14.	I know I'm going to keep on thinking about [one or more specific foods] until I actually have it.	SD	D	N	A	SA
15.	I feel weak because of not eating.	SD	D	N	A	SA

6. The following items ask about your attitudes, feelings, and behaviour. Some of the items relate to food or eating. Other items ask about your feelings about yourself. For each item, decide if the item is true about you ALWAYS (A), USUALLY (U), OFTEN (O), SOMETIMES (S), RARELY(R) or NEVER (N). Respond to all of the items, making sure that you choose the rating that is true about you.

		Always	Usually	Often	Sometimes	Rarely	Never
1.	I eat sweets and carbohydrates without feeling nervous.	A	U	O	S	R	N
2.	I think that my stomach is too big.	A	U	O	S	R	N
3.	I eat when I am upset.	A	U	O	S	R	N
4.	I stuff myself with food.	A	U	O	S	R	N
5.	I think about dieting.	A	U	O	S	R	N
6.	I think that my thighs are too large.	A	U	O	S	R	N
7.	I feel extremely guilty after overeating.	A	U	O	S	R	N
8.	I think that my stomach is just the right size.	A	U	O	S	R	N
9.	I am terrified of gaining weight.	A	U	O	S	R	N
10.	I feel satisfied with the shape of my body.	A	U	O	S	R	N
11.	I exaggerate or magnify the importance of weight.	A	U	O	S	R	N
12.	I have gone on eating binges where I felt that I could not stop.	A	U	O	S	R	N
13.	I like the shape of my buttocks.	A	U	O	S	R	N
14.	I am preoccupied with the desire to be thinner.	A	U	O	S	R	N
15.	I think about bingeing (overeating).	A	U	O	S	R	N
16.	I think my hips are too big.	A	U	O	S	R	N
17.	I feel bloated after eating a normal meal.	A	U	O	S	R	N
18.	I eat moderately in front of others and stuff myself when they're gone.	A	U	O	S	R	N
19.	If I gain a pound I worry that I will keep gaining.	A	U	O	S	R	N
20.	I have the thought of trying to vomit to lose weight.	A	U	O	S	R	N
21.	I think that my thighs are just the right size.	A	U	O	S	R	N
22.	I think that my buttocks are too large.	A	U	O	S	R	N
23.	I eat or drink in secrecy.	A	U	O	S	R	N
24.	I think that my hips are just the right size.	A	U	O	S	R	N
25.	When I am upset, I worry that I will start eating.	A	U	O	S	R	N

Appendix D

WOMEN'S HEALTH ACROSS TIME STUDY
COVER LETTER

Dear Potential Participant,

You are invited to participate in a study conducted by Ms. Jessica Bird and Dr. Kirsten Oinonen, of the Department of Psychology, at Lakehead University. Portions of this study will constitute the dissertation of Ms. Jessica Bird. The purpose of this study is to examine factors affecting women's health over time. Participation in this project will involve completing an online questionnaire three times over the course of one year and, for participants residing in Thunder Bay, a laboratory session where some body measurements will be taken. Some participants will also be asked to provide samples of saliva to be analyzed.

Students at Lakehead University will receive one bonus point towards their Introductory Psychology mark for completing each portion of this study, including the two online questionnaires that will occur during the academic year and the laboratory session, for a total of three bonus points.

The completion of the online questionnaire will take approximately 30 to 40 minutes. The questionnaire includes personal questions about topics such as: demographic information, health information, medical information, reproductive history, sexual behaviour, relationship information, personality and mood. Participation in this study is voluntary. You may decline to answer any question, and you may withdraw from the study at any time without penalty.

The possible benefits of this study include: a better understanding of one's own physical and mental health, learning about the research process, the receipt of bonus points towards Introductory Psychology, and contribution to research that will enhance the understanding of factors affecting women's health. The risks of this study are mild if any, but may include discomfort at answering personal questions.

All records of your participation will be kept in strict confidence and any reports of the study will not identify you as a participant. As per university requirements, all data will be stored for five years by Dr. Oinonen at Lakehead University and remain anonymous and confidential. This study is longitudinal, and we will need to contact you for the follow-up questionnaires and laboratory session. Therefore, we have asked for your name, email address, and phone number. Once you have completed the study, your name and email will be removed from your questionnaire and your information will remain both anonymous and confidential. There will be no way that your name can be connected to your responses.

If you have any questions or concerns regarding this study please contact Jessica Bird via email at whstudy@lakeheadu.ca, or Dr. Kirsten Oinonen by phone at 807-343-8096. If you would like to receive a summary of the findings by email once the study is complete, please send such a request to whstudy@lakeheadu.ca. This study has received ethics approval by the Lakehead University Research Ethics Board (807-766-7289). Please print a copy of this letter for your records.

Sincerely,

Jessica Bird, MA., Doctoral Candidate
Department of Psychology
Lakehead University
955 Oliver Road,
Thunder Bay, ON P7E 5E1
whstudy@lakeheadu.ca

Kirsten Oinonen, Ph.D., C. Psych.
Department of Psychology
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Appendix E

WOMEN'S HEALTH ACROSS TIME STUDY

CONSENT FORM A

Please read the following points regarding this study:

1. Your participation is voluntary, you may refuse to participate in any part of the study, and you may withdraw from the study at any time.
2. You may decline to answer any question.
3. This portion of the study consists of a questionnaire that will take approximately 30 to 40 minutes to complete.
4. There are no known serious risks involved in participating in this study.
5. The purpose of this research is to find out what factors are related to women's health. The benefits you may expect from the study are (a) an appreciation of research on health, (b) an opportunity to contribute to scientific research and (c) course credit (One bonus point for Introductory Psychology Students).
6. All of the data collected will remain strictly confidential, and will only be accessed by Jessica Bird, Dr. K. Oinonen, and members of Dr. Oinonen's lab group who have been trained in research ethics. Your name and contact information will only be used for the purposes of inviting you to participate in subsequent portions of the study. Your responses will not be associated with your name. Instead, your data will be associated with a code number when the researchers store the data. Data will be published in aggregate form and individual participants will not be identified.
7. The data will be securely stored for five years by Dr. K Oinonen at Lakehead University.
8. You may contact the researchers if you would like to receive a summary of the findings.

☐ **I have read and understand both the cover letter and the above points. I agree to participate in this study.**

Appendix F

WOMEN'S HEALTH ACROSS TIME STUDY

DEBRIEFING FORM A

Thank you for participating in the questionnaire phase of our study. Portions of this study constitute Jessica Bird's Ph.D. dissertation. You will be contacted approximately six months from now, and one year from now to complete this questionnaire again. You may also be contacted in the near future to participate in the laboratory phase of this study. Lakehead University Introductory Psychology students will receive an additional bonus mark for each part of the study in which they participate. Participants who complete all three online questionnaires will be entered in a draw for an *Apple 4GB iPod nano.*

Please be assured that once the study is completed all contact information will be removed and there will be no way to identify your responses. All of your responses will be coded to conceal your identity on the questionnaires and all data will remain anonymous. If you have any questions, please feel free to contact Jessica Bird or Dr. Oinonen at the contact information below. This study has received ethics approval by the Lakehead University Research Ethics Board (807-766-7289).

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Appendix G

WOMEN'S HEALTH ACROSS TIME STUDY

DEBRIEFING FORM B

Thank you for completing the second of three questionnaires that comprise the online portion of this study. We appreciate your participation in this project. You will be contacted in approximately six months from now to complete the last questionnaire. Participants who complete all three online questionnaires will be entered in a draw for an *Apple 4GB iPod nano.*

Please be assured that once the study is completed all contact information will be removed and there will be no way to identify your responses. All of your responses will be coded to conceal your identity on the questionnaires and all data will remain anonymous. If you have any questions, please feel free to contact Jessica Bird or Dr. Oinonen at the contact information below. This study has received ethics approval by the Lakehead University Research Ethics Board (807-766-7289).

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Appendix H

WOMEN'S HEALTH ACROSS TIME STUDY

DEBRIEFING FORM C

Thank you for completing the final online questionnaire. To show our appreciation for your participation in this study, your name will be entered in a draw for an *Apple 4GB iPod nano.* Now that the study is complete all contact information will be removed and there will be no way to connect your name with your responses. All of your responses will be coded to conceal your identity on the questionnaires and all data will remain anonymous.

The purpose of this study was to look at the relationship between hormones (such as those found in the birth control pill) and eating disorders symptoms over time. If you are interested in learning more, some relevant articles are listed below:

Klump, K.L., Gobrogge, K.L., Perkins, P.S., Thorne, D., Sisk, C.L., & Breedlove, S.M. (2006). Preliminary evidence that gonadal hormones organize and activate disordered eating. *Psychological Medicine, 36,* 539-546.

Culbert, K.M., Breedlove, S.M., Burt, S.A., & Klump, K.L. (2008). Prenatal hormone exposure and risk for eating disorders: A comparison of opposite-sex and same- sex twins. *Archives of General Psychiatry, 65*, 329-336.

Lester, N.A., Keel, P.K., & Lipson, S.F. (2003). Symptom fluctuation in bulimia nervosa: Relation to menstrual-cycle phase and cortisol levels. *Psychological Medicine, 33,* 51-60.

If you have any questions, please feel free to contact Jessica Bird or Dr. Oinonen at the contact information below. In addition, if you are interested n receiving a summary of the findings once the study is completed, please send such a request to whstudy@lakeheadu.ca. This study has received ethics approval by the Lakehead University Research Ethics Board (807-766-7289).

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Appendix I

WOMEN'S HEALTH ACROSS TIME STUDY
CONSENT FORM B

I agree to participate in this study that is investigating factors affecting women's health over time. I understand that my participation is entirely voluntary: I can leave the experiment at any time and this will have no bearing on the remuneration I will receive for that portion of the study, nor will it have any undesirable consequences.

The following points have been explained to me:

1. The purpose of this research is to find out what factors are related to women's health. The benefits I may expect from the study are (a) an appreciation of research on health, (b) an opportunity to contribute to scientific research and (c) course credit (One bonus point for Introductory Psychology Students).
2. The procedure will be as follows: During a single session, researchers will obtain the following body measurements: height, weight, hand measurements, waist and hip circumference.
3. There are no known serious risks involved in participating in this study.
4. All of the data collected will remain strictly confidential. My responses will not be associated with my name. Instead, my data will be associated with a code number when the researchers store the data.
5. If I have any other questions or concerns, I can address them to Jessica Bird (whstudy@lakeheadu.ca) or Dr. Kirsten Oinonen 343-8096, (koinonen@lakeheadu.ca).
6. This study has been approved by the Lakehead University Research Ethics Board (807-766-7289).

_____
Participant's Name (Please print)

_____ _____
Participant's Signature Date

Appendix J

WOMEN'S HEALTH ACROSS TIME STUDY

DEBRIEFING FORM D

Principal Investigators:

Dr. K. Oinonen,
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Ms. Jessica Bird, PhD Candidate,
Psychology Department
Lakehead University
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whstudy@lakeheadu.ca

We appreciate your participation in our study, and thank you for spending your time to help us with our research. For those participants who provided salivary samples, please remember to e-mail the experimenter (whstudy@lakeheadu.ca) with the start date of your next menstrual period. The experimenter may also contact you about this information.

We hope that you have enjoyed participating in our study. Please be assured that once the study is completed all contact information will be removed and there will be no way to identify your information. Please feel free to contact either Jessica Bird or Dr. Oinonen if you have any further questions or concerns about this study. This study has been approved by the Lakehead University Research Ethics Board (807-766-7289).

Appendix K

WOMEN'S HEALTH ACROSS TIME STUDY
CONSENT FORM C

I agree to participate in this study that is investigating factors affecting women's health over time. I understand that my participation is entirely voluntary: I can leave the experiment at any time and this will have no bearing on the remuneration I will receive for this portion of the study, nor will it have any undesirable consequences. I am not required to answer any questions I do not feel comfortable with.

The following points have been explained to me:

1. The purpose of this research is to find out what factors are related to women's health. The benefits I may expect from the study are (a) an appreciation of research on health, (b) an opportunity to contribute to scientific research and (c) course credit (One bonus point for Introductory Psychology Students).
2. The procedure will be as follows: During a single session, researchers will obtain a saliva sample, body measurements (height, weight, hand measurements, waist and hip circumference), and I will fill out a paper-and-pencil questionnaire.
3. There are no known serious risks involved in participating in this study.
4. All of the data collected will remain strictly confidential. My responses will not be associated with my name. Instead, my data will be associated with a code number when the researchers store the data.
5. If I have any other questions or concerns, I can address them to Jessica Bird (whstudy@lakeheadu.ca) or Dr. Kirsten Oinonen 343-8096, (koinonen@lakeheadu.ca).
6. This study has been approved by the Lakehead University Research Ethics Board (807-766-7289).

_____
Participant's Name (Please print)

_____ _____
Participant's Signature Date

Appendix L

Comparison of Complete and Incomplete Responders to the EDI-3 at Time 1

Variable	*M* (*SD*)	*t*	*df*	*p*	*N*
Depression Score		1.63	615	.288	
Complete	12.86 (9.26)				571
Incomplete	11.37 (7.62)				46
Anxiety Score		1.274	628	.203	
Complete	6.51 (6.07)				582
Incomplete	5.35 (5.33)				48
Bulimia Score		.670	621	.503	
Complete	2.96 (1.03)				589
Incomplete	2.84 (0.93)				34
Drive for Thinness Score		-.638	615	.524	
Complete	16.84 (10.00)				589
Incomplete	18.07 (10.37)				34
Body Dissatisfaction Score		1.337	612	.080	
Complete	23.96 (11.00)				589
Incomplete	20.04 (9.44)				25
OC Physical Side Effects Score (Ever Use)		-.082	204	.935	
Complete	11.63 (12.58)				188
Incomplete	11.89 (13.92)				18
OC Emotional Side Effects Score (Ever Use)		.540	201	.590	
Complete	10.72 (21.34)				185
Incomplete	7.89 (20.44)				18
OC Sexual Side Effects Score (Ever Use)		.747	234	.456	
Complete	3.66 (7.41)				218
Incomplete	2.33 (4.67)				18
BMI		.350	611	.727	
Complete	24.02 (5.52)				568
Incomplete	23.72 (4.67)				45
Age (using estimated age data)		-.315	524	.753	
Complete	20.43 (3.12)				471
Incomplete	20.57 (3.04)				55

Note. Given that participants with and without missing EDI-3 data did not differ on any of the variables examined, subscale scores for participants with missing data were not calculated.

Appendix M

Internal Consistency of OC Side Effect Scales at Time 1 for Ratings of Side Effects Reported for Past Month and Ever During Use

	Number of Items	*N*	Cronbach's Alpha
Past Month			
OC Physical Side Effects	29	250	.858
OC Emotional Side Effects	42	257	.857
OC Sexual Side Effects	12	277	.884
Ever During Use			
OC Physical Side Effects	29	208	.865
OC Emotional Side Effects	42	204	.894
OC Sexual Side Effects	12	239	.891

Appendix N

Correlations Between EDI-3 Subscale Scores and Hormonal Variables

	BUL	DT	BD	PSE	ESE	SSE	HS	DR
BUL	___	.641***	.585***	.275***	.255***	.228***	.252***	-.010
N =		608	603	245	253	272	473	129
DT		___	.706***	.188**	.203***	.163***	.134**	-.017
N =			598	241	249	268	469	132
BD			___	.177**	.127*	.063	.120**	.039
N =				240	249	266	467	133
PSE				___	.720***	.509***	.181**	-.145
N =					214	225	213	58
ESE					___	.630***	.215***	-.166
N =						246	221	64
SSE						___	.148*	-.140
N =							236	65
HS							___	.025
N =								111
DR								___

Note. BUL = Bulimia subscale score, DT = Drive for Thinness subscale score, BD = Body Dissatisfaction subscale score, PSE = OC Physical Side Effects score, ESE = OC Emotional Side Effects score, SSE = OC Sexual Side Effects score, HS = Hormonal Sensitivity score, DR = Right 2D:4D. Pearson correlations are presented for all variables except the dichotomous OC Sexual Side Effects score, where Spearman correlations are presented.

* $p < .05$. ** $p < .01$. *** $p \leq .001$.

Appendix O

Means and Standard Deviations (Untransformed Values) of Key Variables for Lab Participants in Study 2 (N = *52*)

	M (*SD*)	Minimum	Maximum
Bulimia Subscale	12.15 (8.76)	1.00	33.00
Drive for Thinness Subscale	18.19 (8.00)	5.00	34.00
Body Dissatisfaction Subscale	20.88 (7.28)	4.00	40.00
Depression Scale	5.79 (5.98)	0.00	33.00
Anxiety Scale	2.67 (3.91)	0.00	25.00
BMI	24.43 (8.72)	16.61	41.47

Appendix P

Multiple Regressions Examining the Explanation of Body Dissatisfaction and Bulimia Scores by Salivary Estradiol and Testosterone Levels

Predictors	Body Dissatisfaction (Post-Menses Phase, $N = 31$)		Body Dissatisfaction (Mid-Luteal Phase, $N = 14$)	
	ΔR^2	β	ΔR^2	β
Step 1	.04		.47*	
Salivary Estradiol		.18		-.31
Salivary Testosterone		-.12		.68*
Total R^2	.04		.47*	
F	0.608		4.775	
Df	2, 27		2, 13	
Step 1	.26*		.21	
BMI		.55**		.12
Waist/Hip Ratio		-.02		.44
Step 2	.04		.52*	
Salivary Estradiol		.01		-.29
Salivary Testosterone		-.22		.73**
Total R^2	.30^t		.73**	
F	2.707		6.027	
Df	4, 29		4, 13	
	Bulimia (Post-Menses Phase)		Bulimia (Mid-Luteal Phase)	
	ΔR^2	β	ΔR^2	β
Step 1	.01		.06	
Salivary Estradiol		.07		-.25
Salivary Testosterone		-.08		.05
Total R^2	.01		.06	
F	0.154		0.347	
Df	2, 27		2, 13	
Step 1	.16		.21	
BMI		.10		-.16
Waist/Hip Ratio		.42^t		.42
Step 2	.02		.04	
Salivary Estradiol		-.15		-.19
Salivary Testosterone		-.05		.12
Total R^2	.18		.25	
F	1.382		0.740	
Df	4, 29		4, 13	

$^t p < .06$. * $p < .05$. ** $p \leq .01$. *** $p \leq .001$.

Appendix Q

Comparison of OC Users and Non-Users at Time 1

Variable	*M* (*SD*) Users	*M* (*SD*) Non-Users	*t*	*df*	*p*
Viewing hours of TV/movies[a]	13.14 (11.83)	14.18 (14.47)	.955	585	.340
Number magazines read[b]	1.80 (1.58)	2.10 (2.11)	1.942	590	.053
Number fashion magazines read[b]	1.17 (1.23)	1.24 (1.50)	.617	575	.537
Depression score (transformed)	3.47 (1.18)	3.50 (1.29)	.212	572	.832
Anxiety score (transformed)	0.74 (0.39)	0.70 (0.39)	1.471	584	.142
Mean number of alcoholic drinks per occasion[c]	11.39 (11.25)	11.37 (10.93)	-.018	456	.986
Frequency of 5+ drinks on one occasion[b]	1.85 (2.44)	2.09 (3.28)	.908	495	.365
Frequency of cannabis use[c]	1.53 (1.00)	1.48 (1.02)	-.628	558	.530
Number of cigarettes per day	1.02 (2.86)	1.04 (3.31)	-.066	349	.948
Number of sexual partners[d]	1.78 (3.30)	1.17 (1.53)	-2.765	542	.006
"Sex without love is OK"	4.28 (2.57)	3.81 (2.55)	-2.195	552	.029
Frequency of sexual thoughts	5.36 (1.87)	2.95 (2.82)	-4.327	545	.000
Sexual orientation	2.82 (2.13)	2.59 (2.15)	-1.246	544	.213

Note. See Appendix A for specific wording and rating scales for all items. For current relationship status, χ^2 (4) = 47.983, $p < .001$.
[a] Per week; [b] Per month; [c] In the last 3 months; [d] In the last year.

Appendix R

Pearson Correlations between Pre-menstrual Symptoms Seven Days Before Menses (MDQ) and both Bulimia and Drive for Thinness Subscale Scores

	Bulimia Scores		Drive for Thinness Scores	
	Controlling for Weight Gain	Controlling for Mood/Anxiety	Controlling for Weight Gain	Controlling for Mood/Anxiety
Dizziness	.090*			
Headaches	.126**	.100*	.146***	.145***
Skin Blemishes	.106*	.113**		
Swelling	.100*		.099*	.113**
Irritability	.103*			
Fatigue	.120**		.099*	
Aches/pains			.093*	
Insomnia	.089*			
↑ Appetite	.161***	.144***	.100*	.116**
Food cravings	.141***	.124**		
Cramps				.092*

Note. $N = 537$. Correlations are presented after controlling for pre-menstrual weight gain and both pre-menstrual low mood (feeling sad or blue) and anxiety.
* $p < .05$. ** $p < .01$. *** $p \leq .001$.