

KATRIN KUKK

Risk factors  
of binge eating and overeating –  
towards an integrated model





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Institute of Psychology, University of Tartu, Estonia

The dissertation has been accepted for the commencement of the degree of Doctor of Philosophy (in Psychology) on April 29, 2020 by the Council of the Institute of Psychology, University of Tartu.

Supervisor: Kirsti Akkermann, PhD  
University of Tartu, Estonia

Opponent: Unna N. Danner, PhD  
University of Utrecht, The Netherlands

Commencement: June 19, 2020 at 12.00, in Näituse 2–102, Tartu

Publication of this thesis is granted by the Institute of Psychology, University of Tartu.

ISSN 1024-3291  
ISBN 978-9949-03-341-6 (print)  
ISBN 978-9949-03-342-3 (pdf)

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University of Tartu Press  
[www.tyk.ee](http://www.tyk.ee)

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## LIST OF ORIGINAL PUBLICATIONS

- I. **Kukk, K., & Akkermann, K.** (2017). Fluctuations in negative emotions predict binge eating both in women and men: An experience sampling study. *Eating Disorders: The Journal of Treatment & Prevention*, 25 (1), 65–79, 10.1080/10640266.2016.1241058
- II. Sultson, H., **Kukk, K., & Akkermann, K.** (2017). Positive and negative emotional eating have different associations with overeating and binge eating: Construction and validation of the Positive-Negative Emotional Eating Scale. *Appetite*, 116, 423–430. <http://dx.doi.org/10.1016/j.appet.2017.05.035>
- III. **Kukk, K. & Akkermann, K.** (2019). Emotion regulation difficulties and dietary restraint independently predict binge eating among men. *Eating and Weight Disorders – Studies on Anorexia, Bulimia and Obesity*, <https://doi.org/10.1007/s40519-019-00791-9>
- IV. **Kukk, K. & Akkermann, K.** (2020). Towards integrated models of binge eating. manuscript submitted for publication.

The author of the current dissertation contributed to the listed publications as follows:

- Study I: Participation in designing the study; organizing the study and collecting the data; analyzing the data; interpretation of results; writing the manuscript as the main author
- Study II: Participation in designing part of the study; collecting part of the data; writing part of the manuscript as a coauthor.
- Study III: Participation designing the study; organizing the study; analyzing the data; interpretation of results; writing the manuscript as the main author
- Study IV: Participation in designing the study; organizing the study and collecting the data; analyzing the data; interpretation of results; writing the manuscript as the main author

## ABBREVIATIONS

AN	<i>anorexia nervosa</i>
APA	American Psychiatric Association
BE	binge eating
BED	binge eating disorder
BMI	Body Mass Index
BN	<i>bulimia nervosa</i>
DERS	Difficulties in Emotion Regulation Scale
DSM-5	Diagnostic and Statistical Manual of Mental Disorders (5 <sup>th</sup> edition)
ED	eating disorder
EDAS	Eating Disorder Assessment Scale
EMA	ecological momentary assessment
ER	emotion regulation
LOC	loss of control
NA	negative affect
NA MSSD	fluctuations in negative affect
OBE	objective binge eating
OE	overeating
PA	positive affect
PA MSSD	fluctuations in positive affect
PANAS-X	Positive and Negative Affect Scale
PNEES	The Positive and Negative Emotional Eating Scale
SBE	subjective binge eating

# 1 INTRODUCTION

Eating is mostly regulated by homeostatic processes involving hormones designed to preserve energy balance. However, eating can occur in the absence of energy depletion. Eating in response to cues other than hunger is defined broadly as nonhomeostatic eating. These cues can be, for example, contextual, behavioral, emotional and cognitive. Further, there are likely individual differences in the vulnerability to eating in response to such cues (Racine, Hagan, & Schell, 2019). Overeating and binge eating are aspects of nonhomeostatic eating (Goldschmidt, 2017) that can influence a person's mental and physical health such as increasing the risk of psychological disturbances and overweight (Bedrosian, Striegel, Wang, & Schwartz, 2012). As obesity and eating disorder rates are growing worldwide (World Health Organization, WHO, 2020) and are associated with numerous other health concerns, it is important to further assess the risk factors of overeating and binge eating.

## 1.1 Binge eating and overeating

### 1.1.1 Definitions

Binge eating is defined by eating a large quantity of food during a brief period of time accompanied by a feeling of loss of control (LOC) (American Psychiatric Association, APA, 2013). Additionally, at least three of the following characteristics must also be present for an objective binge eating (OBE) episode: eating much more rapidly than normal, eating until feeling uncomfortably full, eating large amounts of food when not feeling physically hungry, eating alone because of feeling embarrassed by one's behavior and subsequent feelings of depression, guilt or disgust with oneself (Diagnostic and Statistical Manual of Mental Disorders, DSM-5; APA, 2013). Binge eating is a core diagnostic criterion of eating disorders (ED) such as binge eating disorder (BED), *bulimia nervosa* (BN) and binge-purge type of *anorexia nervosa* (AN) (APA, 2013).

Overeating is defined by consumption of a large quantity of food during a brief period of time without the feeling of LOC (Goldschmidt, 2017). Given that overeating is not a part of a clinical syndrome, while binge eating is, overeating has received far less attention in the literature on its prevalence and risk factors.

### 1.1.2 Loss of control

Some researchers discuss that overeating and binge eating lie along the continuum of normal to disordered eating with the latter being more pathological (Davis, 2013). Others discuss that these may be separate constructs, albeit highly overlapping (Racine et al., 2019). By definition, LOC is the key component

differentiating overeating and binge eating. Binge eating is thought to be more related to psychopathology due to LOC and subsequent feelings of guilt and shame (Wolfe, Baker, Smith, & Kelly-Weeder, 2009). Indeed, it has been found that binge eating is associated with more psychological distress and impaired health-related functioning (Goldschmidt et al., 2015) and emotion regulation difficulties (Racine & Horvath, 2018) compared to overeating, supporting the more pathological nature of binge eating. However, some researchers have found that those who experience overeating do not differ significantly from those with binge eating in terms on psychological adversities (Kelly, Cotter, & Guidinger, 2018).

Although presence of both overeating and LOC (i.e. objective binge eating, OBE) is required for the diagnosis of an ED, several studies have questioned this approach's validity as a criterion (Jenkins, Conley, Hoste, Meyer, & Blissett, 2012; Wolfe et al., 2009). Indeed, LOC has been found to be more significant psychopathological indicator than the amount of food eaten (Jenkins et al., 2012). Studies comparing OBE and subjective binge eating (SBE; eating a *subjectively* large quantity of food accompanied by LOC) have not found significant differences in their effects on various psychopathological variables such as distress, ED symptoms and general psychopathology (Latner, Hildebrandt, Rosewall, Chisholm, & Hayashi, 2007; Palavras, Morgan, Borges, Claudino, & Hay, 2013). Thus, disregarding SBE may result in underdiagnosing EDs.

LOC has also been found to associate most with psychological disturbance as it is accompanied by intense feelings of upset and remorse (Colles, Dixon, & O'Brien, 2008). Although any overeating (with or without LOC) is associated with negative health consequences (Goldschmidt et al., 2015), LOC has been found to be uniquely linked to adverse effects on health and general psychopathology beyond the effects of eating a large quantity of food (Latner et al., 2007; Sonnevile et al., 2013). LOC is also associated with poorer quality of life (Jenkins et al., 2012). Additionally, LOC, but not the amount of food consumed, has been found to be associated with higher premeal negative affect (Goldschmidt et al., 2012). Interestingly, it has been found that LOC eating, not overeating, predicted incident overweight (Sonneville et al., 2013). Nevertheless, individuals with overeating or SBE have a higher risk of developing OBE compared to those without any disordered eating (Goldschmidt et al., 2015).

### 1.1.3 Prevalence

Although binge eating is a symptom of ED it occurs at a subclinical level in general community as well. The prevalence of binge eating ranges between 4.5–44% in clinical and community samples (Hudson, Hiripi, Pope, & Kessler, 2007; Napolitano & Himes, 2011). Stice and colleagues (2013) reported that by the age of 20, 18% of women experience binge eating at a subclinical level. It has been found that up to 41% of female students experience binge eating every

week and 15% of them binge eat daily (Vanderlinden, Grave, Vandereycken, & Noorduin, 2001). Furthermore, the rates of disordered eating behavior, e.g. binge eating, has been found to grow over time in the general population, especially among college students (Mitchison, Touyz, González-Chica, Stocks, & Hay, 2017; White, Reynolds-Malear, & Cordero, 2011). The prevalence of overeating has been found to be 18% in women and 26% in men (Striegel-Moore et al., 2009).

#### **1.1.4 Comorbidity and potential health concerns**

Binge eating is associated with mental and physical health problems and lowered quality of life (Bedrosian et al., 2012). According to Hudson and colleagues (2007), 59.5% of those who experience binge eating have a comorbid anxiety disorder and 44% have a comorbid mood disorder. Moreover, 45 % of individuals who experience binge eating and have a comorbid disorder have three or more comorbid disorders. Similarly, 84.8% of patients with BN and 73.8–79.0% of BED meet the criteria for other mental disorder (Grilo, White, & Masheb, 2008; Kessler et al., 2013). Binge eating has been shown to be associated with depression, panic disorder, phobias and alcohol dependence (Bedrosian et al., 2012).

Majority of individuals who report binge eating have been found to be overweight or obese (Bedrosian et al., 2012; Hudson et al., 2007; Kessler et al., 2013). Binge eating and related EDs are prospectively associated with obesity in adolescents (Marzilli, Cerniglia, & Cimino, 2018) and adults (Kessler et al., 2013; McCuen-Wurst, Ruggieri, & Allison, 2018). It has been found that individuals who suffer from binge eating at a young age have an increased risk of developing various adverse outcomes in (early) adulthood, such as anxiety and depressive symptoms (Marzilli et al., 2018) and psychological distress (Mustelin, Bulik, Kaprio, & Keski-Rahkonen, 2017) both in men and women. Similarly, binge eating is associated with medical concerns related to overweight (Kelly et al., 2018; Mustelin et al., 2017). EDs characterized by binge eating such as BN and BED have a higher odds ratio of various chronic physical conditions such as diabetes, hypertension, ulcers and heart attacks compared to controls (Kessler et al., 2013). BED, for instance, is linked to metabolic syndrome, which in turn is associated with aforementioned health concerns such as diabetes and cardiovascular problems over and above obesity (Hudson et al., 2007; Kessler et al., 2013). Similarly, those who experience binge eating are more likely to miss work due to illness (Bedrosian et al., 2012).

Interestingly, although the rate of binge eating is growing, it has been found that the clinical significance (i.e. the association between binge eating and the impairment in mental and physical health related quality of life) has slightly decreased over time (Mitchison et al., 2017). The authors discussed whether binge eating has become more “normative” and less stigmatized and thus less

distressing. Nevertheless, binge eating is still associated with various mental and physical health concerns and thus needs further attention.

## **1.2 Risk factors of binge eating**

In addition to physiological needs, eating can be influenced by external (e.g. food cues) and internal factors (e.g. emotions) (Canetti, Bachar, & Berry, 2002; Michael Macht, 2008; Marcus & Wildes, 2009). Below, I will describe several established risk factors of binge eating and outline some of the most cited theories pertaining them.

### **1.2.1 Dietary restraint**

Restrained eating behavior such as dieting is a common risk factor for all EDs (Hilbert et al., 2014) contributing to both the onset and maintenance of EDs (Stice, 2002). Further, dietary restraint is consistently associated with binge eating (Bulik, Sullivan, Carter, & Joyce, 1997; Goldschmidt et al., 2012; Racine, Burt, & Klump, 2011; Stice, 2002). Thus, early models of binge eating have highlighted the role of dietary restraint in binge eating (Polivy & Herman, 1985). The association between restraint and binge eating has been explained by physiological reactions (a response to energy deficiency), and psychological processes such as goal-conflict model (Stroebe, Koningsbruggen, Papies, & Aarts, 2012), resource depletion (Vohs & Heatherton, 2000), overly rigid rules that enable all-or-nothing thinking (Polivy & Herman, 1985), and paradoxical effects of food-related thought suppression (Buchanan, Sheffield, & Tan, 2019). Interestingly, it has been discussed that restrained eaters are vulnerable to overeating irrespective of actual caloric restriction due to general preoccupation with food and eating (Stice, Martinez, Presnell, & Groesz, 2006). Moreover, restraint intention has been found to be better predictor of binge eating compared to restraint behavior (Larsen, van Strien, Eisinga, Herman, & Engels, 2007). These findings suggest that the relationship could be partially cognitively mediated as dieters apply cognitive control to restrain their eating rather than relying on physiological cues.

Furthermore, it has been found that those who restrain their eating are more vulnerable to overeating in response to negative emotions (Evers, Dingemans, Junghans, & Boevé, 2018) and stress (Greeno & Wing, 1994). Thus, dietary restraint and negative affect interact in predicting binge eating (Woods, Racine, & Klump, 2010). It has been speculated that strong emotions may interfere with cognitive control and thus lead to binge eating (Polivy & Herman, 1993). Furthermore, Carrard and colleagues (2012) found that a subgroup characterized with both high dietary restraint and high negative affect reported higher binge eating frequency among individuals with BED.

### **1.2.2 Affective state**

Studies suggest that affective states can influence eating (Canetti et al., 2002; Michael Macht, 2008). It has been speculated that those who eat in response to emotions might have poor interoceptive awareness and thus have difficulties distinguishing between different physiological sensations (van Strien & Ouwens, 2007). Similarly, stress has been associated with increased eating in the literature (Greeno & Wing, 1994; Torres & Nowson, 2007). Moreover, animal studies have suggested that stress can induce eating via changes in hypothalamic–pituitary–adrenal axis functioning (Marcus & Wildes, 2009).

Overall negative affective state has been associated with binge eating and negative emotions have been found to precede binge eating in various studies (Haedt-Matt & Keel, 2011; Smyth et al., 2007). In accord, binge eating has been found to be more likely on days with higher negative mood and more daily stressors (Smyth et al., 2007; Stevenson, Dvorak, Wonderlich, Crosby, & Gordon, 2018). In contrast, negative affect has not been found to precede overeating (Berg et al., 2015; Goldschmidt et al., 2012). However, there may be subtypes vulnerable to overeating in response to emotions, such as emotional eaters.

Positive emotions have received markedly less attention in the eating behavior research. Some studies have found that positive emotions can elicit binge eating as well (Bongers, Jansen, Havermans, Roefs, & Nederkoorn, 2013; Evers, Adriaanse, de Ridder, & de Witt Huberts, 2013) and are associated with increased food intake (Evers et al., 2018). Eating in response to positive emotions has been explained with hedonic motives and associative learning as celebrations and social gatherings are often accompanied by food (Evers et al., 2013). However, some ecological momentary assessment (EMA) studies suggest that negative affect increases and positive affect decreases prior to binge eating episodes (Smyth et al., 2007). Still, there are ambivalent findings regarding the trajectories of emotions preceding and succeeding binge eating suggesting that there might be additional factors mediating or moderating these associations.

### **1.2.3 Fluctuations in affect**

Changes in emotions can also influence eating behavior. Research shows that individuals who consistently experience rapidly changing emotions exhibit impaired coping skills and are therefore more vulnerable to engaging maladaptive behaviors when experiencing strong emotions (Anestis, Peterson, et al., 2009). Several studies have shown a link between emotional instability and binge eating (Stevenson et al., 2018; Zander & de Young, 2014). For example, Anestis and colleagues (2010) found that individuals with higher emotional fluctuations exhibited a higher average number of binge eating episodes on any given day. Another study found an association between instability of positive emotions and psychological distress (Gruber, Kogan, Quoidbach, & Mauss,

2013). However, to our knowledge there are currently no studies regarding the associations between overeating and emotional instability. In our studies the term fluctuations in affect is used as it refers to the tendency to experience emotions that quickly change. Other terms such as emotional instability, emotional lability and emotional variability have been used interchangeably in the literature.

#### **1.2.4 Emotion regulation difficulties**

Above-described findings have led researchers to discuss whether binge eating is associated with the need to regulate one's emotions. Emotion regulation refers to group of automatic and controlled processes involved in the initiation, maintenance, and modification of the occurrence, intensity, and duration of emotions (Gross, 2008). There are various strategies that one can use to regulate one's emotions, however not all of them are adaptive. Adaptive ones include acceptance, problem solving and reappraisal, while rumination, avoidance and suppression are often maladaptive (Gross, 2008). Affect regulation theory of binge eating conceptualizes binge eating as a self-regulatory failure that is maintained via negative reinforcement, meaning that negative emotions alleviate after a binge eating episode. It has been speculated that binge eating may regulate negative emotions by providing escape from self-awareness (Heatherton & Baumeister, 1991), or masking of other problems (Polivy & Herman, 1993). Others have implied a "trade-off" as initial negative emotions are substituted for a less distressing consequence such as guilt after a binge eating episode (Kenardy, Arnou, & Agras, 1996). Taken together – all these models imply distressing emotions and a need to regulate them.

Some studies have indeed found that negative affect subsides after a binge eating episode (Berg et al., 2015; Smyth et al., 2007) but the results are inconsistent. Furthermore, a meta-analysis concluded that there appears to be no mood-enhancing effect, moreover the negative affect increased post-binge (Haedt-Matt & Keel, 2011). The ambivalent results regarding the emotion regulation aspect of binge eating may be due to methodological challenges as it is difficult to determine the exact temporal position of the binge eating episode. Also, it may indicate possible impact of mediating or moderating factors affecting the relationship between emotions and eating. For instance, among obese individuals emotion regulating effect of binge eating has been found (Berg et al., 2015).

However, the need to regulate one's emotions may still precipitate binge eating, as difficulties in emotion regulation have been associated with binge eating (Svaldi, Griepenstroh, Tuschen-Caffier, & Ehring, 2012). Specifically, binge eating has been found to be associated with lack of emotional clarity, non-acceptance of emotional reactions and dysfunctional emotion regulation strategies (Bodell et al., 2019; Harrison, Sullivan, Tchanturia, & Treasure, 2010; Prefit, Căndea, & Szentagotai-Tătar, 2019; Svaldi et al., 2012; Vine & Aldao, 2014; Whiteside et al., 2007). In line with that, emotion regulation

difficulties seem to increase with symptom severity or binge frequency (Kenny, Singleton, & Carter, 2017; Lavender et al., 2014; Svaldi et al., 2012) and the improvement in emotion regulation is linked to mitigation of ED symptoms (Mallorquí-Bagué et al., 2018; Racine & Wildes, 2015). Individuals with overeating episodes only have found to report less emotion regulation difficulties comparing to those with LOC eating or binge eating but still more than individuals without any pathological eating (Racine & Horvath, 2018). Similarly, ED patients tend to have fewer adaptive emotion regulation strategies (Svaldi et al., 2012).

Emotion dysregulation is an established transdiagnostic risk factor and is thought to play a role in both development and maintenance of all EDs (Danner, Sternheim, & Evers, 2014; Fairburn, Cooper, & Shafran, 2003) but especially those with binge eating (Mallorquí-Bagué et al., 2018).

### **1.2.5 Preoccupation with body image and body weight**

Disturbances with body image are considered core psychopathology of EDs in the most cited ED model (the cognitive-behavioral model by Fairburn, Cooper & Shafran, 2003) contributing to the maintenance of disordered eating. These disturbances comprise overvaluation of body weight and image, which is defined as paying excessive attention to bodyweight in evaluating one's self worth, and body dissatisfaction that refers to negative evaluation of one's bodyweight and/or shape. These aspects of body image are often used interchangeably in the literature or referred to in more broader terms such as "weight/shape concerns" (Mitchison et al., 2017). We conceptualize preoccupation with body image and body weight as an "umbrella term" reflecting overvaluation of body weight, body dissatisfaction and concern with potential negative judgments from others. Empirical studies have associated these constructs with dieting as well as binge eating (Andrés & Saldaña, 2014; Grilo et al., 2008; Mitchison et al., 2017) and psychopathology (Grilo et al., 2008). It has been suggested that body image disturbances such as body dissatisfaction lead to binge eating through dieting (Andrés & Saldaña, 2014; Stice, 2001). However, a study showed that higher body dissatisfaction was a better prediction of bulimic symptoms (e.g. binge eating) than dietary restraint (Johnson & Wardle, 2005). In line with that, individuals with higher body satisfaction had lower risk of binge eating regardless of bodyweight status (Sonneville et al., 2012).

### **1.2.6 Personality traits**

Personality traits can posit a vulnerability factor to mental disorders, including EDs. More specifically, negative affectivity or neuroticism from the Five-Factor model (Costa & McCrae, 1992) is considered a general risk factor for

psychiatric disorders such as mood disorders, anxiety and EDs (Hilbert et al., 2014). Of the five personality dimensions, neuroticism, low conscientiousness and low extraversion have been found to be associated with EDs (Farstad, McGeown, & von Ranson, 2016) and eating disorder symptomatology such as binge eating (Lee-Winn, Townsend, Reinblatt, & Mendelson, 2016) and eating in response to emotions (Ellickson-Larew, Naragon-Gainey, & Watson, 2013). Moreover, neuroticism can predispose one to several eating disorder risk factors and additionally influence the coping strategies thus contributing both to the development and maintenance of disordered eating. Indeed, neuroticism has been found to predict negative affect, body dissatisfaction (Ellickson-Larew et al., 2013) and emotion regulation difficulties (Barańczuk, 2019). Moreover, investigations whether and how personality overlaps with clinical traits relevant to psychopathology, such as emotion dysregulation, have led to conclusions that although emotion regulation difficulties and personality traits overlap considerably, they are distinguishable constructs that make incremental contributions beyond one another in predicting various clinical symptoms and diagnoses (Stanton, Rozek, Stasik-O'Brien, Ellickson-Larew, & Watson, 2016).

Other relevant dispositional factors associated with ED symptoms, including binge eating, are impulsiveness, perfectionism, avoidance motivation (Farstad et al., 2016). There are mixed results on the association of impulsivity and binge eating (Lee-Winn et al., 2016), probably due to the multifaceted nature of impulsivity (comprising lack of planning, sensation seeking, lack of perseverance, negative urgency) and the lack of consensus on its definition (Whiteside & Lynam, 2001). Moreover, different aspects of impulsiveness can affect different aspects of (eating) behavior (Meule, 2013). This further complicates the research on the relationship between impulsivity and eating behavior. However, researchers have agreed that it is important to acknowledge the importance of emotion-based rash action in affecting eating behavior. Negative urgency – a tendency to act rashly when experiencing negative emotions – has been frequently associated with bulimic behavior, including binge eating (Anestis, Peterson, et al., 2009; Fischer, Smith, & Cyders, 2008) and it is considered to be a construct integrating negative emotionality and impulsivity (Fischer et al., 2008; Whiteside & Lynam, 2001).

### **1.2.7 Bodymass**

Research has shown that individuals who binge eat, tend to have a higher body mass index (BMI) (Stice, 2002). Moreover, higher BMI is associated with body dissatisfaction, pressure to be thin and restrained eating (Goldfield et al., 2010; Stice, 2002; Stice & Whitenton, 2002). Stice (2002) discussed that higher BMI can lead to negative affect and body dissatisfaction due to societal pressure. This, in turn, predisposes one to disordered eating behavior such as dieting and binge eating. Another study found that the association between BMI and binge

eating was mediated rather by the perception of oneself as overweight that is linked to body dissatisfaction (Saules et al., 2009).

### 1.3 Gender differences

The literature on ED and eating behavior has predominately focused on female samples due to the general notion that ED prevalence is higher among women than men (Hudson et al., 2007; Raevuori, Keski-Rahkonen, & Hoek, 2014). Indeed, the point prevalence of ED among women is 2.3–8% and among men .3–2.5%. Lifetime prevalence of any ED among women is found to be 5.6%, among men 2.24% (Duncan, Ziobrowski, & Nicol, 2017). The lifetime prevalence of any binge eating among women is 4.9–5.41 and 4.0–4.05% among men (Duncan et al., 2017; Hudson et al., 2007) and 12-month prevalence 2.5 and .9–1.9% respectively (Duncan et al., 2017; Hay, Mond, Buttner, & Darby, 2008; Hudson et al., 2007; Mitchison & Mond, 2015). However, another study has not found significant gender differences in the point-prevalence of binge eating (Gruzca, Przybeck, & Cloninger, 2007). A study by Striegel-Moore et al (2009) reported that men are more likely to experience overeating while women were more likely to experience loss of control while eating. Furthermore, the rates of disordered eating are growing in both men and women (Hay et al., 2008; White et al., 2011) and the difference in the prevalence rates between men and women is closing (Hilbert, de Zwaan, & Braehler, 2012). However, as men are less studied, there is a gap in knowledge regarding both the prevalence and the risk factors of disordered eating in men.

Studies conducted in BED individuals have shown that men are more likely to have higher BMI and women exhibited higher ED related pathology while there were no differences in binge eating frequency (Lydecker & Grilo, 2018). Several studies have found that compared to women, men report less LOC although they exhibit similar eating behavior (Carey, Saules, & Carr, 2017; Reslan & Saules, 2011). Another study found that men in clinical trials for BED reported lower levels of weight and shape concerns than women (Shingleton, Thompson-Brenner, Thompson, Pratt, & Franko, 2015). A qualitative study found that men perceive overeating as masculine and are thus less distressed about it (Carey et al., 2017). These results have led to an interpretation that men experience less pathological form of overeating which is reflected on the BED prevalence rates (Carey et al., 2017). In contrast, ED symptoms (e.g. binge eating) have been found to be similarly debilitating for both men and women (Bedrosian et al., 2012; Bentley, Mond, & Rodgers, 2014; Mitchison, Hay, Slewa-Younan, & Mond, 2014). One study found that objective binge eating was associated with greater impairment in mental health related quality of life among men but less impairment in physical health related quality of life (Mitchison et al., 2014). In similar vein, while dietary restraint has so far been associated more with women, a German study found, that the gender differences in the prevalence are decreasing (Hilbert, De Zwaan, & Braehler, 2012).

Similarly, 2.4% of men reported to engage in extreme caloric restriction weekly (Mitchison et al., 2014). Still, among individuals with BED, men exhibit less dietary restraint compared to women (Velázquez López, Vázquez Arévalo, & Mancilla Díaz, 2018).

Regarding risk factors, some studies conducted on male samples show similar associations as among women. For instance, LOC, but not overeating, has been associated with more dietary restraint and excessive exercising among men (as well) (Kelly et al., 2018). Similarly, emotion regulation difficulties have been associated with binge eating in men (Lavender & Anderson, 2010). However, women have been found to be more vulnerable to stress-induced eating whereas men are more likely to use other emotion regulation strategies such as drinking alcohol and smoking in response to stress (Torres & Nowson, 2007). Studies comparing men and women with BED have shown that men report less concern over food and body image (Velázquez López et al., 2018) as well as body dissatisfaction and drive for thinness (Barry, Grilo, & Masheb, 2002).

As there are few studies assessing eating behavior, e.g. binge eating, among men, researchers stress the need to expand the literature on male eating behavior (Bedrosian et al., 2012; Bentley et al., 2014).

## **1.4 Towards an integrative model of binge eating**

Current models of binge eating tend to focus on either the dietary restraint or the emotion regulation pathway. A frequent critique to the above described restraint theory and emotion regulation theory is that they are overly simplistic and do not explain all of the binge eating. For instance, not all people who experience binge eating restrain their eating (McManus & Waller, 1995; Waters, Hill, & Waller, 2001). Moreover, empirical studies indicate the role of moderating and mediating factors that need to be considered for a more comprehensive model of binge eating. For example, it has been found that eating expectancies mediated the effect of emotion dysregulation on binge eating and this relationship was moderated by anticipatory reward (Smith et al., 2018). Similarly, ED-specific risk factors (such as dietary restraint) are thought to enhance the effect of the high-risk traits (such as negative urgency, neuroticism, emotion regulation difficulties) resulting in disordered eating (Racine & Martin, 2017).

Consequently, growing number of studies are geared towards building models that integrate various transdiagnostic and disorder-specific risk factors as they seem to interplay (Pearson, Wonderlich, & Smith, 2015; Smith et al., 2018). A review of the theoretical and empirical models by Burton and Abbott (2017) concluded that the factors most in common in these models were dieting, negative affect, emotion regulation, low self-esteem and preoccupation with body, shape and weight. The transdiagnostic model of eating disorders (Fairburn et al., 2003) and integrated cognitive behavioral model of eating disorders (Williamson, White, York-Crowe, & Stewart, 2004) include most of these

variables with the former being more empirically supported. A newer model by Burton and Abbott (2019) integrates low self-esteem, negative affect, emotion regulation difficulties, restraint and eating beliefs in predicting binge eating in a community sample of men and women. In that model, low self-esteem is the source of negative affect, which in turn leads to difficulties in regulating emotions. Emotion regulation difficulties further lead to binge eating via two pathways: dietary restraint (as an attempt to gain some control) and eating beliefs (as a way to cope with negative emotions) (Burton & Abbott, 2019). However, it is plausible that emotion regulation is not always the aim of dietary restraint. Additionally, negative affect may arise from other sources besides low self-esteem, such as internal (e.g. thoughts) and external events.

Nevertheless, current integrative models target limited factors and / or focus on either state or trait aspects. Additionally, most comprehensive models (such as transdiagnostic model of EDs) have been developed and tested on clinical samples thus hindering implications for subclinical levels of binge eating.

## **2 AIMS OF THE STUDY**

The aim of the doctoral thesis was to assess emotion regulation difficulties and other relevant risk factors influencing binge eating and overeating. Specifically, the aim was to specify the nature of binge eating and overeating, and clarify these constructs exploring the associations with ED symptoms, emotion regulation difficulties, and emotional experience (Studies I, II, III). As research on eating behavior among men is limited, an important aim of the thesis was to test whether two of the most discussed pathways of binge eating– emotion regulation and dietary restraint – are valid among men (Study III). Additionally, we sought to investigate potential gender differences in risk factors of binge eating (Studies I and III). Finally, we aimed to integrate important risk factors including emotion regulation difficulties, dietary restraint, negative affect, fluctuations in negative affect and preoccupation with body image and body weight predicting binge eating among women (Study IV).

## **3 MATERIALS AND METHODS**

### **3.1 Participants**

#### **Women**

The sample of Study I and IV consisted of 97 women with mean age of 21.4 (SD = 3.04). The BMI ranged from 17.4 to 32.7 (M = 21.7, SD = 3.18). One participant was excluded from Study IV due to scale-level missing data on the personality measure. The sample of Study II was a subsample of the above described 97 women comprising 60 female participants with the mean age of 21.6 (SD = 2.85). Participants were recruited via university mailing lists, social media, advertisements in local campuses and libraries. Data was collected from spring 2013 to early spring 2015 in two waves.

#### **Men**

The sample of Study I consisted of 61 men with mean age of 24.1 (SD = 6.70), BMI ranged from 17.8 to 31.1 (M = 23.5, SD = 2.65). The sample of Study III consisted of 104 men of whom 61 were the same as in the Study I. Additional 46 men were obtained from a study with similar design. Three participants were excluded from Study III due to scale-level missing data. The two samples did not differ in terms of mean number of overeating and BE episodes per day, difficulties in emotion regulation and ED symptoms as measured by below described self-report measures, thus justifying the merge. The mean age of the participants was 27.3 (SD = 8.02, range 17–60) with a mean BMI of 24.2 (SD = 2.92, range 17.79–34.72). Participants were recruited via university mailing lists, social media and advertisements in local campuses.

### **3.2 Measures**

#### **3.2.1 Ecological momentary assessment (Studies I, II, III and IV)**

The data from EMA was used in all studies. The EMA was programmed and conducted with palmtop computers using the freeware software (Studies I, II, IV) and smartphone app (PACO app) (Study III). The duration of the study was 3 days in Studies I, II and IV, and 7 days in Study III. Both in 3- and 7-day period, the devices signaled randomly 7 times per day (from 8:30 am to 23:05 pm). Participants were informed about the type of questions with special emphasis on the questions regarding binge eating episodes and its definitions. The compliance rate for the EMA was 80.4% for women (Studies I, II and IV) and 71.3% for men (Study III).

### **3.2.1.1 Mean affect (EMA measure)**

At each occasion of EMA measurement, participants were asked to indicate on a 4-point (Studies I, II and IV) or 9-point (Study III) Likert-type scale (1 = *not at all* to 4 = *to a large extent*) the extent to which each of the emotion-related adjectives described their current emotional state as quickly and accurately as possible. Mean negative affect (NA) was aggregated based on following emotions assessed via EMA: *sadness, shame, guilt, irritation, tedium, anxiousness, anger, disappointment* (Studies I and IV) and *boredom, sadness, shame, loneliness, guilt, irritation, tedium, anxiousness, anger, disappointment* among men (Study I and III). Mean positive affect (PA) was aggregated based on following emotions: *excitement, joy, satisfaction, confidence, motivation* (Study I).

### **3.2.1.2 Fluctuations in negative and positive affect**

Fluctuations in negative affect (NA MSSD) and positive affect (PA MSSD) were measured by using mean squared successive differences (MSSD) formula – the squared difference in NA/PA ratings across successive EMA measurements (Ebner-Priemer, Eid, Kleindienst, Stabenow, & Trull, 2009).

### **3.2.1.3 Eating behavior**

Binge eating and overeating was assessed via EMA with two items: “Have you had a binge eating episode after the last signal?”, if yes “During that episode did you experience a loss of control over eating?”. If both items were answered affirmatively then binge eating was registered, if the latter was “no” then overeating was registered.

## **3.2.2 Positive and Negative Emotional Eating Scale (Study II)**

The Positive and Negative Emotional Eating Scale (PNEES; Sultson, Kukk, & Akkermann, 2017) consists of 19 items that measure eating in response to various positive and negative emotions. Participants were instructed to indicate on a five-point Likert-type scale ranging from 0 (never) to 4 (very often) the extent to which the item describes their eating behaviour. The scale has two subscales: Positive emotional eating and Negative emotional eating, which consist of 7 and 12 items, respectively.

## **3.2.3 Difficulties in Emotion Regulation Scale (Studies I, III and IV)**

The Difficulties in Emotion Regulation Scale (DERS) (Gratz & Roemer, 2004) is a 36-item, self-report questionnaire designed to assess multiple aspects of emotion regulation difficulties. The Estonian version consists of 34 items. The measure yields six subscales: non-acceptance of emotional responses, difficulties engaging in goal directed behavior, impulse control difficulties, lack of

emotional awareness, limited access to emotion regulation strategies, lack of emotional clarity.

### **3.2.4 Positive and Negative Affect Scale (Study I and II)**

The Positive and Negative Affect Scale (PANAS-X) (Watson & Clark, 1988; the Estonian version Allik & Realo, 1997) comprising 20 items, assesses the specific and distinguishable emotional states that emerge from within the broader general dimensions of positive and negative emotional experience.

### **3.2.5 Eating Disorders Assessment Scale (Studies I, III and IV)**

The Eating Disorders Assessment Scale (EDAS) (Akkermann, 2010) is a 29-item self-report scale with four subscales measuring ED symptoms: restrained eating, binge eating, purging and preoccupation with body image and body weight (from now on preoccupation). The scale was designed to screen for individuals with ED from the general population and the subscales have shown good internal consistency and discriminant validity.

### **3.2.6 “Short Five” (Study IV)**

“Short Five” (S5; Konstabel, Lönnqvist, Walkowitz, Konstabel, & Verkasalo, 2012) is a 60-item questionnaire constructed for measuring 30 facets of the Five-Factor Model for personality. The neuroticism subscale was used in the analyses.

### **3.2.7 Barratt Impulsiveness scale (Study I)**

The Barratt Impulsiveness Scale (BIS-11) (Patton, Stanford, & Barratt, 1995, Estonian version Paaver, 2007) was designed to assess different aspects of impulsiveness. The total score was used in the analyses.

## 4 RESULTS AND DISCUSSION

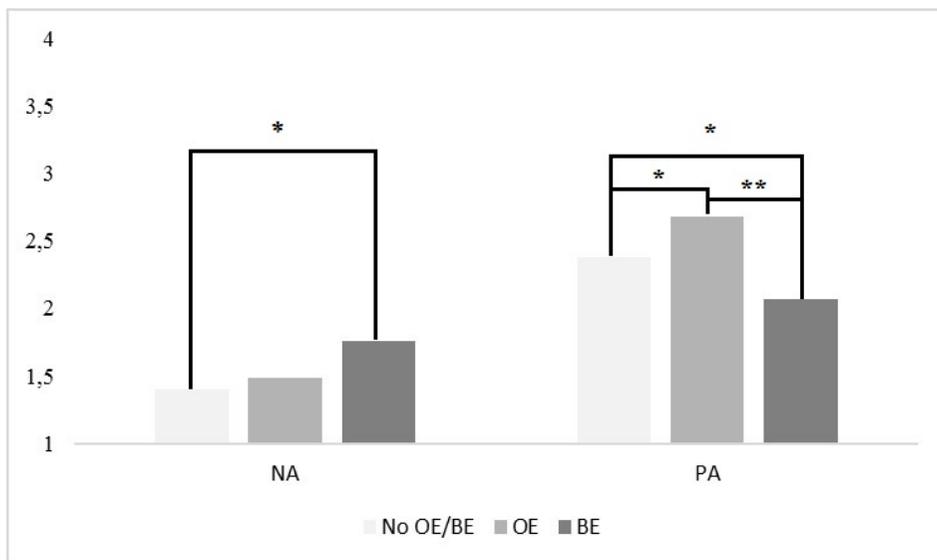
### 4.1 Differentiating overeating and binge eating (Study I, II and III)

Binge eating and overeating have been considered both on the continuum of nonhomeostatic eating with the former being more pathological (Davis, 2013). It has been discussed that the loss of control aspect which is a crucial element of binge eating is the most salient indicator of psychopathology regardless of the amount of food eaten (Latner et al., 2007). We found that the number of binge eating episodes measured via EMA correlated positively with most self-reported ED symptoms both in women and men (Study 1). However, overeating was not correlated with ED symptoms, with the exception that among men overeating was positively correlated with EDAS total score and its subscale preoccupation. Similarly, binge eating, but not overeating, was positively correlated with difficulties in emotion regulation.

In accord, both men and women who experienced binge eating episodes during the study period reported significantly higher levels of ED symptoms and emotion regulation difficulties compared to those who did not experience any overeating. Moreover, binge eaters had the highest scores and those without overeating / binge eating had the lowest scores among both men and women while overeaters fell in-between (Table 1). This is in accord with previous studies showing that binge eating is associated with disordered eating behavior (Kelly et al., 2018; Lewinsohn, Seeley, Moerk, & Striegel-Moore, 2002) and difficulties in emotion regulation (Racine & Horvath, 2018) when comparing to overeating (Goldschmidt et al., 2015). Similarly, it has been found that emotion regulation difficulties increase as the pathology increases (Agüera et al., 2019; Lavender et al., 2014).

Regarding eating in response to emotions, in Study 2 we assessed the associations between self-reported positive and negative emotional eating, binge eating and overeating. Overeating was significantly correlated with positive emotional eating (measured via PNEES) while binge eating was not associated with either positive or negative emotional eating. When comparing emotional antecedents of binge eating and overeating (unpublished data) among both men and women, negative affect was significantly higher and positive affect was significantly lower before binge eating episode compared to measurements where no overeating / binge eating was reported (see Figure 1). However, overeating and no overeating / binge eating conditions did not differ in the degree of preceding negative affect. Similarly, Goldschmidt and colleagues (2016) found among obese individuals that LOC, but not the amount of food consumed, was associated with higher premeal negative affect. However, we found that positive affect was significantly higher before an overeating episode compared to both a binge eating episode and when no overeating / binge eating was reported. Although mean levels of positive affect or fluctuations in positive affect were

associated with neither overeating nor binge eating (Study I), temporal associations suggest that positive emotions may play a role in eliciting overeating but not binge eating.



**Figure 1. Mean positive affect and negative affect before overeating, binge eating and when no overeating / binge eating was reported.** Note: PA – positive affect, NA – negative affect, OE – overeating, BE – binge eating, No OE/BE – no overeating

A meta-analysis (Cardi, Leppanen, & Treasure, 2015) showed that healthy participants consumed significantly more food after positive or negative mood was induced compared to neutral mood. Conversely, eating elicited by positive emotions may indicate hedonic motives as positive emotions have been linked to enhanced pleasantness of food and increased enjoyment food (Macht, 1999). Additionally, it may be that positive emotions contribute to overall wellbeing and affect the attitude towards (over)eating and serve as a resilience factor against binge eating. Conversely, prior negative emotions may make the individual more vulnerable to dysfunctional inferences thus leading him or her to be unable to control one’s behavior potentially resulting in binge eating. Nevertheless, the ambivalent findings regarding the associations between emotions and eating behavior are likely due to differences in methodology (i.e. naturalistic studies vs. experimental studies), aspects of eating behavior in focus (i.e. increase in food intake vs. binge eating) and/or potential mediating and moderating factors (i.e. emotion regulation difficulties).

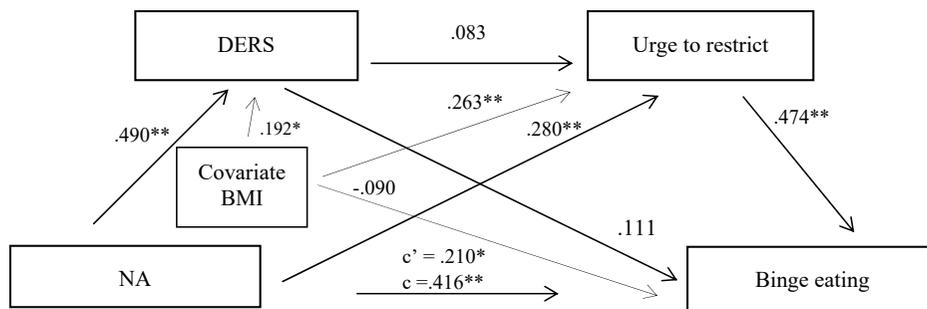
Taken together, these results support the differentiation between binge eating and overeating as the former is associated with more ED psychopathology both in men and women. Additionally, models of binge eating comprising negative

affect and difficulties in emotion regulation did not predict overeating (Studies I and III) implying different etiology. While studies indicate that overeating and binge eating (or LOC eating) are distinct, albeit overlapping constructs (Racine et al., 2019), the gradual increase in psychopathology in observed groups may reflect the developmental course of disordered eating (Davis, 2013). It has been found that overeaters are at higher risk of developing binge eating and further eating disorders (Goldschmidt et al., 2015) as the eating can become more uncontrollable and compulsive (Davis, 2013). Some researchers discuss that in some individuals binge eating and BED can further develop into a “food addiction” which is considered a form of behavioral addiction encompassing withdrawal, tolerance and social/emotional difficulties. However, the concept of “food addiction” has not found consistent support in the literature and is currently under debate (Adams et al., 2019).

## **4.2 Binge eating and emotion regulation difficulties (Studies I, II, III and IV)**

Significant association between negative affect and binge eating was found in Studies I, II, III and IV corroborating previous findings (Berg et al., 2015; Smyth et al., 2007). Vast studies showing a link between negative affect and binge eating have led researchers to discuss whether binge eating serves as a function of regulating one’s emotions (Haedt-Matt & Keel, 2011). Similarly, when comparing emotional antecedents, negative affect was highest before a binge eating episode in comparison to overeating and no overeating / binge eating condition (unpublished data), implying a need to regulate one’s emotions. We also found significant univariate associations between emotion regulation difficulties and binge eating among both men and women (Studies I, III and IV). However, it is plausible that emotion regulation difficulties interplay with emotional disturbances such as high negative affect and emotional instability in predicting binge eating. The interactions between emotion regulation difficulties and affective variables – negative affect and fluctuations in negative affect – were significantly associated with binge eating among women (Study I and IV). Interestingly, emotion regulation difficulties lost its significance within an integrated model among women (see below Fig 3). Conversely, we found that emotion regulation difficulties mediated the effect of negative affect on binge eating among men (Study III) but not among women (unpublished data, see Figure 2). These results suggest that the relationship between emotion regulation difficulties and binge eating is not straightforward and emotion regulation difficulties play a role in binge eating in conjunction with other variables. Thus, emotional disturbances alone might not lead to binge eating if a person has adequate skills to regulate them. Similarly, emotion regulation difficulties need actual emotional disturbances to manifest into action. This is in line with the affect regulation theory, which posits that if a person experiences negative emotions that one does not know how to regulate adequately, he or she might

utilize dysfunctional strategies such as binge eating (Whiteside et al., 2007). Thus, it is plausible that emotion dysregulation represents a vulnerability factor and emotional disturbances serve as triggers setting off a binge eating episode.



Note: \*  $p < .05$ , \*\*  $p < .01$ ,  $c'$  = direct effect,  $c$  = total effect

**Figure 2. Integrated model of emotion regulation and urge to restrict among women.**

### 4.3 Binge eating and urge to restrict (Studies I, III and IV)

Dieting is considered a precipitating and maintaining factor of binge eating in many studies (Polivy & Herman, 1985). We found that self-reported dietary restraint (measured via EDAS) and momentary urge to restrict (measured via EMA) were significantly correlated with binge eating in both men and women (Study I, III, IV). Moreover, the urge to restrict had the strongest main effect on binge eating within an integrated model in women (Study IV). These results are in line with previous studies showing that individuals who restrain their eating are more vulnerable to binge eating (Andrés & Saldaña, 2014; Goldschmidt et al., 2012; Racine et al., 2011). As urge to restrict reflects intention rather than actual dietary restraint, our results suggest that the relationship between restraint and binge eating is partially cognitively mediated (for instance, due to preoccupation with food and eating) rather than just a physiological reaction. Also, it has been found that restraint intention may even be a better predictor of disordered eating than self-reported restraint behavior (Rodgers, Fuller-Tyszkiewicz, Holmes, Skouteris, & Broadbent, 2018). However, the urge to restrict (measured via EMA) and EDAS subscale restraint, which reflects both restraint intention and dietary restraint, were positively correlated.

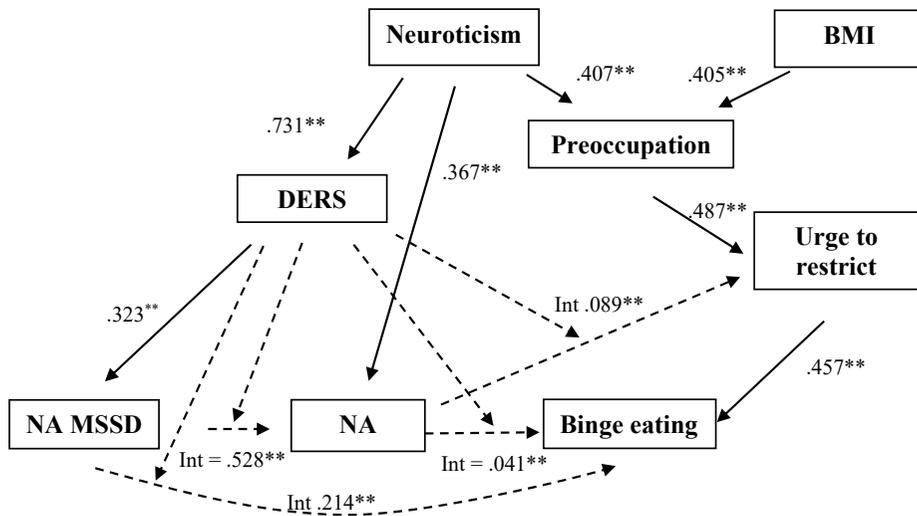
Further, it has been found that restrained eaters are more vulnerable to eating in response to emotions (Evers et al., 2018). We did not see a significant interaction between negative affect and urge to restrict in predicting binge eating in women (Study IV). However, we found that urge to restrict mediated the effect

of negative affect on binge eating in both men (Study III) and women (unpublished data, see Figure 2).

#### **4.4 The integrated model of binge eating (Study IV)**

In Study IV we aimed to integrate the above-described associations along with neuroticism as a trait level risk factor into one model to elaborate the interrelations of different risk factors in predicting binge eating. This model (Figure 3) highlighted the multifaceted role of emotion regulation difficulties as it acted as a moderator in predicting binge eating both directly and indirectly. We found that the interaction between emotion regulation difficulties and fluctuations in negative affect was associated with mean negative affect. It is possible that constant changes in the emotional experience without the ability to regulate them leads to overall increases in negative affect. Similarly, the interplay between emotion regulation difficulties and negative affect predicted the urge to restrict among women. While emotion regulation difficulties independently predict binge eating, the main effect of emotion regulation difficulties on these variables was not significant within a multiple regression model. These results suggest that emotion regulation difficulties are not a robust predictor of binge eating but rather a transdiagnostic vulnerability factor related to various maladaptive behaviors in conjunction with other risk factors (e.g. negative affect).

Moreover, we found that emotion regulation and restraint pathways are relatively independent from each other in predicting binge eating. This is also supported by the findings in Study III where both emotion regulation difficulties and urge to restrict independently mediated the effect of negative affect on binge eating among men while we did not find an association between emotion regulation difficulties and urge to restrict. However, we found that the interplay between emotion regulation difficulties and negative affect was associated with urge to restrict in women. This implies that restraint could be partly driven by the need to regulate one's emotions via distraction or tentative sense of control. The results from Study IV suggest that restraint and emotion regulation pathways operate concurrently but emotion regulation can contribute to restraint indirectly.



Note: Standardized coefficients. Dashed lines represent moderation, Int. = interaction effect. \*  $p < .05$ , \*\*  $p < .01$ . DERS – Difficulties in Emotion Regulation Scale; NA – negative affect, measured via EMA; NA MSSD – fluctuations in negative affect, based on EMA measures.

**Figure 3. Structural model of emotional experience, emotion regulation difficulties, neuroticism, preoccupation with body image and body weight momentary urge to restrict in predicting binge eating among women.**

Unsurprisingly, neuroticism was associated with binge eating, ED symptoms, emotion regulation difficulties and negative affect. This is in accord with previous research showing that neuroticism is a robust predictor of psychopathology (Hilbert et al., 2014). However, in our integrative model, we view neuroticism as an indirect predictor of binge eating as it is associated with emotion regulation difficulties and preoccupation, which in turn contribute to binge eating more directly. This is supported by previous research conceptualizing neuroticism as a higher order vulnerability factor affecting lower order risk factors (Naragon-Gainey, 2011).

Impulsivity is often associated with binge eating (Lee-Winn et al., 2016). We did not see this association among women while among men impulsivity was a significant predictor of binge eating (Study I). Thus, impulsivity was not included in the integrated model among women. However, impulsivity is a multifaceted trait and different instruments have found to measure different aspects of impulsiveness (Meule, 2013). Accordingly, different aspects of impulsiveness show differential associations with dysfunctional behavior such as binge eating (Espel, Muratore, & Lowe, 2017). Of the impulsiveness facets, negative urgency has been found to be most predictive of binge eating (Anestis, Smith, Fink, & Joiner, 2009).

As the integrated model was based on cross-sectional data, it precludes causal inferences. It is plausible that there are bidirectional relations between the variables. For instance, binge eating may cause more negative affect and the need to restrain one's eating resulting in dysfunctional feedback loops that maintain the problem of binge eating. Further longitudinal studies are necessary for specifying causal relationships.

#### **4.5 Gender differences (Studies I, III and IV)**

Regarding the prevalence of overeating and binge eating, men and women showed similar rates of occurrence during the three-day study period. Of men, 55.4% experienced overeating and 26.9% experienced binge eating, among women the rates were 57.1% and 21.7% respectively. Similarly, the frequency of binge eating and overeating (mean number of binge eating or overeating episodes per day) did not differ among men and women. The evidence so far is mixed regarding gender differences in the prevalence of binge eating. Some studies report higher rates of binge eating among women (Hudson et al., 2007) while others claim no differences (Grucza et al., 2007).

In general, similar associations between binge eating, overeating and emotion regulation difficulties emerged among men and women. Meaning that binge eating was associated with emotion regulation difficulties, eating disorder symptoms and momentary negative affect in both men and women. Group comparisons indicated similar patterns within men and women as those who reported binge eating showed more emotion regulation difficulties and eating disorder symptoms compared to those who did not endorse any form of overeating (with or without LOC).

However, regarding eating pathology, men scored significantly lower in EDAS and its subscales compared to women. Similar tendencies appeared regarding subscales of DERS, with the exception of nonawareness of emotional reactions where men scored significantly higher. When comparing men and women some gender differences emerged among those who experienced overeating, binge eating and no overeating (see Table 1). Among those who endorsed overeating and those without overeating or binge eating women scored significantly higher in eating disorder symptoms and emotion regulation difficulties compared to men in respective groups. However, no such differences emerged between men and women within the binge eating group. Women had still significantly higher scores in the EDAS total score but not in its subscales. These results are in line with previous studies, which have shown that men and women who binge eat experience similar psychosocial and clinical impairment associated with eating disorder behavior, including binge eating (Bentley et al., 2014). Thus, although women seem to be generally more vulnerable to eating disorder symptoms men “catch up” with them once they start binge eating i.e. exhibit similar associations with ED symptoms and emotion regulation difficulties.

Conversely there appeared slight differences in bivariate analysis where among women, the number of overeating episodes was not correlated with any disordered eating behavior nor emotion regulation difficulties (apart from the subscale lack of emotional awareness which was negatively correlated), while among men the number of overeating episodes was correlated with EDAS total score and its subscale preoccupation. This is somewhat contrary to the notion that men are less vulnerable to negative inferences about overeating and consider it somewhat masculine (Carey et al., 2017). However, a recent study showed that overeating was associated with depressive symptoms and emotion dysregulation in men but not in women (Racine et al., 2019). These discrepancies further highlight the need to specify the role and risk factors of male eating behavior.

In study I we aimed to model binge eating via emotion regulation difficulties, eating disorder symptoms, negative affect, fluctuations in negative affect and impulsiveness. The models differed slightly among men ( $n = 61$ ) and women ( $n = 97$ ). Among women, emotion regulation difficulties as well as its interaction with fluctuations in negative affect were significant predictors of binge eating. Among men, in the joint model, emotion regulation difficulties were not a significant predictor while impulsiveness was (which was not significant in women). Similarly, when testing the integrated model of state and trait variables (Study IV) among a larger sample of men ( $N = 104$ ), the model did not fit the data well [ $\chi^2 = 76.76$  (18); CFI = .829; TLI = .744; RMSEA = .179 (90% CI .139, .221)]. Upon closer inspection, the moderating effects of emotion regulation difficulties were not significant in predicting binge eating. Similarly, in Study III we found that emotion regulation difficulties and urge to restrict mediated the effect of negative affect on binge eating. However, among women emotion regulation difficulties were not a significant mediator while urge to restrict was (Figure 2). Our results suggest that the role of emotion regulation difficulties is somewhat different in men and women. In women it serves as a moderating variable that enhances the effect of emotional variables such as negative affect and fluctuations in negative affect. In men, emotion regulation difficulties seem to have a mediating effect, however the cross-sectional data hinders causal inferences.

**Table 1. Gender differences based on the EMA reporting of binge eating, overeating and when no overeating / binge eating was reported.**

	Women without OE/BE (n=42)		Men without OE/BE (n=42)		ANOVA		Women with OE (n=36)		Men with OE n=35		ANOVA		Women with BE (n=21)		Men with BE (n=27)		ANOVA	
	M(SD)	M(SD)	F	p	M(SD)	M(SD)	F	p	M(SD)	M(SD)	F	p	M(SD)	M(SD)	F	p		
<b>BMI</b>	21.51 (3.07)	23.10 (2.35)	6.84	<b>.010</b>	21.80 (3.57)	24.85 (2.94)	15.20	< <b>.0001</b>	21.86 (2.94)	25.34 (3.20)	14.62	< <b>.0001</b>	21.86 (2.94)	25.34 (3.20)	14.62	< <b>.0001</b>		
<b>EDAS total score</b>	37.95 (15.0)	21.33 (10.14)	34.85	< <b>.0001</b>	44.67 (18.6)	32.79 (12.51)	9.70	<b>.003</b>	57.35 (14.36)	46.46 (19.61)	4.36	<b>.043</b>	57.35 (14.36)	46.46 (19.61)	4.36	<b>.043</b>		
<b>Restrainted eating</b>	12.80 (5.67)	7.67 (6.12)	15.48	< <b>.0001</b>	14.44 (7.25)	11.53 (5.20)	4.90	<b>.030</b>	17.15 (6.19)	13.77 (6.09)	3.43	<b>.071</b>	17.15 (6.19)	13.77 (6.09)	3.43	<b>.071</b>		
<b>Binge eating</b>	14.20 (7.06)	8.21 (4.84)	20.23	< <b>.0001</b>	15.69 (7.0)	11.53 (6.17)	6.94	<b>.010</b>	19.60 (6.64)	17.00 (7.72)	1.44	<b>.236</b>	19.60 (6.64)	17.00 (7.72)	1.44	<b>.236</b>		
<b>Purging</b>	.43 (1.43)	.119 (.45)	1.74	.191	.778 (1.88)	.353 (.81)	1.47	.230	1.20 (1.51)	1.04 (1.68)	.11	.738	1.20 (1.51)	1.04 (1.68)	.11	.738		
<b>Preoccupation</b>	10.48 (7.70)	5.33 (3.57)	15.27	< <b>.0001</b>	13.56 (7.54)	9.82 (6.23)	5.07	<b>.028</b>	19.80 (9.46)	14.65 (9.86)	3.19	<b>.081</b>	19.80 (9.46)	14.65 (9.86)	3.19	<b>.081</b>		
<b>DEERS total score</b>	69.36 (14.47)	67.31 (14.81)	3.69	.531	80.14 (14.6)	67.63 (13.69)	13.72	< <b>.0001</b>	86.80 (14.77)	78.93 (25.09)	1.56	.218	86.80 (14.77)	78.93 (25.09)	1.56	.218		
<b>Goal-directedness</b>	16.49 (5.24)	16.86 (6.43)	.080	.778	19.69 (5.94)	16.77 (5.73)	4.36	<b>.041</b>	21.55 (5.06)	19.19 (6.58)	1.76	.191	21.55 (5.06)	19.19 (6.58)	1.76	.191		
<b>Lack of clarity</b>	13.67 (3.12)	14.19 (3.90)	.440	.509	15.57 (4.52)	13.97 (4.18)	2.37	.129	17.35 (4.73)	16.35 (5.33)	.441	.510	17.35 (4.73)	16.35 (5.33)	.441	.510		
<b>Impulse control</b>	6.74 (3.05)	5.48 (1.66)	5.51	<b>.021</b>	7.57 (3.33)	6.63 (2.56)	1.64	.205	8.45 (4.80)	7.69 (5.33)	.324	.572	8.45 (4.80)	7.69 (5.33)	.324	.572		
<b>Non-acceptance</b>	7.44 (2.95)	6.79 (2.81)	1.04	.312	8.69 (4.16)	7.11 (3.11)	3.20	.078	8.75 (3.75)	8.67 (4.33)	.005	.945	8.75 (3.75)	8.67 (4.33)	.005	.945		
<b>Non-awareness</b>	10.18 (4.25)	12.14 (3.92)	4.67	<b>.034</b>	10.29 (4.11)	12.06 (4.20)	3.18	.079	10.20 (3.09)	13.42 (5.08)	6.24	<b>.016</b>	10.20 (3.09)	13.42 (5.08)	6.24	<b>.016</b>		
<b>Limited strategies</b>	12.46 (5.14)	11.86 (4.32)	.33	.568	15.49 (5.53)	11.09 (3.95)	14.66	< <b>.0001</b>	16.60 (4.85)	15.27 (7.26)	.50	.484	16.60 (4.85)	15.27 (7.26)	.50	.484		
<b>BIS-11</b>	58.30 (9.09)	57.00 (13.52)	.26	.612	60.40 (9.37)	52.18 (9.17)	13.53	< <b>.0001</b>	61.55 (7.47)	60.73 (15.95)	.045	.833	61.55 (7.47)	60.73 (15.95)	.045	.833		
<b>PANAS-X positive emotions</b>	33.65 (7.09)	28.31 (9.13)	8.69	<b>.004</b>	32.89 (6.65)	28.85 (8.67)	4.81	<b>.032</b>	31.05 (6.92)	22.31 (11.46)	9.06	<b>.004</b>	31.05 (6.92)	22.31 (11.46)	9.06	<b>.004</b>		
<b>PANAS-X negative emotions</b>	21.53 (6.93)	17.98 (10.81)	3.10	.082	26.06 (7.50)	15.94 (10.44)	21.86	< <b>.0001</b>	26.80 (8.70)	20.46 (9.03)	5.74	<b>.021</b>	26.80 (8.70)	20.46 (9.03)	5.74	<b>.021</b>		

Note: EDAS – Eating Disorder Assessment Scale, DEERS – Difficulties in Emotion Regulation Scale, BIS-11 – Barratt’s Impulsiveness Scale, PANAS – The Positive and Negative Affect Scale. OE – overeating, BE – binge eating, DERS subscales: Goal-directedness – difficulties in engaging in goal-directed behavior, Lack of clarity – lack of emotional clarity, Impulse control – impulse control difficulties; Non-acceptance – non-acceptance of emotional responses; Non-awareness – lack of emotional awareness, Limited strategies – limited access to emotion regulation strategies

## 5 SUMMARY, CONCLUSIONS AND FUTURE DIRECTIONS

The main aim of the current dissertation was to assess the associations between binge eating, overeating and emotion regulation difficulties among men and women. Additionally, we aimed to develop a more comprehensive overview of the risk factors playing a role in binge eating by integrating several established risk factors into one model. The dissertation aimed to expand the literature on eating behavior in men and test emotion regulation and restraint pathways among them. This also enabled us to assess potential gender differences in the prevalence and risk factors of overeating and binge eating.

Binge eating is common among non-clinical population as approximately quarter of participants experienced binge eating during the study period. We found support for the differentiation of overeating and binge eating as the latter was more associated with various psychopathological indices. More specifically, binge eating was associated with emotion regulation difficulties, eating disorder symptoms, negative affect and neuroticism while overeating was not. Furthermore, the results are in line with the hypothesis that overeating and binge eating represent different gradations of pathological eating. Although overeating was not associated with psychopathological indices it may further develop into binge eating and needs thus attention as well. The results also highlight the importance of loss of control during eating. Future research would benefit of differentiating overeating, binge eating and loss of control eating (without the large amount of food eaten) in order to develop more effective prevention and treatment programs.

The investigation of the binge eating risk factors revealed that emotion regulation difficulties, urge to restrict, momentary negative affect and fluctuations in negative affect, neuroticism and preoccupation with body image and body weight play a role in precipitating binge eating on different levels. Structural equation modeling showed that neuroticism has an indirect role in predicting binge eating in women as it is associated with preoccupation with body image and body weight and emotion regulation difficulties, which in turn, predict binge eating.

The role of emotion regulation difficulties was also specified. Among women, emotion regulation difficulties had a moderating effect on emotional variables measured via EMA (negative affect and fluctuations in negative affect) in predicting binge eating among women. Whereas among men emotion regulation difficulties mediated the effect of negative affect on binge eating. Among both men and women urge to restrict also predicted binge eating and mediated the effect of negative affect on binge eating. The results suggest that both emotion regulation and restraint pathways are important in predicting binge eating and they seem to operate independently from one-another. However, there are still many potentially important factors (e.g. negative urgency, perfectionism) that should be tested within an integrated model for a more comprehensive understanding of the precipitants of binge eating.

A promising line of research is to specify the temporal associations between binge eating and specific emotions using EMA. It is plausible that there are key emotions precipitating binge eating. In addition, more attention should be paid to positive emotions as well. It is likely that by aggregating emotions into mean values some important associations with specific emotions might have gotten lost.

Gender differences in the prevalence rates and risk factors of binge eating were minor. Both men and women reported similar rates of binge eating and overeating. Binge eating had similar associations with eating disorder symptoms, emotion regulation difficulties, urge to restrict and emotional variables in men and women. Slight differences emerged in the specific role of emotion regulation difficulties as described above (moderator vs. mediator). Additionally, among men, but not among women, impulsivity was significantly associated with binge eating. An important future direction is to further expand the research on eating behavior among men as it is still inconclusive. It is possible that there are specific risk factors among men that may not be significant among women.

The results of the thesis give practical implications for developing more comprehensive treatment and prevention programs. For instance, including both the emotion regulation (e.g. teaching adaptive emotion regulation strategies) and dietary restraint (e.g. educating on the effects of dietary restraint) in the prevention programs could be more effective than focusing on only one of them.

## **ACKNOWLEDGEMENTS**

First and foremost I would like to thank my supervisor, Kirsti Akkermann, for motivating and encouraging me throughout the doctoral studies. I am grateful for her advice and ideas that have been an essential input for my scientific endeavors. She has also played an important role as a supervisor in my clinical practice. I'm also thanking Anu Aluoja for providing valuable feedback and suggestions regarding this doctoral thesis.

I am grateful to my support group throughout bachelor's, master's and doctoral studies – Iris Velling, Karmen Vool and Maria Kivimäe. Their support and words of encouragement have helped me immensely.

I would also like to thank our writing camp group – Kärol Soidla, Elis Paasik, Sheryl Võsu and Hedvig Sultson – for both productive and entertaining time as well as interesting and amusing discussions that have uplifted me.

Most of all, I would like to thank my friends and family, especially Meelis, Juku and the little one, for their endless support and love that has kept my spirits up throughout different challenges.

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## SUMMARY IN ESTONIAN

### Ülesöömise ja liigsöömise riskitegurid – integreeritud mudeli väljatöötamine

Ülesöömine ja liigsöömine on häirunud söömiskäitumise ilmingud, mida esineb sagedasti ka tavapopulatsioonis. Üleöömine ja liigsöömine on seotud mitmete psühholoogiliste ja kehaliste probleemidega, nende seas söömishäired ja ülekaalulisus. Kuna nii häirunud söömiskäitumine kui ka ülekaalulisus on maailmas kasvava tendentsiga, on ülesöömise ja liigsöömise riskitegurite uurimine jätkuvalt aktuaalne. Käesoleva doktoritöö eesmärk oli uurida ülesöömise ja liigsöömise riskitegureid, integreerides seejuures olulisemaid riskitegureid ühes mudelis. Lisaks oli töö eesmärgiks laiendada teadmisi meeste söömiskäitumisest, kuna mehed on selles vallas väga alauuritud. See võimaldas uurida ka soolisi erinevusi söömiskäitumises ja nende riskitegurites.

Ülesöömiseks nimetatakse tavapärasest oluliselt suurema toidukoguse söömist. Liigsöömine on oluliselt suurema toidukoguse söömine, millega kaasneb kontrollikadu söömise üle. Liigsöömine on mitmete söömishäirete, nagu liigsöömishäire, *bulimia nervosa* ja ülesööv-väljutavat tüüpi *anorexia nervosa* oluline sümptom. Kontrollikadu söömise üle seostatakse nii söömishäirete kui üldiselt psühhopatoloogiaga, seejuures on mitmed uurijad arvamusel, et kontrollikadu võib olla isegi olulisem näitaja kui söödud toidukogus. Käeoleva doktoritöö tulemused on nende leidudega kooskõlas, sest liigsöömine, kuid mitte ülesöömine, seostus söömishäirete sümptomite ja emotsiooniregulatsiooni raskustega nii naistel kui ka meestel (Uurimus I). Ühtlasi leidsime, et enne liigsöömist on negatiivse afekti tase kõrgem, seevastu aga enne ülesöömist oli positiivse afekti tase oluliselt kõrgem. Tulemused viitavad kontrollikao olulisusele söömiskäitumisel. Edasised uurimused võiksid veelgi enam eristada erinevaid häirunud söömiskäitumise tüüpe kontrollikao baasil, näiteks ülesöömine, liigsöömine ja kontrollimatu söömine (ingl kl. *loss of control eating*, viidates kontrollikaole ilma ebatavaliselt suurt toidukogust söömata) täpsustamaks nende riskitegureid. Ehkki ülesöömine on vähemal määral seotud psühhopatoloogia ilmnemisega, väärub selle riskitegurite uurimine senisest rohkem tähelepanu, kuna ülesöömine võib edasi kujuneda liigsöömiseks.

Enimsiteeritud liigsöömise teooriad on piiramise ja emotsiooniregulatsiooni teooriad. Piiramise teooria kätkeb toitumise piiramist (nt dieedipidamine, näljutamine) kui olulist liigsöömise riskitegurit. Seejuures võib toitumise piiramine mõjutada nii füsioloogilisel (nälja mõju kehas) kui ka psühholoogilisel (liigselt jäigad reeglid söömise korrigeerimiseks) tasandil. On leitud, et need, kes piiravad oma toitumist, kogevad rohkem liigsöömist. Emotsiooniregulatsiooni teooria viitab sellele, et liigsöömist võidakse kasutada emotsioonide reguleerimiseks, st. negatiivsete emotsioonide leevendamiseks. Seda teooriat toetavad leiud, et negatiivne afekt tõuseb vahetult enne liigsöömist ning liigsöömine seostub emotsiooniregulatsiooni raskustega. Teisalt on tulemused liigsöömise meeolelu parandava mõju osas ambivalentsed. Käesolev doktoritöö leidis, et nii

piiramine kui ka emotsiooniregulatsiooni raskused mängivad rolli liigsöömise ennustamisel nii meeste kui ka naiste seas (Uurimused III ja IV). Seejuures viitavad tulemused sellele, et piiramise ja emotsiooniregulatsiooni “rajad” toimivad teineteisest sõltumatult liigsöömise ennustamisel.

Lisaks toidupiiramistungile ja emotsiooniregulatsiooni raskustele kaasime naiste valimil integreeritud mudelisse (Uurimus IV) neurootilisuse, hõivatuse välimusest ja kehakaalust, kehamassi indeksi (KMI) ning emotsionaalse kogemuse näitajad (negatiivne afekt ja negatiivse afekti kõikumine) mõõdetuna kogemuse väljavõtte meetodiga (ingl kl. *ecological momentary assessment*), et hinnata nende näitajate omavahelist koosmõju. Integreeritud mudelis ennustasid liigsöömist tung piirata, emotsiooniregulatsiooni raskuste koosmõju negatiivse afektiga ning emotsiooniregulatsiooni raskuste koosmõju negatiivse afekti kõikumisega. Neurootilisus ennustas ootuspäraselt emotsiooniregulatsiooni raskusi ja hõivatust välimusest ning kehakaalust. Mudelis ilmnis emotsiooniregulatsiooni raskuste mitmekülgne roll moderaatorina – emotsiooniregulatsiooni raskused koosmõjus negatiivse afekti kõikumisega ennustasid negatiivse emotsiooni kogemist ja liigsöömist, ning emotsiooniregulatsiooni raskused koosmõjus negatiivse afektiga ennustasid nii liigsöömist kui ka tungi söömist piirata. Seejuures emotsiooniregulatsiooni raskuste peamõju polnud statistiliselt enam oluline kui võtta arvesse toidupiiramistungi ja ülal mainitud koosmõjusid. Need tulemused viitavad sellele, et ainuüksi emotsionaalsest kogemusest ega emotsiooniregulatsiooni raskustest ei piisa liigsöömise vallandamiseks, vaid oluline on nende koosmõju. Seega emotsiooniregulatsiooni raskused viivad liigsööamiseni juhul, kui esineb ka tugev negatiivne afekt või negatiivse afekti kõikumine.

Meeste ja naiste erinevused liigsöömise ja ülesöömise riskitegurites olid vähesed. Meestel ja naistel esines nii ülesöömist kui ka liigsöömist sarnasel määral. Liigsöömine seostus nii meestel kui ka naistel söömishäirete sümptomite ja emotsiooniregulatsiooni raskustega. Tung söömist piirata vahendas negatiivse afekti mõju liigsöömisele nii meeste (Uurimus III) kui naiste seas. Erinevus oli emotsiooniregulatsiooni raskuste rollis – emotsiooniregulatsiooni raskused vahendasid negatiivse afekti mõju liigsöömisele meeste seas, naiste seas ilmnis emotsiooniregulatsiooni raskuste modereeriv mõju negatiivsele afektile liigsöömise ennustamisel. Lisaks oli erinevalt naistest meeste seas impulsiivsus oluline liigsöömise ennustaja (Uurimus I). Kui liigsöömishoogudega inimeste seas olid soolised erinevused minimaalsed, siis esines naistel võrreldes meestega oluliselt enam emotsiooniregulatsiooni raskuseid ja söömishäirete sümptomeid nende seas, kes kogesid ülesöömist ja kes ei kogenud ei ülesöömist ega liigsöömist. Need tulemused viitavad sellele, et mehed on esialgu vastupidavamad häirunud söömiskäitumise tekkeks, kuid patoloogia tekkides sarnanevad nad sümptomaatika poolest naistega. Kuna uuringuid meeste söömiskäitumise kohta on vähe, siis on vajalikud edasised uuringud täpsustamiseks spetsiifilisi riskifaktoreid, mis ei pruugi naiste valmil tehtud uuringutes ilmsiks tulla.

Kokkuvõttes leiti doktoritöös, et liigsöömine seostub emotsiooniregulatsiooni, piiramise ja negatiivse afekti ning negatiivse afekti kõikumisega. Käesoleva doktoritöö panus oli täiendada söömiskäitumise kirjandust integreerides olulisemad riskitegurid ühte mudelisse hindamaks nende koosmõjusid. Antud töö on praktiline väljund töötamaks välja tõhusamaid ravi- ja ennetusmeetodeid. Näiteks võiks liigsöömishoogude ennetamisel keskenduda emotsiooniregulatsiooni oskuste õpetamisele. Samuti on oluline ennetustöös käsitleda nii toitumise piiramist kui ka emotsiooniregulatsiooni.



## **PUBLICATIONS**

## CURRICULUM VITAE

**Name:** Katrin Kukk  
**Date of birth:** August 22, 1991  
**Citizenship:** Estonian  
**E-mail:** katrin.kukk@ut.ee

### Education:

2015–2020 Doctoral studies (PhD), University of Tartu,  
Institute of Psychology  
2013–2015 Master’s degree (MA), University of Tartu,  
Institute of Psychology  
2010–2013 Bachelor’s degree (BA), University of Tartu,  
Institute of Psychology  
2007–2010 Secondary education with highest honors,  
Tallinna Nõmme Gümnaasium  
1998–2007 Primary education, Tallinna Kivimäe Põhikool

### Employment:

2018–2019 University of Tartu, junior research fellow in clinical  
psychology  
2016–2016 University of Tartu, teaching assistant  
2017–... University of Tartu Clinic, psychiatric clinic,  
clinical psychologist

### Field of research:

eating behavior, emotion regulation, ecological momentary assessment

### List of publications:

- Kukk, K., & Akkermann, K. (2017). Fluctuations in negative emotions predict binge eating both in women and men: An experience sampling study. *Eating Disorders: The Journal of Treatment & Prevention*, 25 (1), 65–79, 10.1080/10640266.2016.1241058
- Kukk, K. & Akkermann, K. (2019). Emotion regulation difficulties and dietary restraint independently predict binge eating among men. *Eating and Weight Disorders – Studies on Anorexia, Bulimia and Obesity*, <https://doi.org/10.1007/s40519-019-00791-9>
- Sultson, H., Kukk, K., & Akkermann, K. (2017). Positive and negative emotional eating have different associations with overeating and binge eating: Construction and validation of the Positive-Negative Emotional Eating Scale. *Appetite*, 116, 423–430. <http://dx.doi.org/10.1016/j.appet.2017.05.035>

# ELULOOKIRJELDUS

**Nimi:** Katrin Kukk  
**Sünniaeg:** 22. august, 1991  
**Kodakondsus:** Eesti  
**E-post:** katrin.kukk@ut.ee

## Hariduskäik:

2015–2020 Doktorantuur (PhD), Tartu Ülikool, Psühholoogia Instituut  
2013–2015 Magistrikraad (MA), Tartu Ülikool, Psühholoogia Instituut  
2010–2013 Bakalaureusekraad (BA), Tartu Ülikool, Psühholoogia Instituut  
2007–2010 Keskkooli lõpetatud kuldmedaliga, Tallinna Nõmme  
Gümnaasium  
1998–2007 Põhiharidus, Tallinna Kivimäe Põhikool

## Teenistuskäik:

2018–2019 Tartu Ülikool, nooremteadur kliinilises psühholoogias  
2016–2016 Tartu Ülikool, õppeassistent  
2017–... Tartu Ülikooli Kliinikumi Psühhiaatrikliinik, kliiniline  
psühholoog

## Uurimistöõ põhisuunad:

söömiskäitumine, emotsiooniregulatsioon, kogemuse väljavõtte meetod

## Publikatsioonid:

- Kukk, K., & Akkermann, K. (2017). Fluctuations in negative emotions predict binge eating both in women and men: An experience sampling study. *Eating Disorders: The Journal of Treatment & Prevention*, 25 (1), 65–79, 10.1080/10640266.2016.1241058
- Kukk, K. & Akkermann, K. (2019). Emotion regulation difficulties and dietary restraint independently predict binge eating among men. *Eating and Weight Disorders – Studies on Anorexia, Bulimia and Obesity*, <https://doi.org/10.1007/s40519-019-00791-9>
- Sultson, H., Kukk, K., & Akkermann, K. (2017). Positive and negative emotional eating have different associations with overeating and binge eating: Construction and validation of the Positive-Negative Emotional Eating Scale. *Appetite*, 116, 423–430. <http://dx.doi.org/10.1016/j.appet.2017.05.035>

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