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Disordered Eating – What Role do Hormonal Contraception and Self-Esteem Play?

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Abstract

Disordered eating is a predictor of clinical eating disorders, which have an increasing prevalence nowadays. Thus, it is important to understand risk and protective factors for the prevention of disordered eating. It has been shown that sex hormones affect eating behaviour, but research on how eating behaviour may be affected by hormonal contraceptives is scarce. However, self-esteem has been shown to be one of the main predictors of disordered eating in several studies. The association between hormonal contraception and self-esteem is less understood. The hypothesis of the study is that hormonal contraception is positively related to disordered eating and possibly mediated/moderated by self-esteem. To test this, a sample of 760 female participants filled out the Rosenberg Self-Esteem questionnaire, SCOFF and answered questions regarding their contraceptive use. A mediation analysis found out that there is no direct relationship, but a mediated one. In a moderation analysis a significant interaction between hormonal contraception and self-esteem has been found. This suggests that people taking hormonal contraceptives and having lower levels of self-esteem are potentially at a higher risk of developing disordered eating. Future research should focus on examining the different types of hormonal contraceptives and exogenous sex hormones, since this study was not able to make a differentiation.

Keywords: [hormonal contraception, disordered eating, self-esteem, moderation, mediation.]

Layman's Abstract

If someone displays disordered eating behaviour, e.g., being concerned about their weight or exercising excessively to reduce weight, they are more likely to later develop a clinical eating disorder, such as having an extremely low body weight (anorexia nervosa). There are more and more people nowadays with a clinical eating disorder, so intervening at a less severe stage, disordered eating, becomes very important. Past research has shown that sex hormones affect eating behaviour, but there is only little research into hormonal contraception and eating behaviour. However, self-esteem has been shown to be one of the main predictors of eating behaviour. Although the association between hormonal contraception and self-esteem is still unclear. In this study 760 female participants filled out various questionnaires to be able to understand these associations better. The results showed that people who use hormonal contraception and have lower levels of self-esteem are at higher risk of developing disordered eating. However, there is no direct relationship between hormonal contraception and disordered eating, only in association with self-esteem. These preliminary findings indicate that more education to the general public about potential side effects of hormonal contraception are needed to prevent the further increase in clinical eating disorders. Future research should focus on following participants over time to establish a trend in their behaviour.

Disordered Eating – What Role do Hormonal Contraception and Self-Esteem Play?

Eating disorders pose a challenge in today's time. More and more people are getting diagnosed in recent years. In females in the period of 2000 to 2006 the prevalence was at 3.5%, whereas it increased to a prevalence of 7.8% in the period of 2013 to 2018 (Galmiche et al., 2019). In recent developments, researchers have been advocating for a transdiagnostic approach to eating disorders (EDs; Vervaet et al., 2020). Reasons for this approach are the frequent changes of clients between the EDs, core symptoms (body checking, fear of weight gain, feeling fat), the heterogeneity within the diagnostic categories, and common factors influencing the maintenance of the different EDs. However, many people do not fulfil the diagnostic criteria for the specific eating disorders since their symptoms are subclinical, e. g. their weight does not go below the normal BMI for an Anorexia Nervosa diagnosis, nevertheless, their eating pattern still influences body and health (Tanofsky-Kraff & Yanovski, 2004). This is then termed disordered eating. To prevent eating disorders from developing, screening for disordered eating and intervening at this subclinical stage is an important step.

Disordered eating is a significant predictor of clinical eating disorders (American Psychiatric Association, 2013). Higher levels of disordered eating are associated with increased levels of comorbid insomnia, anxiety disorders, and mood disorders (Aspen et al., 2014). Zeiler et al. (2015) have shown that it is related to lower quality of life, poorer social support and peer relationships, and worse relationships with parents. Additionally, symptoms remain stable or even increase throughout the lifetime shown by a longitudinal study (Neumark-Sztainer et al., 2011). The estimated prevalence of disordered eating varies from around 6% to 49% depending on the study and sample (Richter et al., 2017).

Several studies tried to explain the high prevalence of disordered eating by looking at its predictors. It is a replicated understanding that self-esteem is one of the main predictors

for disordered eating (Shea & Pritchard, 2007). Self-esteem is defined as the evaluative view of oneself, synonyms may include self-confidence or self-concept (Kästner et al., 2018). Shea and Pritchard (2007) assessed which of several health behaviours best predicts disordered eating in 196 male and 263 female students. They found that self-esteem was the secondary predictor to gender for bulimia nervosa, drive for thinness, and body dissatisfaction. Martyn-Nemeth et al. (2008) found that lower levels of self-esteem indirectly predicted overeating and gaining weight mediated by avoidant coping. Their study suggests that individuals with lower self-esteem engage in more avoidant coping, which in turn is related to more unhealthy eating behaviours, related to disordered eating, and depression. Self-esteem has also been shown to have a negative effect on compensatory behaviour, restrained eating and binge eating, as well as a mediating effect between depression and disordered eating behaviours (Brechan & Kvalem, 2015). Concluding, multiple studies have linked lower levels of self-esteem to higher levels of disordered eating behaviours, such as unhealthy, compensatory, restrained, and binge eating.

The Menstrual Cycle

As Shea et al. (2007) have found, female gender is the best predictor for bulimia nervosa, drive for thinness, and body dissatisfaction. Since the prevalence of eating disorders is much higher among females and in most cases has an onset between the age of puberty and the age of 40, some researchers have suggested a link between the menstrual cycle and (disordered) eating behaviour (American Psychiatric Association, 2013; Galmiche et al., 2019). There are about 1.8 billion people menstruating every month, including girls, women, transgender men and non-binary people (Menstrual Hygiene, n.d.). Menstruation starts on average at the age of 13 and continues until the age of about 49, when menopause starts (Thomas et al., 2001). The menstrual cycle is divided into two phases, the follicular and the luteal phase, which can again be divided into sub-phases for research purposes (Carmichael et

al., 2021). The early follicular phase begins with the menstruation or menses, all sex hormones are relatively low during this four-to-six-day long phase. During the late follicular phase oestrogen is at its peak concentration but decreases again before ovulation. The main follicular phase ends with ovulation. Ovulation is considered as the release of a mature follicle from the ovary, after which the luteal phase starts. During the early luteal phase progesterone starts to increase and there is a slight increase in oestrogen. In the mid luteal phase progesterone is at its peak, oestrogen is at its second, lower peak. The luteal phase either ends with pregnancy if a fertilised egg is implanted or if it remains unfertilised, both sex hormones decrease in the late luteal phase to prepare for a menses. Thus, a new cycle starts. The entire cycle lasts for about 28 days on average (Carmichael et al., 2021).

To prevent the fertilisation of an egg, thus, avoid pregnancy, about 18% of North American and European women (approximately 44 million) and about 8% of women worldwide (approximately 151 million) use hormonal contraceptives according to a 2019 United Nations' survey (Division, 2019). There are different forms of hormonal contraception on the market, including the oral contraceptives (OC), contraceptive skin patches, vaginal rings, intra-uterine devices (IUD), implants and three-monthly injections (Institute for Quality and Efficiency in Health Care (IQWiG), 2017). Most of these work via administering synthetical forms of the sex hormones progesterone and oestrogen, which inhibit ovulation and change the mucus and endometrium, making sperm movement and embryo implantation less likely (Wood et al., 1993). However, the effects on the downregulation of oestrogen and progesterone through the administration of their synthetic forms vary according to the type and brand of oral contraception (Elliott-Sale et al., 2013). Additionally, Zimmerman et al. (2013) have shown that the administration of oral contraceptives decreased testosterone levels. In general, endogenous sex hormones (progesterone, oestrogen, testosterone) are decreased through the increase of exogenous

synthetic sex hormones, thus affecting the natural menstrual cycle and the natural hormone levels significantly (Hampson, 2020).

Sex Hormones and Mental Well-Being

Several studies have shown that the administration of synthetical sex hormones through hormonal contraception and its effect on the natural hormone levels, can be related to several mental health adversities (Andersson et al., 1994; Skovlund et al., 2016; Skovlund et al., 2018; Slattery et al., 2018).

A cohort study by Slattery et al. (2018) has shown that the use of hormonal intrauterine devices (IUDs), which use a progesterone called levonorgestrel, was significantly related to depression, anxiety and sleep problems. IUDs were also related to higher incidence rates of depression, acne, headaches, weight change, and breast tenderness (Andersson et al., 1994). The combined oral contraceptive pill (COC), using a combination of progesterone and oestrogen, has been shown to increase previously reported side effects such as depression, mood swings and fatigue significantly compared to placebo controls (Gingnell et al., 2013). A prospective cohort study including 1010 girls showed that even though anhedonia and sadness were unaffected, COC users reported higher depressive symptoms compared to non-COC users (de Wit et al., 2020). In another prospective cohort study by Skovlund et al. (2016) including over 1 million women it was shown that hormonal contraception was related to subsequent depression diagnoses and the prescription of antidepressants. Since depression and adverse mood effects are strongly related to suicide and suicide attempts (Bergfeld et al., 2018), studies have also focused on the link between hormonal contraception and suicidal behaviour. A positive link has been shown in a cohort study following women from the age of 15, before they started using hormonal contraception (Skovlund et al., 2018).

Despite this evidence, there have also been studies that do not support an association between exogenous progesterone administration and depression according to a literature

review by Worly et al. (2018). In their review they argued that evidence thus far is inconclusive, and studies have several limitations. Due to the big variety in progesterone-based contraception it is difficult to draw firm conclusions, however, tentatively one could say that there has been no association in the most robust studies. Due to these findings and their lack of confidence, it is even more pressing to continue studying sex hormones and their potential (adverse) effects on the female mind and body.

Sex Hormones and Disordered Eating

One of these adverse effects that have been tentatively linked to the menstrual cycle phases and the changes in sex hormone concentration throughout the cycle is eating behaviour (Johnson et al., 1994; Pelkman et al., 2001; Reed et al., 2008; Reimer et al., 2005). Disordered eating is comorbid with mood disorders, such as depression (Santos et al., 2007), which, as mentioned above, has been shown to be positively associated with hormonal contraception (Gingnell et al., 2013; Skovlund et al., 2016; Slattery et al., 2018). Researchers have been studying the link between sex-hormones and eating behaviour partly due to the link between mood and physical symptoms as well as the idea that the menstrual cycle and the age of onset of eating disorders might be correlated. However scarce the research into the effects of hormonal contraception on changes on eating behaviour, based on the abovementioned factors, it can be deduced that hormonal contraception should be positively associated with disordered eating. Nevertheless, the link between different sex hormones differing effects on food intake in menstruating people/animals has been shown in several studies.

In animal studies progesterone has been shown to increase food intake in several experiments with ovariectomized rats (Roberts et al., 1972). Additionally, administration of testosterone has also been shown to increase energy intake as well as change starvation responses in female mice. The response to food deprivation in female mice is usually to

decreased energy expenditure, but this led to increased energy intake upon testosterone administration (Nohara et al., 2011). Oestrogen, on the other hand, inhibited food intake by decreasing the meal size but not the meal frequency in rats. It could bring body weight and food intake back to normal in ovariectomized rats, which showed an increased food intake (Geary & Asarian, 1999). Furthermore, in human research, antiandrogenic treatments and hormone replacement treatments decreased bulimic behaviours and postmenopausal weight gain, respectively (Espeland et al., 1997; Naessén et al., 2007).

Throughout the menstrual cycle women have a decreased food intake in the late follicular phase, when oestrogen is at its peak and progesterone is relatively low, and an increased food intake in the mid luteal phase, when progesterone is at its peak (Johnson et al., 1994; Pelkman et al., 2001; Reed et al., 2008; Reimer et al., 2005). These effects of sex hormones on food intake have also been shown in women with Bulimia Nervosa (BN). Decreased levels of oestrogen and increased levels of progesterone have been shown to be associated with increased levels of binge eating, thus causing an increase in binge eating behaviour during the mid-luteal phase (Edler et al., 2006; Lester et al., 2002).

Despite the significant association between sex hormones and eating behaviour, only little research has been done into hormonal contraception and its relationship to eating behaviour. Bird and Oinonen (2011) have studied the association between oral contraception (OC) side effect history and eating disorder symptomatology. They found that a history of experiencing physical or emotional side effects from OC use predicted higher levels of eating disorder symptoms (body dissatisfaction and drive for thinness). A study by Eck et al. (1997) into weight affecting differences in OC users and non-users showed no significant difference between the groups in energy intake, but a slight significant interaction between menstrual cycle phase and OC use. This suggests that the two groups have different energy intake patterns across the cycle. In a more recent study by McVay et al. (2011) food craving, hunger

level, and amount eaten was compared between OC-users and non-users. Fluctuations of food craving intensity and amount eaten were similar among both groups, but hunger level showed a small significant difference. OC-users reported elevated hunger levels during the late luteal phase and menses, whereas non-users only reported elevated hunger levels during the late luteal phase. There has been a relationship between eating disorder symptoms and fluctuations in food cravings, hunger levels, and amount eaten on non-users, but not in OC-users. This might be due to self-selection. OC use is thought to be related to increases in weight gain, thus women with a higher fear of fatness might choose to not take OCs, limiting the scope of interpretation. There are several additional limitations to the abovementioned studies. First, Bird et al. (2011) did not study the direct effect of OC use but a history of its side effects. Thus, not showing the direct association between exogenous hormone administration and eating behaviour. The study by Eck et al. (1997) is rather old and since it was conducted, there have been new advancements in hormonal contraception (Christin-Maitre, 2013). Additionally, the sample size is relatively low with only 17 women in the OC group and 15 in the non-OC group and large in-group variability, leading to low statistical power and generalizability.

A relationship between sex hormones and eating behaviour has been established by several studies, showing fluctuations in food intake related to hormone levels. Studies on hormonal contraception and eating behaviour are scarce and have limitations, making interpretations difficult. Results on the relationship are inconclusive due to these limitations despite the fact that they found a relationship between hormonal contraception and disordered eating. Based on these studies it is still unclear if there is an association between hormonal contraception and disordered eating, however, a positive trend is suggested.

As it has been established so far, hormonal contraception might affect disordered eating, which in turn is predicted by lower levels of self-esteem. Current literature has not yet

been able to establish a consistent body of research on the relationship between hormonal contraception and self-esteem, which might have a combined relationship to disordered eating.

Sex Hormones and Self-esteem

Generally, girls have lower levels of self-esteem, and it decreases as they start puberty, which might be due to the effect of sex hormones on their nervous system (Piqué & Brizuela-Gamino, 2002). However, studies on the relationship of hormonal contraception and self-esteem are inconsistent. Results show that self-esteem was higher in the postmenstrual phase (follicular phase) and lower in the premenstrual phase (luteal phase) in women with premenstrual syndrome (Taylor, 1999). Another study found self-esteem to be lowest when women are most fertile/around ovulation in the late follicular/early luteal phase and higher when women are least fertile (Hill & Durante, 2009). Brock et al. (2016) found that positive self-esteem was lower during the period of menses and negative self-esteem to be higher during this time compared to mid-cycle. Their study defined positive self-esteem as a positive self-evaluation and negative self-esteem as a negative self-evaluation. However, a study by Edmonds et al. (1995) found no association between self-esteem and menstrual cycle. These studies assessed the relationship between menstrual phases and self-esteem but did not assess the role of hormonal contraception.

Palacios and Lilue (2018) hypothesised that self-esteem might increase with the use of oral contraception due to the improvement of acne and hyperandrogenism.

Hyperandrogenism is defined as an excess of androgen levels in women of reproductive age and can result in one of many different disorders and phenotypes, e.g., acne (Yildiz, 2006). Furthermore, self-esteem was positively correlated with consistent hormonal contraception use (Ghobadzadeh et al., 2016). In contrast to these findings and hypotheses, a study by Fehring et al. (1989) found that couples using natural family planning compared to at least a

one-year oral contraceptive use showed higher levels of self-esteem. However, this study is rather old and assessed self-esteem of a couple, not directly the self-esteem of the menstruating person affected by endogenous hormones. As can be seen, research on hormonal contraception and self-esteem is scarce.

Aim of the Study

The current study aims to improve the understanding of hormonal contraception's relationship with disordered eating. Since self-esteem is one of the main predictors of disordered eating, this is considered in the current study as well. Trying to understand the association of hormonal contraception and self-esteem can improve treatment focuses and a person's understanding of their own psyche and body when using hormonal contraception.

The current study is an exploratory one since the existing research basis is scarce and it is difficult to confirm any results thus far. The study expects that hormonal contraception is positively associated with disordered eating levels and possibly mediated by lower levels of self-esteem. A mediation analysis has been chosen since hormonal contraception might be negatively related to self-esteem which in turn is expected to have a negative relationship with disordered eating, suggesting a mediating role of self-esteem in the relationship of hormonal contraception and disordered eating.

Furthermore, this study investigates whether self-esteem is potentially moderating the effect of hormonal contraception on disordered eating. A moderator analysis is included since an alternative explanation might be that the relationship between hormonal contraception and disordered eating is strengthened for people who have lower levels of self-esteem.

Methods

Procedure

The current study was a sub-project of the WARN-D study (Fried et al., under review). The WARN-D project aims to create an early warning system for depression by

using data attained throughout two years from about 2000 students studying in the Netherlands. It is a multicohort design with four cohorts of 500 students and four stages. The current study will use the data from the initial phase, a 90-minute baseline survey of the first two cohorts.

The study was advertised online and offline in universities as well as vocational schools. After signing the informed consent and being screened regarding the inclusion and exclusion criteria, the participants could fill out the baseline survey.

The baseline survey assessed general demographics (e.g., physical appearance, sex & gender, SES & finances, education, living situation, religion, menstruation), sleep, several mental health constructs (e.g., depression, anxiety, suicidal ideation, mania, disordered eating, substance use), physical activity, social constructs (e.g., relationships, social media use, loneliness), traits and resilience factors (e.g., stress recovery, self-esteem, locus of control). The current study looked at the constructs of menstruation, specifically use of contraception, disordered eating, and self-esteem. Participants received 7.50 Euro for completing the survey. After the baseline survey the participants of WARN-D received a smartwatch, with which data was collected daily. Then a series of eight short follow-up surveys were administered.

The larger research study, WARN-D, was approved by the Leiden University Research Ethics Committee Leiden (2021-09-06-E.I.Fried-V2-3406).

Participants

For the WARN-D study the inclusion criteria were the following: being ≥ 18 years old; fluent in English or Dutch; studying at a Dutch educational institution; currently living in the Netherlands, Germany or Belgium; having a European bank account; and a smartphone that works with iOS or Android.

Exclusion criteria included moderate levels of depression, current mania, current thought disorders; a primary substance use disorder; being currently in treatment for or waiting for treatment for one of the above disorders; having moderate suicidal ideation; and lastly indicating being stressed when seeing a daily burnt calorie estimate.

The target group of the current study was all people with female reproductive hormones and a menstrual cycle, since they can be affected by hormonal and cyclical changes. Thus, additional criteria for the current study were female sex, 18-40 years old sample since it was looking at hormonal contraceptive use. Six participants older than or 40 were removed from the dataset since they might skew the data due to variable hormone levels due to approaching menopause. Additionally, participants with a different gender than female were removed from the dataset as well. WARN-D only assessed the sex assigned at birth and not the current sex, thus it was unclear whether they used sex-affirming medication or underwent surgery. A total of 36 participants with differing gender and female sex-assigned at birth had to be removed. This left the data set with 860 participants in total, of which 727 are female (84.5%) and 133 are male (15.5%). From now on only the female participants were being considered.

The average age was 22.19 years ($M = 22.19$, $SD = 3.08$), with a minimum of 18 years and a maximum of 39 years. Regarding the sexual orientation, 443 were heterosexual (60.9%), 140 were bisexual (19.3%), 72 were not sure (9.9%), 28 had another orientation (3.9%), 28 were homosexual (3.9%) and 14 were asexual (1.9%). A total of two values for the sexual orientation question were missing. Most of the participants were single, namely 339 (46.6%), 263 were in a steady relationship (36.2%), 60 were dating (8.3%), 44 were in a marriage-like relationship (6.1%), 11 were in some other form of relationship (1.5%) and 10 were married (1.5%). Of the entire sample 7 had children (1%). A total of 392 participants were Dutch (53.9%), 260 were of another nationality (35.8%) and 75 had two nationalities

(10.3%). The highest level of education reached by 342 participants was the secondary school diploma (47.0%), 246 have reached university's bachelor's degree (33.8%), 50 have reached a university's master's degree (6.9%), 45 have reached an applied university's bachelor's degree (6.2%), 32 have reached a vocational school degree (4.4%), three have reached an applied university's master's degree (0.4%) and two have reached a doctoral degree (0.3%), there were seven missing values.

Measures

Hormonal contraception was operationalized on a categorical measurement level with seven answer options (1 = no contraception or only physical contraception, 2 = oral contraception, 3 = hormonal intra-uterine device, 4 = other hormonal contraception, 5 = copper intra-uterine device, -998 = I am not sure, -999 = I prefer not to say). For the present study, only answer options 1 to 5 were being considered since otherwise it was unclear whether they are using hormonal contraception or not. Answer options 1 and 5 constituted non-hormonal contraception, coded as 0, and answer options 2, 3 and 4 constituted hormonal contraception, coded as 1.

Self-esteem was defined as the positive or negative attitude to oneself. In the current study it was measured with the Rosenberg Self-Esteem Scale (RSE) (e.g., "I feel that I have a number of good qualities" (Gnambs et al., 2018)), which was a 10-item questionnaire. Answer options were on a 4-point Likert-scale ranging from 1 = strongly disagree, 2 = disagree, 3 = agree to 4 = strongly agree. The score ranged from a minimum of ten to a maximum of 40, with a higher score indicating higher levels of self-esteem (Sinclair et al., 2010). The scale showed good internal consistency in our sample (Cronbach's $\alpha = .891$). Previous examinations on the test-retest reliability of this scale using intraclass correlations was .87, thus determined as good (Torrey et al., 2000).

Disordered eating was defined as a non-normative eating pattern that affects body and health but does not qualify for a clinical eating disorder (Tanofsky-Kraff & Yanovski, 2004). In this study it was assessed with the SCOFF questionnaire, consisting of five items with dichotomous answer options (0 = No, 1 = Yes). The five questions assessed the core symptoms of disordered eating: intentional vomiting, loss of control, weight loss, food thoughts and body image concerns (e.g., “Do you make yourself sick because you feel uncomfortably full?”). A score of two or higher indicated people at risk for disordered eating (Richter et al., 2017). An internal consistency test in this sample showed insufficient reliability (Cronbach’s $\alpha = .570$). Another study on the psychometric properties of the SCOFF also found low internal consistency (Cronbach’s $\alpha = .470$) and a test-retest reliability ranging from $k = 0.211$ to $k = 0.591$. However, the sensitivity was at 77.4% and the specificity at 60.5% (Wahida et al., 2017).

Additionally, the current study controlled for weight and body dissatisfaction, two constructs assessed in the baseline survey by two direct questions with a 7-point Likert scale (1 = very dissatisfied, 7 = very satisfied; “How satisfied are you with your current weight” and “How satisfied are you with your overall physical appearance”). These are strongly related to disordered eating as well as self-esteem (Brechan and Kvalem, 2015). Depression, assessed using an adapted version of the Public Health Questionnaire (PHQ-9) with good internal consistency in this sample (Cronbach’s $\alpha = .827$), was also controlled for. In previous research a good internal consistency (Cronbach’s $\alpha = .892$) and good test-retest reliability of .737 has been found for the PHQ-9 (Sun et al., 2020). It has been shown to have a relationship with several disordered eating factors, such as restrained eating and binge eating (Brechan and Kvalem, 2015). Another construct controlled for was self-efficacy, which is a form of self-esteem that is more specific towards a certain situation (Ghobadzadeh et al., 2016). It was assessed using the General Self-Efficacy Scale (GSE) with good internal

consistency in this sample (Cronbach's $\alpha = .837$) and moderate 4-month test-retest reliability in previous research (intraclass correlation coefficient = .64; Lazić et al., 2021). Lastly, age has been controlled for as well since higher age is related to a more stable, less contingent and higher self-esteem (Meier et al., 2011) as well as choice of contraception (Kavanaugh & Pliskin, 2020).

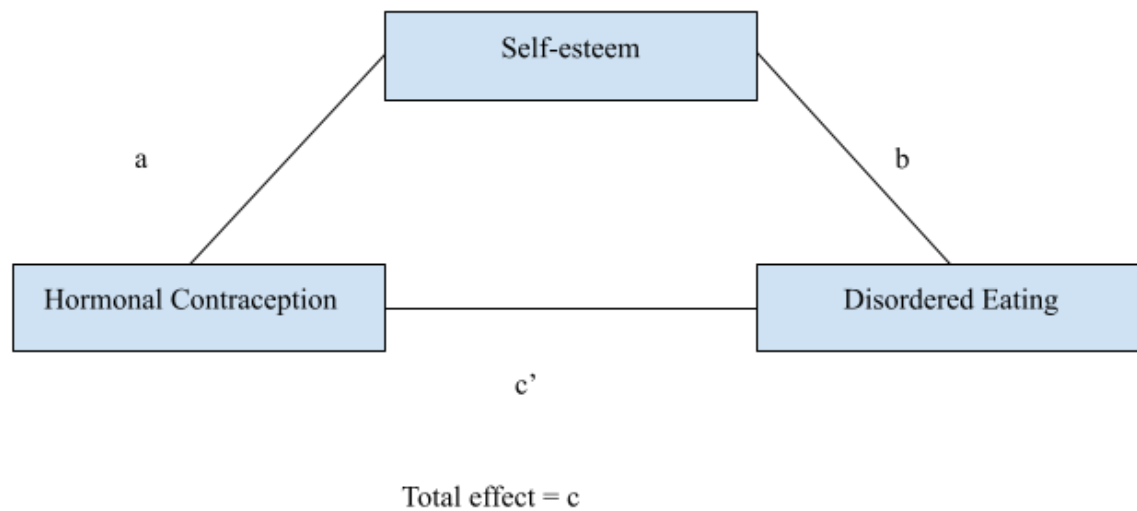
Statistical Analyses

SPSS was used for the analyses. The main statistical analysis was a mediation analysis with hormonal contraceptive use as the independent variable, self-esteem as the mediator and disordered eating as the dependent variable. Secondly, a moderation analysis with hormonal contraception as the independent variable, self-esteem as the moderator and disordered eating as the dependent variable was run. For both analyses the extension PROCESS v4.2 by Andrew F. Hayes was used with 5000 bootstraps for each analysis. Before running the analyses, the variables disordered eating, self-esteem, self-efficacy, depression, age, and satisfaction with looks and weight have been standardized.

First, the mediation analysis was run (Figure 1). For the first step the main effect between hormonal contraception and disordered eating was assessed (pathway c'). Then the main effect between hormonal contraception and self-esteem was assessed (pathway a). Lastly, hormonal contraception and self-esteem combined as predictors for disordered eating were assessed, thereby estimating pathways b and total effect c. A p-value of ≤ 0.05 of the coefficients indicated a significant effect. For all steps the covariates were included as well, namely age, depression, satisfaction with weight, satisfaction with looks, and self-efficacy.

Figure 1

Mediation Model

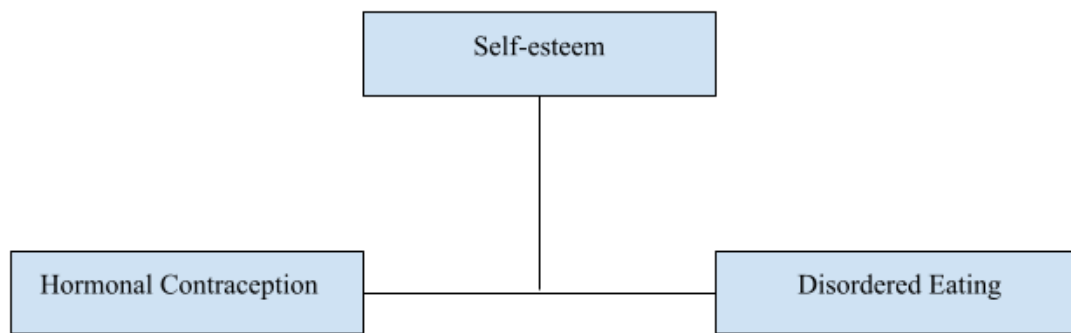


Note. Hormonal contraception (1 = hormonal contraception, 0 = non-hormonal contraception) as independent variable, self-esteem (RSE) as mediator and disordered eating (SCOFF) as dependent variable. With pathways a, b and c'. Total model effect c.

Secondly, the moderation analysis was run. Therefore, self-esteem was now the moderator instead of the mediator. The main effects of hormonal contraception on disordered eating as well as the main effect of self-esteem on disordered eating were analysed. Additionally, the interaction effect between hormonal contraception and self-esteem was studied. Again, the study controlled for satisfaction with weight, satisfaction with looks, depression, self-efficacy, and age. For all the effects a p-value of $\leq .05$ indicated a significant result.

Figure 2

Moderation Model



Note. Hormonal contraception (1 = hormonal contraception, 0 = non-hormonal contraception) as independent variable, self-esteem (RSE) as moderator and disordered eating (SCOFF) as dependent variable.

Since linear regression analyses were used the assumptions of normality, linearity, homoscedasticity, and the absence of multicollinearity were checked. Normality was tested by showing that the residuals follow a normal distribution. Homoscedasticity was checked by plotting the predicted values and residuals on a scatterplot. If the residuals were normally distributed and homoscedastic, linearity was already checked for. To check for multicollinearity the VIF score was calculated. A score close to 1 was desired, meaning no correlation, however, a score of below 5 was acceptable since it meant moderate correlation. Additionally, the data was checked for outliers that might significantly affect the outcome. After context specific and individual consideration, it was decided whether to exclude these and the analyses was rerun to check the robustness of results.

Results

Of all participants in the study, 404 (55.6%) used non-hormonal contraception of which 379 (52.1%) did not use contraception or only physical contraception (e.g., condoms, calendar method, fertility tracking) and 25 (3.4%) used a copper IUD as contraception. Whereas 323 (44.4%) used hormonal contraception of which 202 (27.8%) used oral

contraception, 78 (10.7%) used a hormonal IUD, 23 (3.2%) used another form of hormonal contraception (e.g., implant, injection). Regarding the mediator/moderator self-esteem the average score on the RSE was relatively high ($M = 28.5$, $SD = 5.4$) with a minimum of 12 and the total maximum of 40. There was a total of 711 valid responses for the RSE. For the dependent variable, disordered eating, there were 711 valid responses. The average score on the SCOFF was low with a relatively high standard deviation ($M = 0.8$, $SD = 1.1$). All possible scores were present from a minimum of 0 to a maximum of 5.

Table 1*Descriptives of covariates*

	N	Minimum	Maximum	Mean	Std. Deviation
GSE	711	13	40	29.23	4.33
PHQ9	711	0	27	7.68	4.61
Age	727	18	39	22.19	3.08
Satisfaction Looks	719	1	7	4.42	1.38
Satisfaction Weight	719	1	7	4.17	1.75

Note. General Self-Efficacy Scale (GSE); Patient Health Questionnaire (adapted PHQ9) used to assess depression; age; satisfaction with looks and satisfaction with weight assessed using a 7-point Likert scale (1 = very dissatisfied, 7 = very satisfied).

As for the assumptions, the test for normality of the residuals of the SCOFF shows that they are not perfectly normal distributed (Appendix A). A scatterplot showed that there was homoscedasticity (Appendix A). Furthermore, the VIF score indicated that there was no multicollinearity (VIF=1.0). As for the residuals of the RSE, they showed perfect normality

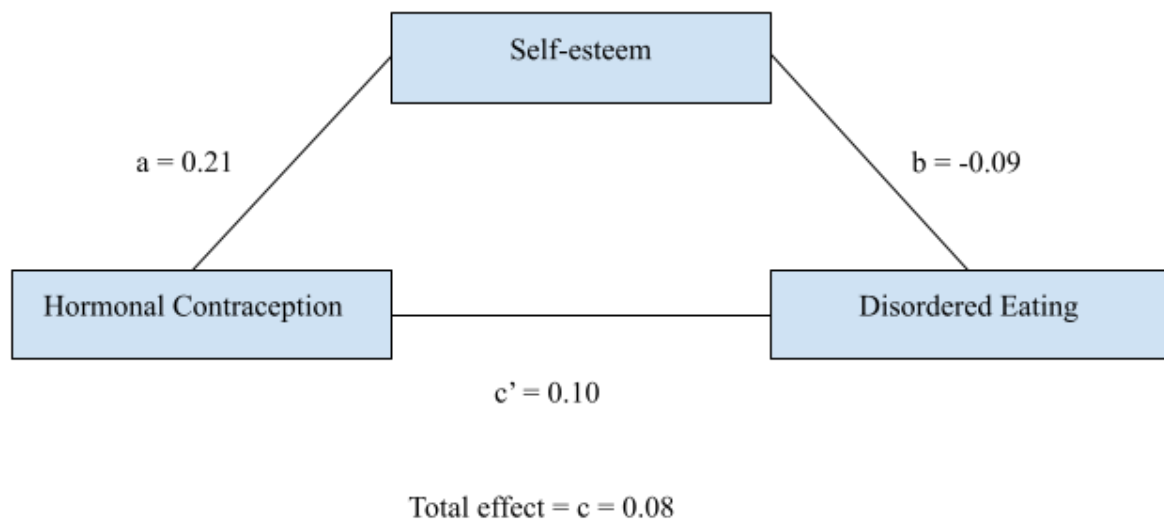
(Appendix A). However, the scatterplot showed two columns, suggesting heteroscedasticity (Appendix A).

Mediation Analysis

For the first hypothesis, that self-esteem mediates the relationship between hormonal contraception and disordered eating, the total effect model explains 28% of the variation in disordered eating, $R^2 = 0.28$, $F(7.0, 703.0) = 38.97$, $p > .001$. Pathway c', the main effect between hormonal contraception and disordered eating was not significant, $b = 0.10$, $p = .129$, 95% CI [-0.03, 0.23], $R^2 = 0.28$. Regarding the second step, pathway a, the main effect between hormonal contraception and self-esteem showed to be significant, $b = 0.21$, $p < .001$, 95% CI [0.10, 0.32], $R^2 = 0.48$. For the final step, the main effect between self-esteem and disordered eating, pathway b, was looked at as well and showed to be significant, $b = -0.09$, $p = .043$, 95% CI [-0.18, -0.01], $R^2 = 0.28$. The total effect, pathway c, showed to be non-significant, $b = 0.08$, $p = .216$, 95% CI [-0.05, 0.21], $R^2 = 0.28$. Self-esteem in the indirect effect of hormonal contraception on disordered eating, however, showed to be significant, $b = -0.02$, 95% CI [-0.04, -0.01]. This suggests that hormonal contraception was only related to disordered eating when mediated by self-esteem, but not on its own.

Figure 3

Mediation Model



Note. Hormonal contraception as independent variable, self-esteem as mediator and disordered eating as dependent variable. With pathways a, b, c' and total effect c.

For a summary of the estimates and the control variables with disordered eating as the outcome variable refer to Table 2. Noteworthy, satisfaction with looks as well as with weight were negatively related to disordered eating and depression was positively related to disordered eating. Self-efficacy and age were not significantly related to disordered eating.

Table 2

Estimated Model Coefficients for Mediation Analysis

	b	p	LLCI	ULCI
Contraception	.10	.129	-.03	.23
RSE	-.09	.043	-.18	-.01
Satisfaction Looks	-.11	.021	-.19	-.02
Satisfaction Weight	-.31	.000	-.39	-.23
GSE	-.01	.689	-.09	.06

PHQ9	.16	.000	.09	.24
Age	.01	.716	-.05	.08

Note. Hormonal contraception (1 = hormonal contraception, 0 = non-hormonal contraception)

as independent variable, self-esteem (RSE) as mediator, disordered eating (SCOFF) as dependent variable, satisfaction with looks, satisfaction with weight, self-efficacy (GSE), depression (PHQ9) and age as control variables. A 95% confidence interval was applied.

Statistically significant associations in bold font.

As for estimates of all variables with self-esteem as the outcome refer to Table 3. As can be seen the only variable not related to self-esteem is satisfaction with weight, $b=-0.05$, $p = .140$, 95% CI [-0.12, 0.02]. All other variables are related to self-esteem.

Table 3

Estimated Model Coefficients for Mediation Analysis

	b	<i>p</i>	LLCI	ULCI
Contraception	.21	.000	.10	.32
Satisfaction Looks	.33	.000	.26	.40
Satisfaction Weight	-.04	.241	-.11	.03
GSE	.29	.000	.24	.36
PHQ9	-.34	.000	-.40	-.28
Age	-.07	.009	-.12	-.02

Note. Hormonal contraception (1 = hormonal contraception, 0 = non-hormonal contraception)

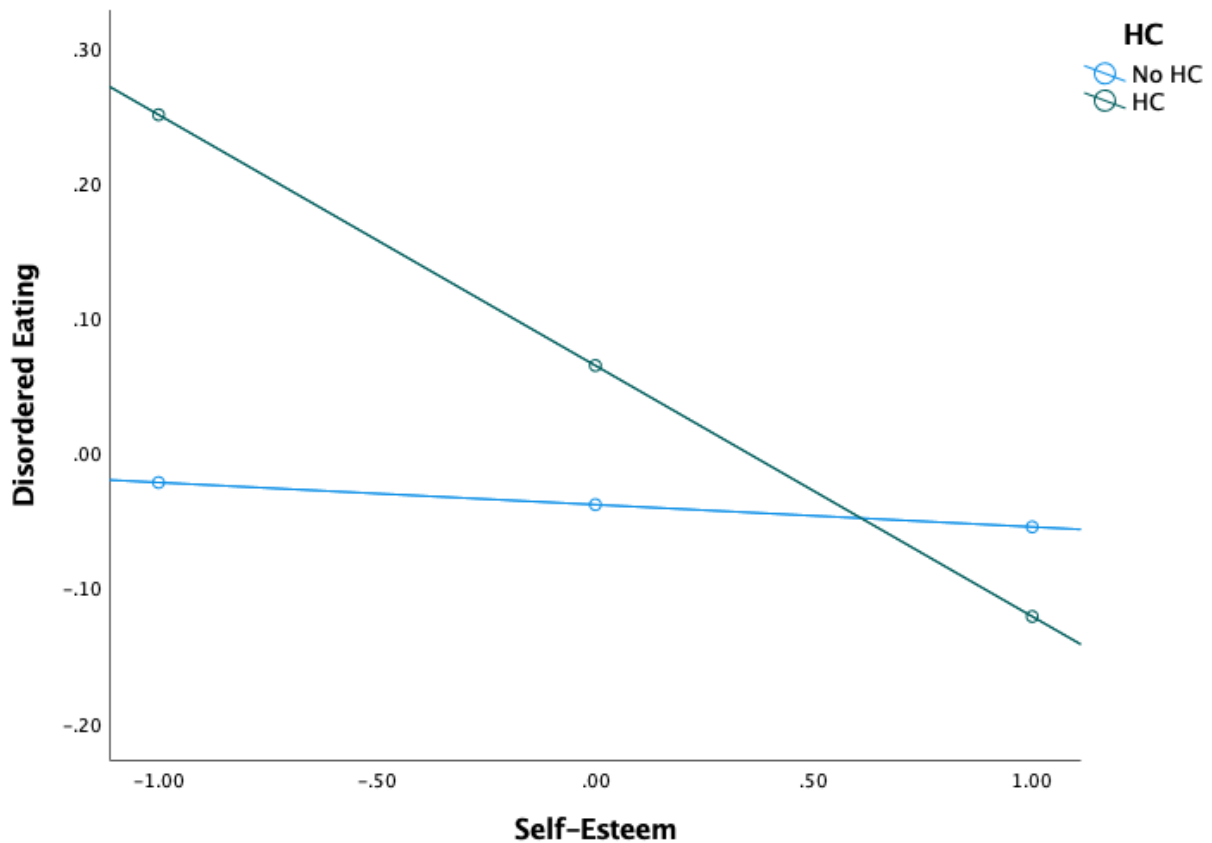
as independent variable, self-esteem (RSE) as dependent variable, satisfaction with looks, satisfaction with weight, self-efficacy (GSE), depression (PHQ9) and age as control variables. A 95% Confidence Interval was chosen. Statistically significant associations in bold font.

Moderation Analysis

For the second hypothesis, whether self-esteem moderates the relationship between hormonal contraception and disordered eating, the total model has been found to explain 29% of the variation in disordered eating, $R^2 = .29$, $F(8.0, 702) = 35.21$, $p > .001$. However, the relationship between hormonal contraception and disordered eating, $b = 0.10$, $p = .114$, 95% CI [-0.02, 0.23], and self-esteem and disordered eating, $b = -0.02$, $p = .756$, 95% CI [-0.12, 0.09], were not significant. The interaction between hormonal contraception and self-esteem has been found to be significant, $b = -0.17$, $p = .009$, 95% CI [-0.29, -0.04]. This suggests that neither self-esteem nor hormonal contraception on its own are related to disordered eating, but when they were interacting together, they are negatively related to disordered eating (Figure 4). In women using hormonal contraception lower levels of self-esteem were associated with higher levels of disordered eating. Whereas this effect was less pronounced or absent in women who do not use hormonal contraception.

Figure 4

Interaction of Hormonal Contraception and Self-Esteem



Note. HC = hormonal contraception, Plot showing the interaction of hormonal contraception (1 = hormonal contraception, 0 = non-hormonal contraception) and self-esteem (RSE) on disordered eating (SCOFF).

For an entire list of the estimates of the covariates and hormonal contraception as well as self-esteem refer to Table 4. As can be seen, satisfaction with weight and depression were both related to disordered eating, however, the other covariates were not significant.

Table 4

Estimated Model Coefficients for Moderation Analysis

	b	p	LLCI	ULCI
Contraception	.10	.114	-.025	.23
RSE	-.02	.756	-.12	.09

Contraception	-.17	.009	-.29	-.04
x RSE				
Satisfaction Looks	-.12	.012	-.21	-.03
Satisfaction Weight	-.31	.000	-.39	-.23
GSE	-.02	.573	-.09	.05
PHQ9	.16	.000	.08	.23
Age	.01	.716	-.05	.07

Note. Hormonal contraception (1 = hormonal contraception, 0 = non-hormonal contraception)

as independent variable, self-esteem (RSE) as moderator, disordered eating (SCOFF) as dependent variable, satisfaction with looks, satisfaction with weight, self-efficacy (GSE), depression (PHQ9) and age as control variables. A 95% Confidence Interval was chosen. Statistically significant associations in bold font.

Discussion

Mediation

The first hypothesis of the study stated that hormonal contraception is positively related to disordered eating and this relationship is mediated by self-esteem. The results suggested that there was no relationship between hormonal contraception and disordered eating, but the indirect effect, mediated by self-esteem, showed to be significant.

Although the study did not find a significant total effect between hormonal contraception and disordered eating, the results can still be interpreted according to a new suggestion by O'Rourke and MacKinnon (2018). They propose that despite the previous notion that a total effect must be present to assess a mediation effect, there are certain circumstances under which mediation might be significant without a significant total effect. One of these circumstances is when the direct and indirect effect have opposing signs, as in

the current study. This is termed inconsistent mediation and can lead the total effect to be close to zero. Thus, the association between hormonal contraception and disordered eating mediated by self-esteem is negative, but significant, however, the direct effect between hormonal contraception and disordered eating is positive, possibly making the total effect somewhere close to zero.

The direct effect between hormonal contraception and disordered eating seems to be non-significant. Suggesting that people who take hormonal contraception are only more at risk of developing disordered eating patterns through lower levels of self-esteem, but not directly. This means that hormonal contraception does not seem to affect menstruating people the same way regarding their eating pattern as with their mood, e.g., depression (Skovlund et al., 2016). A possible explanation might be that permanent exogenous, artificial sex hormones, have different effects on a body than fluctuating endogenous, natural sex hormones, due to their different duration in the system. There has been no study on the difference between these hormone types on eating behaviour, however, Stadler et al. (2019) reviewed the impact of exogenous and endogenous progesterone on stress. They found that they have different impacts on the bodies stress systems. While endogenous progesterone does not affect the system, exogenous progesterone might reduce the stress response. This review suggests that exogenous sex hormones, the ones in hormonal contraception, and endogenous sex hormones, the ones naturally occurring in the body, have different effects on the body.

This study expected that hormonal contraception is negatively associated with self-esteem, but it found that this association seems to be positive. A reason for caution, however, is that there can be no causal deductions from this study, since it was not a longitudinal experimental design. This can mean that higher levels of self-esteem can cause the use of hormonal contraception, or the use of hormonal contraception can cause higher self-esteem.

The findings support the study by Ghobadzadeh et al. (2016), who found that higher levels of self-esteem predict consistent use of hormonal contraception. Additionally, it supports the hypothesis by Palacios and Lilue (2018) that hormonal contraception could increase self-esteem through treating acne and hyperandrogenism. A possible explanation for the association between hormonal contraception and self-esteem might be that higher self-esteem might increase women's confidence in their reproductive decision-making, thus, encouraging them to use (hormonal) contraception effectively (Peer et al., 2013).

The current study could replicate past findings that self-esteem and disordered eating are negatively associated. Meaning lower levels of self-esteem might lead to higher levels of disordered eating or vice versa. A review by Krauss et al. (2023) suggests that self-esteem and disordered eating affect each other reciprocally. One mechanism through which low self-esteem might affect disordered eating is through the mediation of externalised self-perception and body shame (Woodward et al., 2019). On the other hand, disordered eating can affect self-esteem via social isolation and alienation from family, and stigma from society (Robinson, 2014), which in turn can lower self-esteem (Harris & Orth, 2020; Link et al., 2001).

As other studies have shown satisfaction with looks and weight as well as depression are all associated with disordered eating (Brechan and Kvaem, 2015). These findings could be replicated by the current study. For satisfaction with weight and looks a negative association was found, meaning less satisfaction is related to higher levels of disordered eating, and for depression a positive association was detected, meaning higher levels of depression are associated with higher levels of disordered eating. Surprisingly, satisfaction with weight and self-esteem had a non-significant relationship, even though previous research has found a positive association (Frederick et al., 2016).

Moderation

A moderation analysis was included in the study design to test whether a relationship between self-esteem and disordered eating would be different for people who use or do not use hormonal contraception. Regarding the moderation analysis, there has been no main effect between hormonal contraception and disordered eating. As with the mediation analysis a possible explanation for the lack of a relationship might be the different effects of exogenous and endogenous sex hormones.

However quite surprisingly, the relationship between self-esteem and disordered eating was not significant. Thus, a strong body of research (Shea et al., 2007; Martyn-Nemeth et al. 2008; Brechan et al., 2015) on this association could not be confirmed in this moderation analysis. A possible explanation for this non-significant association might be that the interaction effect best explains the variance in the model. In that case the main effects show weaker results, and the focus then lies on the interaction effect. It is also in line with the fact that self-esteem is not the main predictor of disordered eating, but rather a multitude of different factors predict disordered eating habits (Shea & Pritchard, 2007). Thus, interaction terms should show higher effects than when assessing a main effect between self-esteem and disordered eating. In the future, studies should keep this in mind and assess self-esteem in an interaction context with possible other predictors of disordered eating.

Despite not having found an association with neither self-esteem nor hormonal contraception, the interaction of these two was significant. This supports the mediation analysis in a way that on its own hormonal contraception does not seem to be related to disordered eating whereas with self-esteem an association can be found. It can, thus, be said that the moderation was significant. Since the interaction term is negative, it means that for people who use hormonal contraception lower levels of self-esteem are related to higher levels of disordered eating. If self-esteem, however, is high in this group, then disordered

eating levels would be lower. However, this effect is less pronounced or absent in people who do not use hormonal contraception.

This can again be explained by the cycle that hormonal contraception might increase self-esteem through treating acne or self-esteem might affect the use of hormonal contraception though increasing someone's confidence in reproductive decision making (Palacios and Lilue, 2018; Peer et al., 2013). And then self-esteem can be associated with disordered eating via one's externalised self-perception and (the lack of) body shame (Woodward et al., 2019).

Limitations

When interpreting the results, following limitations of the study should be considered. Foremost, regarding the SCOFF questionnaire, a flooring effect is present. This might be due to an exclusion criterion of the WARND-D study, namely those who indicate being stressed when seeing a daily burnt calorie estimate were excluded. A criterion like this could have excluded people with higher levels of disordered eating since they are more concerned about food related aspects such as calories. This means that most data points are towards the lower end of the questionnaire and only a few participants reported high levels of disordered eating as could be seen in the normality assumption test. A floor effect can lead to several problems, such as that it is difficult to measure the central tendency and dispersion. Another problem is that it is difficult to assess differences among participants since many scored the same way. Most importantly, however, is that it is difficult to differentiate between two groups, in this case people using hormonal contraception and people using non-hormonal contraception. If everyone scores low, then it is difficult to examine the average score of each group and compare these. Furthermore, the reliability test of the SCOFF showed insufficient reliability. This would entail that the consistency and accuracy of the test measure is not as high as desired, making interpretations less accurate and more difficult to draw conclusions from.

Additionally, since the data was part of a larger study on depression and not necessarily on hormonal contraception, detailed information regarding this is lacking. There is no distinction between the different forms of hormonal contraception in this study, but rather various oral contraceptives, different IUDs, and other hormonal contraceptives such as the injection or patch are all one group. This might make it more difficult to detect effects of exogenous hormones on the menstruating body and its eating behaviour, since there is a huge variability in hormones being used and their dosages. Before conducting the analyses, it has been decided to group all hormonal contraceptives together, since there is a lack of exact knowledge which hormones were used. Most of the time the only available data concerned the form of contraception. Thus, to have a first understanding of exogenous sex hormones relationship with disordered eating a larger sample size at the expense of exact information of which hormones were used was chosen. Alternatively, only oral contraceptives could have been used, however even among those there is huge variability (Lidegaard et al., 2011).

Another limitation of the current study is its cross-sectional nature of the sample and that the menstrual cycle phase has not been considered during the study. Thus, the data only captures one moment in time, but the study is unaware which moment/menstrual cycle phase that is. This might have affected the results if most people in the non-hormonal group were in the follicular phase, but the effect is only present in the luteal phase. With this study design it is difficult to assess a trend in behaviour over time, such as eating behaviour or self-esteem, and to assess a causal relationship.

Future Directions

This study could provide a first understanding into which roles hormonal contraception and self-esteem play when it comes to disordered eating. It is of the utmost importance to increase our understanding of the risk and protective factors for disordered eating to help prevent these and their further development into pathological eating disorders.

As the results of this study suggest, there is an association between hormonal contraception, self-esteem and disordered eating. People who use hormonal contraceptives and have lower levels of self-esteem seem to be at higher risk of having disordered eating habits.

However, due to the nature of the study design and its limitations future research should attempt to increase our understanding of this relationship by using causal designs. Through a causal design the direction of the association could be better explained, suggesting if disordered eating is a predictive factor of self-esteem and hormonal contraception or vice versa. Even though this kind of study design is quite difficult due to ethical constraints, manipulating contraception and self-esteem is not a feasible option. A possibility might be to follow women throughout their reproductive years and assess their choice of contraception, self-esteem and levels of disordered eating prior to and after starting contraception. This way an antecedent could be established.

Additionally, a sample consisting of more people with disordered eating symptoms, thus, higher scores on the SCOFF should be aimed at. This would increase the chances of finding a difference between groups and consequently larger effect sizes. The study should also aim for more information on what kind of contraception is used with the specific hormones mentioned. This could give a clearer overview on the different effects of different endogenous progesterone and oestrogen and their dosages.

A clearer understanding of the mechanisms behind the interaction of hormonal contraception and self-esteem, as well as the mediation of self-esteem on the relationship between hormonal contraception and disordered eating should be sought after. This can be reached by assessing and including different constructs such as confidence in reproductive decision making or social isolation and withdrawal and feelings of stigma.

Concluding it can be said that menstruating people taking hormonal contraception and having lower levels of self-esteem might be at an elevated risk of developing disordered

eating behaviours. However tentatively, a special consideration should be given to this group when assessing risk and protective factors of eating disorders. Nevertheless, there remains much unknown when it comes to hormonal contraception and disordered eating.

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Appendix

Figure 1

Normality Plot of SCOFF Residuals

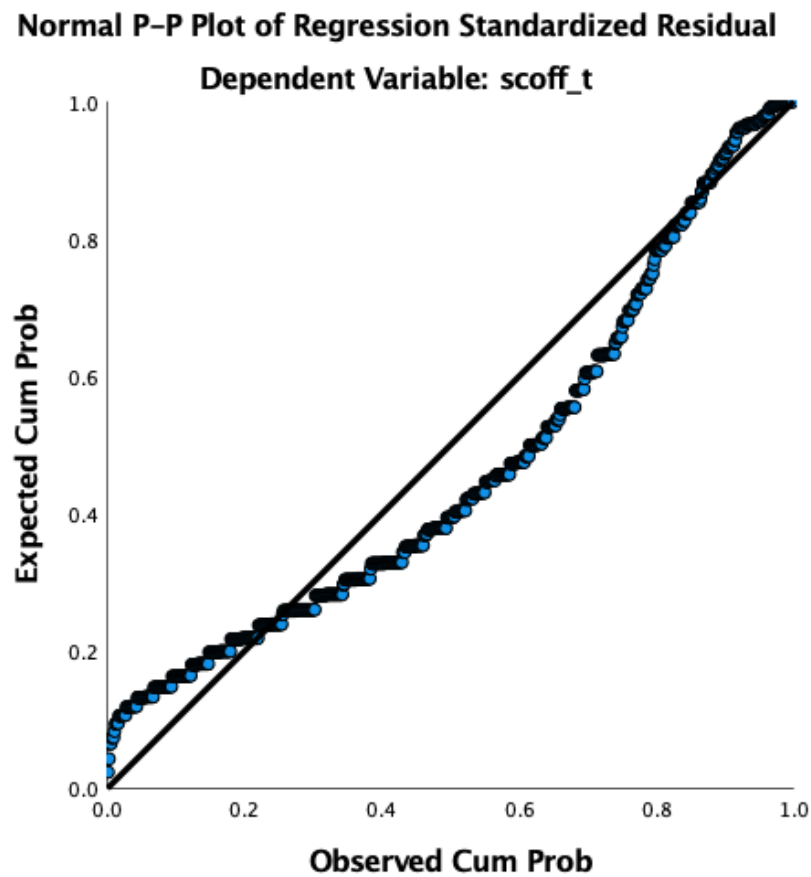


Figure 2

Test for Homoscedasticity of SCOFF Residuals

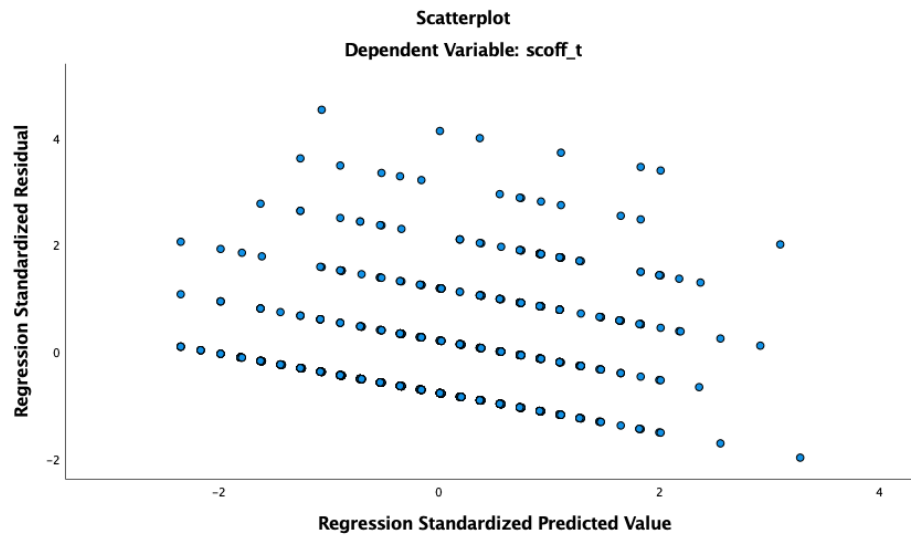


Figure 3

Normality Plot of RSE Residuals

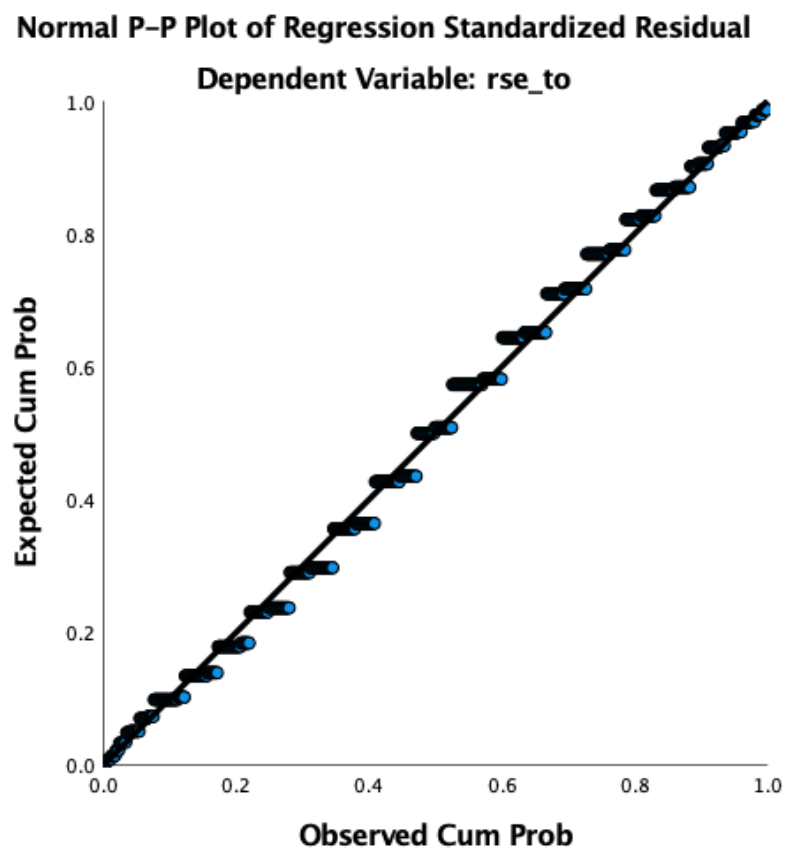


Figure 4

Test for Homoscedasticity of RSE Residuals

