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Essi Sairanen

Behavioral and Psychological Flexibility in Eating Regulation among Overweight Adults

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ABSTRACT

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Weight-loss programs are often based on self-control techniques and they commonly fail in long-term weight management. Identifying psychological processes that explain eating behaviors can help to develop more effective interventions for long-term weight management. This research examined how behavioral and psychological flexibility are related to eating regulation and weight management in overweight adults. The first goal was to study the effects of flexible vs. rigid restraint of eating on weight-loss maintenance and well-being. The second goal was to examine whether psychological flexibility and mindfulness, independently and together, explain intuitive eating regulation. The third goal was to evaluate the mediating effects of mindfulness and psychological flexibility on enhancing intuitive eating and losing weight in acceptance and commitment therapy (ACT) interventions. The first data set included information on 49 overweight persons who participated in a weight-loss intervention. The results indicated that an increase in flexible cognitive restraint was related to better weight-loss maintenance and well-being. Moreover, a larger reduction of rigid restraint during the follow-up period was related to a better maintenance of improved psychological well-being. The second data set featured overweight, psychologically distressed persons (n = 306) who participated in psychological lifestyle interventions. The results indicated that mindfulness and psychological flexibility were related constructs that explain intuitive eating together, but also independently. The third study investigated participants of the ACT interventions (face-to-face in a group and mobile, n = 219). Changes in weight-related psychological flexibility mediated the effects of the interventions on weight and intuitive eating. These findings suggested that enhanced ability to continue with valued activities even when confronted with negative emotions and thoughts related to one's weight mediated the intervention effect in the ACT-based interventions aiming for lifestyle changes. In conclusion, this research supports flexibility and acceptance processes as a means for treating eating and weight issues.

Keywords: psychological flexibility, mindfulness, intuitive eating, acceptance and commitment therapy, flexible vs. rigid eating restraint, weight-loss maintenance, overweight.

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TIIVISTELMÄ (FINNISH ABSTRACT)

Painonpudotusohjelmat perustuvat usein itsekontrolliin pohjautuviin menetelmiin, jotka eivät yleensä toimi pitkäkestoisessa painonhallinnassa. Syömiskäyttäytymistä selittävien psykologisten prosessien tunnistaminen voi auttaa kehittämään toimivampia interventioita painonhallintaan. Tutkimuksessa selvitettiin, kuinka joustavuus on yhteydessä syömisen säätelyyn ja painonhallintaan ylipainoisilla aikuisilla. Ensimmäinen tavoite oli tutkia joustavan ja jäykän syömisen rajoittamisen yhteyksiä painonpudotuksen ylläpitämiseen sekä hyvinvointiin. Toiseksi tutkittiin, selittävätkö psykologinen joustavuus ja tietoisuustaidot intuitiivista syömisen säätelyä yhdessä tai toisistaan riippumatta. Kolmas tavoite oli selvittää, välittävätkö psykologinen joustavuus ja tietoisuustaidot muutoksia intuitiivisessa syömisessä ja painossa hyväksymis- ja omistautumisterapiaan pohjautuvissa interventioissa. Ensimmäisessä aineistossa oli 49 ylipainoista henkilöä, jotka osallistuivat painonpudotusinterventioon. Tulokset osoittivat, että joustavan syömisen rajoittamisen lisääntyminen oli yhteydessä parempaan painonpudotuksen ylläpitämiseen sekä hyvinvointiin. Lisäksi, jäykän syömisen rajoittamisen väheneminen seurantajaksolla oli yhteydessä kohonneen psykologisen hyvinvoinnin ylläpitämiseen. Toinen aineisto koostui henkilöistä, joilla oli psyykkistä kuormittuneisuutta sekä ylipainoa tai lihavuutta (n = 306) ja, jotka osallistuivat psykologisiin elämäntapainterventioihin. Tulokset osoittivat, että tietoisuustaidot ja psykologinen joustavuus ovat toisiinsa liittyviä prosesseja, jotka selittävät intuitiivista syömistä yhdessä, mutta myös toisistaan riippumatta. Kolmannessa tutkimuksessa tutkittiin hyväksymis- ja omistautumisterapia-interventioiden (kasvokkainen ryhmä- ja mobiili-intreventio) vaikutuksia (n = 219). Painoon liittyvä psykologinen joustavuus välitti intervention vaikutusta painoon ja intuitiiviseen syömiseen molemmissa hyväksymis- ja omistautumisterapiaan perustuvissa interventioissa. Tulokset viittaavat siihen, että kyky toimia arvojensa mukaisesti huolimatta mahdollisista negatiivisista painoon liittyvistä ajatuksista ja tunteista välittävät interventiovaikutusta hyväksymis- ja omistautumisterapiaan perustuvissa, elämäntapojen muuttamiseen tähtäävissä interventioissa. Tutkimuksen tulokset tukevat juostavuuden ja hyväksynnän suotuisaa vaikutusta syömiseen ja painoon vaikuttamisessa.

Avainsanat: psykologinen joustavuus, tietoisuustaidot, intuitiivinen syöminen, hyväksymis- ja omistautumisterapia, joustava vs. jäykkä syömisen rajoittaminen, painonhallinta, ylipaino.

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Essi Sairanen

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III Sairanen, E., Tolvanen, A., Karhunen, L., Kolehmainen, M., Järvelä-Reijonen, E., Rantala, S., Peuhkuri, K., Korpela, R., Ermes, M., Mattila, E. & Lappalainen, R. (2015). Weight-related psychological flexibility mediates change in intuitive eating regulation in overweight adults. Submitted manuscript.

Taking into account the instructions given and comments made by the co-authors, the author of the present thesis conducted the analyses and wrote the reports of the three publications. She also participated in collecting the data for the original intervention studies. In the ELIPA study (Study I), she participated in the data collection during the follow-up phase of the intervention study. In the Elixir study (Studies II and III), she participated in collecting the data in all phases of the intervention study. She also participated in planning the ACT mobile and face-to-face group interventions, and worked as a group leader in the ACT group interventions.

FIGURES

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1 INTRODUCTION

1.1 Psychology of weight control

Weight-loss programs based on restricted eating are becoming more and more popular in social contexts where being slim is perceived as an ideal, but being overweight is more common. The long-term benefits of such programs are questionable, as the majority of individuals eventually regain the weight they lose (Jeffery et al., 2000; Mann et al., 2007). Previous research examining the success of dieting have concluded that diets lead to short-term weight loss, usually 5–10% of body weight, but this weight loss is not maintained long-term by the majority of people (Garner & Wooley, 1991; Jeffery et al., 2000; Mann et al., 2007). About 20% of overweight adults in the general population have reported success with long-term weight loss (i.e., a reduction in weight of at least 10% maintained for at least one year; McGuire, Wing, & Hill, 1999; Wing & Phelan, 2005). Most weight-loss diets are only successful as long as people rigidly control consumption. However, poor long-term results suggest that rigid control cannot be sustained by the majority of overweight individuals. Control-based approaches to eating regulation do not appear to provide the hoped-for results in the long run.

Weight control is not a problem of knowledge. Those who participate in obesity interventions are usually motivated to lose weight and receive extensive education in the behavioral changes that are required for successful weight control. The question is why do people who learn how to eat better, exercise and monitor their behavior have difficulties implementing this new, healthier lifestyle sustainably? Health professionals looking for solutions are commonly turning to psychological variables, theories and interventions (Byrne, 2002; Wing & Hill, 2001). A conceptual review of factors associated with weight-loss maintenance concluded that the issue of weight control should be viewed primarily from a psychological viewpoint (Elfhag & Rössner, 2005).

1.1.1 Difficulties in self-regulation

Based on our evolutionary history, foods acts as a reinforcement. However, food can function like a reinforcement even when not associated to a personal learning experience. Thus, if a behavior is followed by access to food, similar behaviors occur more frequently in the future (Cooper, Heron, & Heward, 2007). Besides, pleasure gained from food (or decrease of aversive stimuli, such as hunger) may be related to many different stimuli, such us emotions, smells and other environmental factors based on personal learning history. Consequently, these stimuli may evoke food-related behaviors. These kinds of implicit, automatic processes play a major role in the generation of behaviors, and thus humans are generally likely to favor short-term hedonic pleasure and comfort over long-term objectives (Friese, Hofmann, & Wänke, 2008; Mai et al., 2011). Thus, dietary adherence demands self-regulation, which depends on the ability to maintain a continued awareness both of one's current behavior and of how that behavior compares with a relevant standard (Carver & Scheier, 2001; Miller, Galanter, & Pribram, 1986). Overeating in response to internal (e.g., emotional experiences) and external (e.g., presence of palatable food) cues can be understood as a failure of self-regulation (Forman & Butryn, 2015).

This have been conceptualized as *eating disinhibition,* defined as responsiveness to food stimuli, such as the sight or smell of food, and eating in response to positive and negative emotional states (Stunkard & Messick, 1985). Subsequent research has identified disinhibition as a feature of eating behavior most consistently correlated with obesity and higher energy intake as well as with poorer success in weight loss (Bryant, King, & Blundell, 2008). However, disinhibition is a diverse concept and, as measured by the Three-Factor Eating Questionnaire subscale, it appears to include components of food responsiveness, response to satiety and emotion-based eating. Examples include eating in response to negative affect, overeating when others are eating, not being able to resist the stimulation to eat, and overeating in response to the palatability of food (Bryant et al., 2008). Accordingly, some researchers have conceptualized disinhibition as internal (e.g., eating in response to feelings, thoughts, and cravings) and external (e.g., eating in response to external cues such as presence of palatable food) control of eating (Bond, McDowell, & Wilkinson, 2001; Karlsson, Persson, Sjostrom, & Sullivan, 2000).

At the same time, it has been suggested that people have an innate ability to respond to body signals of hunger and thus to be able to adequately regulate food intake (Birch, Johnson, Andresen, Peters, & Schulte, 1991). However, this ability can be overridden by environmental pressure or individual experiences, such as parental eating practices (Birch, Fisher, & Davison, 2003) or dieting (Herman & Polivy, 1983), that may habituate individuals to negate their body signals of hunger and satiety, resulting in becoming less sensitive to internal cues but more responsive to various environmental factors.

1.1.2 Rigid vs. flexible regulation

Weight management interventions usually include techniques that are based on behavioral or cognitive self-control models to improve cognitive restraint of eating. Although cognitive restraint of eating is considered to be a consistent predictor of weight control (Elfhag & Rössner, 2005), it has been shown to correlate considerably better with short-term weight loss than with long-term weight-loss maintenance (Linde, Rothman, Baldwin, & Jeffery, 2006; Teixeira et al., 2006; Teixeira et al., 2010). Previous studies have also suggested that the relationship between weight control and cognitive restraint of eating may change over time: eating restraint may be positive in the short term, but not necessarily in the long run (Teixeira et al., 2010).

This can be partly explained by physiological factors. Strict eating restraint may disrupt homeostasis, which may lead to weight regain following dieting. In simple terms, not eating when hungry disrupts homeostasis. Diets induce a decline in energy expenditure, reduction in leptin (satiety hormone), and increase in ghrelin (hunger hormone) (Dokken & Tsao, 2007). From an evolutionary perspective, the physical homeostatic resistance to a weight-reduced state is probably a protection against the effects of starvation. Accordingly, cognitive control can only last so long before homeostatic forces become so strong that they are irresistible.

Research concerning processing bias suggests that eating restraint may actually be counterproductive. When a person abuses a substance, he or she displays a processing bias for information in the environment relating to this substance (e.g., Cox, Fadardi, & Pothos, 2006). That is, the person will direct his or her attention toward such information and process it more extensively. Processing bias is important since it may contribute to the maintenance of the addictive behavior (e.g., Cox, Pothos, & Hosier, 2007). A well-documented result is that higher levels of restraint (i.e., attempts to limit food intake) are associated with developing a stronger food-related processing bias (e.g., Tapper, Pothos, Fadardi, & Ziori, 2008). Accordingly, the attempt to limit food intake might make food more tempting, which may explain poor long-term results in weight management. This notion is supported by the experiment showing that trying to abstain from a favorite snack while being surrounded by it, increased later consumption of the snack, at least in the case of disinhibited restrainees (Soetens, Braet, Van Vlierberghe, & Roets, 2008). These results suggest that prohibition combined with exposure may backfire and increase the risk of loss of control over eating behavior.

It is important to note that restrained eaters may not eat less than unrestrained eaters. Studies have shown that the naturalistic intake by restrained compared to unrestrained eaters does not differ significantly (Stice, Fisher, & Lowe, 2004). Indeed, while there are no studies suggesting that restrained eating predicts future weight loss, there are several studies showing that measures of restrained eating (French, Jeffery, Forster, McGovern, Kelder, & Baxter, 1994; Klesges, Isbell, & Klesges, 1992; Stice, Cameron, Killen, Hayward, & Taylor,

1999) and dieting (Lowe et al., 2006) predict future weight gain. These findings suggest that restrained eaters' hyper-responsiveness to food cues and susceptibility to disinhibitory eating is more likely part of a predisposition to weight gain rather than a consequence of chronic dieting (i.e., consuming less than expending). Second, these results suggest that while restrained eaters are not in a state of deprivation-based hunger, they may be in a state of hedonic hunger (i.e., willingness to eat that is driven by pleasure). Accordingly, Lowe and Levine (2005) have suggested that the construct of restraint might reflect eating less than one wants, rather than less than one needs.

Moreover, it has been shown that dietary restraint is not a homogeneous construct, but includes two distinct cognitive and behavioral styles: rigid control and flexible control of eating behavior (Westenhoefer, 2001). Rigid control is characterized by a dichotomous 'all or nothing' approach to eating and weight control, where periods of strict dieting alternate with periods without any weight-control effort. Flexible control, conversely, is characterized by a graduated 'more or less' approach to eating and weight control, which is understood as a long-term or even permanent task. Studies have shown that rigid restraint is consistently associated with higher body mass index (BMI) and poorer weight loss, while flexible restraint is consistently associated with lower BMI and better as well as more sustainable weight loss (Meule, Westenhoefer, & Kübler, 2011; Westenhoefer, 2001; Westenhoefer et al., 2013). As an example, in a study by Teixeira et al. (2010), while dietary restraint (flexible and rigid) predicted short-term weight reduction during a one-year obesity treatment program, only flexible dietary restraint was associated with positive follow-up outcomes after two years. Thus, the quality of restraint needs to be investigated more closely in a context of long-term weight management.

On the other hand, some previous studies have called into question the proposition by Westenhoefer et al. (1999) that flexible control is distinct from rigid control, as their shared variance appears to be substantial. Tylka, Calogero and Daníelsdóttir (2015) indicated that, in their research findings, flexible and rigid control were positively related and shared a substantial percentage of variance (i.e., slightly over 50%), which is in accordance with other studies indicating a strong, positive correlation between flexible and rigid control (Timko & Perone, 2005; Westenhoefer, 1991; Westenhoefer et al., 2013). Tylka, Calogero and Daníelsdóttir's (2015) findings further revealed that flexible control was positively related to well-being and negatively related to psychological distress and BMI only when flexible control's sizeable conceptual overlap with rigid control was removed. In practice, the promotion of flexible control (as operationalized by Westenhoefer et al. (1999) may inadvertently promote rigid control as well. Thus, more research is needed to examine flexibility in eating behavior and weight management.

More generally, non-dichotomous thinking and behavioral flexibility have been the key predictors in weight maintenance (Byrne, Cooper, & Fairburn, 2003; 2004). One qualitative study found dichotomous thinking to be a variable separating maintainers from regainers (Byrne et al., 2003). The authors found

that cognitive rigidity, such as defining success only as reaching a specified goal weight and with any other outcome being associated with absolute failure, was highly associated with weight regain. In another study, weight loss was attributable to increased behavioral flexibility, and the more the participants increased their behavioral flexibility the more weight they lost (Fletcher, Hanson, Page, & Pine, 2011). Behavioral flexibility was also negatively related to pre-intervention BMI, indicating that heavier people were more habitual and constrained in the way they behave. As a conclusion, promoting cognitive and behavioral flexibility might improve weight management.

1.1.3 Behavioral flexibility and experiential avoidance

One factor explaining behavioral (in)flexibility is experiential avoidance; that is, when confronted with difficult thoughts and feelings, some people tend to try and change or avoid these private experiences in an effort to regulate their behavior (Hayes, Luoma, Bond, Masuda, & Lillis, 2006; Lillis & Hayes, 2008). When the unwillingness to remain in contact with uncomfortable private events is allowed to guide behavior, the behavioral repertoire becomes narrowed and behavioral flexibility is reduced. Thus, experiential avoidance is an example of problematic self-regulation, which can explain eating in response to aversive internal experiences (e.g., negative emotions, cravings). The growing body of evidence suggests that experiential avoidance is a central process in the development of a range of mental health and behavioral health problems (Hayes, Luoma, Bond, Masuda, & Lillis, 2006; Lillis & Hayes, 2008). Preliminary evidence suggests that this kind of behavior is relevant to weight-related difficulties (Forman et al., 2007; Hooper, Sandoz, Ashton, Clarke, & McHugh, 2012; Lillis, Hayes, Bunting, & Masuda, 2009).

Accordingly, individuals who are unable to maintain weight loss tend to use avoidant (Byrne et al., 2003) or impulsive styles of coping (Fassino et al., 2002; Lillis & Hayes, 2008; Rydén et al., 2003) in response to stress or negative emotions. Individuals who had poor coping skills regained weight when confronted with stressful life events (Byrne et al., 2003; Gormally, Rardin, & Black, 1980). Regainers typically reported eating in response to negative emotional states as well as using escape-avoidance ways of coping, such as eating, sleeping or wishing the problem would go away (Kayman, Bruvold, & Stern, 1990). By contrast, those who successfully control their weight show more active, flexible and committed styles of adjustment (Westenhoefer, 2001). Furthermore, obese people who have difficulty losing or keeping off weight more often use food as a source of comfort and satisfaction (Castelnuovo-Tedesco & Schiebel, 1975), eat after difficult interpersonal situations (Hockley, 1979), and eat in response to negative emotions (Hudson & Williams, 1981). In addition, people who reported eating in response to negative emotions reported that eating made them feel good when they were feeling "not in control" of a situation or unable to "sort their problems out" (Byrne et al., 2003). Consequently, the pri-

mary function of emotional eating (or stress-related eating) appears to be affect reduction (Ganley, 1989), which can be seen as a form of experiential avoidance.

Experiential avoidance may also explain disinhibited eating and coping with cravings. Rigid limitations in food intake are hypothesized to evoke food cravings and make the dieter vulnerable to disinhibited and emotional eating. Binge eating can be seen as an extreme form of disinhibited eating, or eating in response to emotional states such as anxiety, depression or boredom (Allison, Grilo, Masheb, & Stunkard, 2005; De Zwaan et al., 1994; Hsu et al., 2002). Binging may in part serve to reduce negative thoughts or feelings in the short term (Barnes & Tantleff-Dunn, 2010; Ghaderi, 2003). Indeed, a recent study (Kingston, Clarke, & Remington, 2010) found that experiential avoidance mediated the relationship between negative affect and binge eating. Thus, attempting to avoid negative affect may lead to binge eating.

It has been argued that persons attempting to refrain from hedonically motivated eating will experience internal discomfort, such as cravings, powerful urges to eat, feelings of deprivation and thoughts about eating/food (Forman et al., 2007). When individuals cannot tolerate the distress associated with experiencing these states, they will be motivated to eat in order to reduce this distress. In relation to this, research has suggested that the amount of cravings experienced is less relevant to the control over eating behavior than how the cravings are received (Hooper, Sandoz, Ashton, Clarke, & McHugh, 2012). Practicing acceptance-based techniques, such as defusion (experiencing thoughts from a distance and without any implication for action), has been shown to be more effective than thought suppression for dealing with food cravings (Forman et al., 2007; Hooper et al., 2012). Constant attempting to suppress cravings might actually increase (or maintain) the wanting of palatable foods. It has been shown that trying not to think about food has a rebound effect and actually increases food-related thinking (Soetens & Braet, 2006). Accordingly, attempting to control and avoid private experiences, such as cravings or emotions, may make the dieter vulnerable to disinhibited eating.

To sum up, even though weight-loss programs based on energy restriction and self-control methods can achieve desirable and clinically significant weight-loss results, individuals rarely achieve sustained weight loss. Some psychological factors appear to be related to problems in long-term weight control, including rigidity, behavioral avoidance, disinhibition, and eating in the presence of negative emotional states. Broadly speaking, coping with difficult cognitive and emotional experiences, including food cravings, seems to play a vital role in predicting long-term weight-loss success. Experiential avoidance seems to be one factor explaining problematic behaviors related to weight control (Forman et al., 2007; Hooper et al., 2012; Lillis et al., 2009). However, this psychological process is rarely targeted in clinical trials. Instead, weight-loss programs are based on self-control techniques that commonly fail in long-term weight management.

1.2 Intuitive eating

Intuitive eating, in contrast to controlled eating, is a style of eating that follows natural contingencies of an individual's perception of physical hunger and satiety cues rather than emotional or environmental cues (Avalos & Tylka, 2006; Tylka, 2006). Three central and interrelated components of intuitive eating have been identified: 1) *unconditional permission to eat when hungry and what food is desired* (i.e., lack of restriction in eating); 2) *eating for physical rather than emotional reasons* (i.e., using food to satisfy hunger rather than to alleviate emotional distress); 3) *reliance on internal hunger and satiety cues to determine when and how much to eat* (Tylka, 2006).

Conceptually, intuitive eating (i.e., hunger motivated eating) seems to be the opposite of eating disinhibition (i.e., eating in response to emotional states or food stimuli) (Stunkard & Messick, 1985). Intuitive eating is negatively related to cognitive restraint, emotional eating, and uncontrolled eating as measured by the revised 21-item Three-Factor Eating Questionnaire (Camilleri et al., 2015). However, research has suggested that intuitive eating is more than the mere lack of eating disorder (ED) symptomatology as measured by the Eating Attitudes Test–26 (Garner, Olmsted, Bohr, & Garfinkel, 1982; Tylka & Wilcox, 2006). *Eating for physical rather than emotional reasons* and *reliance on internal hunger and satiety cues* made incremental contributions to the psychological well-being indices after the contribution of ED symptomatology was considered. Further, *unconditional permission to eat* and ED symptomatology (especially dietary restraint) overlapped substantially, such that low levels of ED symptomatology were similar to higher levels of *unconditional permission to eat* (Tylka & Wilcox, 2006). Moreover, intuitive eating is a constructs distinct from flexible control of eating behavior. Intuitive eating was inversely related to both flexible and rigid control, and contributed unique variance to well-being and BMI, above and beyond the variance contributed by flexible and rigid control among women and men (Tylka, Calogero, & Daníelsdóttir, 2015). Conceptually, the difference between intuitive eating and flexible control is that intuitive eating relies on internal hunger and satiety cues and compensation occurs naturally (e.g., not being hungry after a large meal; Tylka, Calogero, & Daníelsdóttir, 2015), whereas flexible control relies on external cues for eating (e.g., portion control, weight, and nutritional information) and compensation is conscious and effortful (Westenhoefer, 1991). Thus, intuitive eating indicates adaptive eating regulation that is separate from disordered eating behaviors and flexible eating restraint.

Dieters think about and respond to food differently than nondieters do (Baumeister, Heatherton, & Tice, 1994). Commonly, weight-loss diets are based on rules about what, how much and when to eat. Thus, eating is guided by external rules instead of internal hunger cues. Accordingly, it has been presented that dieters tend to ignore their internal cues, that is, listening to their body and being aware of hunger, and instead are guided by external cues, such as images,

aromas or time (Herman & Polivy, 1975; Rogers & Hill, 1989). Persons who have no history of dieting seem to eat more intuitively than current or former dieters (Camilleri et al., 2015). It has been shown that persons who had no history of dieting *ate more for physical reasons* and *relied more on hunger and satiety cues* than current or former dieters, for example, in a general French population (Camilleri et al., 2015). Contrastingly, current dieters had more cognitive restraint and less *unconditional permission to eat* than did former dieters, and even less than those who had never dieted. Accordingly, the factor of *unconditional permission to eat* reflects a low tendency to label some foods as forbidden or have self-imposed restrictions on eating behaviors.

In addition, intuitive eating has been associated with taking more pleasure in the selection and consumption of food, having fewer dieting behaviors and food anxieties, and having a more diverse diet (Smith & Hawks, 2006). The present research suggests that obesity may be associated with greater motivation to consume food, possibly directed at energy-dense foods, but without deriving any greater pleasure from the orosensory experience of eating (see Mela, 2006). Thus, obesity may be associated to greater wanting to eat, whereas intuitive eating might be associated to greater eating pleasure (i.e., liking). "Wanting" is likely to be affected by environmental cues and emotional experiences, whereas "liking" seems to be associated to present-moment awareness while eating. For example, in an experiment, LeBel and Dubé (2001) found that individuals whose attention was focused on the sensory experience of eating chocolate reported more pleasure than individuals engaged in a distracting task while eating chocolate. Accordingly, intuitive eating could mean "eating when hungry, and enjoying it".

Each of the three intuitive eating components are related to the absence of eating disorder symptomatology as well as to better physical and psychological well-being (Augustus-Horvath & Tylka, 2011; Avalos & Tylka, 2006; Bacon & Aphramor, 2011; Bacon, Stern, Van Loan, & Keim, 2005). For example, intuitive eaters have been found to show greater unconditional self-regard and body satisfaction and lower levels of depression and disordered eating behaviors (Bacon & Aphramor, 2011; Bacon et al., 2005; Polivy & Herman, 1992; Smith & Hawks, 2006; Tylka, 2006; Tylka & Wilcox, 2006), as well as lower body mass index, cholesterol levels and blood pressure, indicating lower cardiovascular risk (Augustus-Horvath & Tylka, 2011; Bacon & Aphramor, 2011; Bacon et al., 2005; Hawks, Madanat, Hawks, & Harris, 2005; Madden, Leong, Gray, & Horwath, 2012; Smith & Hawks, 2006; Tylka & Wilcox, 2006; Tylka, 2006).

Given that most studies on intuitive eating have used cross-sectional designs, few conclusions regarding the direction of the relationship between intuitive eating and psychosocial/physical health correlates can be drawn. A recent review of 20 studies evaluating intuitive eating interventions (Schaefer & Magnuson, 2014) indicated that a non-diet approach is promising as an effective long-term solution, that is, to improve physical, psychological and emotional well-being. The implementation of intuitive eating strategies via intervention studies has been shown to positively impact psychological health outcomes,

such as improving self-esteem and body image as well as reducing depressive symptoms (Bacon et al., 2005; Hawley et al., 2008; Provencher et al., 2009), and to decrease unhealthy eating behaviors, such as dietary restraint and binge eating, signifying a healthier relationship with food. Results regarding physiological markers of cardiovascular risk are less clear, but improvements have been identified in blood pressure, blood lipid levels, and cardiorespiratory fitness even in the absence of weight loss (Bacon et al., 2002; Bacon et al., 2005; Carroll, Borkoles, & Polman, 2007). Bush and colleagues (2014) investigated a 10-week workplace-based intervention combining intuitive eating and mindfulness (*Eat for Life*). Women in the *Eat for Life* intervention reported higher levels of body appreciation and intuitive eating and lower levels of problematic eating behaviors than did the waitlist comparison group. Mindfulness scores served as a partial mediator of change in the other outcomes, suggesting that mindfulness training can be used to increase awareness necessary for intuitive eating behaviors (Bush et al., 2014). However, experimental and otherwise rigorous methodology have not arrived at a clear understanding of whether increasing intuitive eating (as an intervention) results in a positive impact on health/weight loss among overweight individuals.

Second, few studies have attempted to explain the underlying psychological processes creating adaptive eating behavior. In addition to mindfulness skills (Bush et al., 2014), the ability to perceive one's bodily signals and the acceptance of one's body are proposed to contribute to adopting an intuitive eating style. For example, the accuracy of perceiving one's interoceptive signals (i.e., heartbeat) has predicted levels of intuitive eating, particularly based on the subscales associated with the awareness of hunger and satiety cues and the willingness to eat to satisfy hunger rather than to eat for external and emotional reasons in young women with BMI in the normal range (Herbert, Blechert, Hautzinger, Matthias, & Herbert, 2013). Moreover, interoceptive sensitivity fully mediated the negative relationship between *eating for physical reasons* as well as *reliance on hunger and satiety cues* with BMI. Additionally, the subjective appraisal of one's interoceptive signals independently (regardless of interoceptive sensitivity) predicted *eating for physical reasons* and BMI, so that those experiencing their interoceptive signals as aversive had a higher BMI and lower level of *eating for physical reasons* (Herbert et al., 2013). Thus, recognizing and accepting one's bodily sensations (i.e., not having the urge to change them and not making negative evaluations) may be essential to enable intuitive eating.

Avalos and Tylka's (2006) original acceptance model highlighted the significance of perceiving unconditional acceptance of one's self and one's body by others for promoting an intuitive eating style. The model posits that body acceptance by others helps women to appreciate their body and resist adopting an observer's perspective of their body, and it supports eating intuitively. The model was supported by the results indicating that body appreciation and resistance to adopting an observer's perspective mediated the level of body acceptance by others—intuitive eating link with women in emerging (ages 18–25 years), early (ages 26–39 years), and middle (ages 40–65 years) adulthood (Au-

gustus-Horvath & Tylka, 2011). In comparison to this more interpersonal conceptualization of acceptance, Schoenefeld and Webb (2013) suggested that a self-compassionate orientation may help foster the acceptance of internal unwanted events, which would facilitate greater engagement in an adaptive eating style. Adopting a self-compassionate stance toward difficult internal experiences related to one's body (body-image flexibility) was related to eating more intuitively. Besides this, body-image flexibility accounted for a strong positive link between self-compassion and intuitive eating. Schoenefeld and Webb further suggested that intuitive eating could be viewed as acting in accordance with one's values in the specific domain of food consumption even amidst experiencing negative thoughts and feelings regarding one's physical form.

Adopting an accepting approach to one's internal events (e.g., bodily sensations, emotions and cravings) without the need to react to them, might decrease eating based on emotions or external cues related to food, and may thus facilitate making eating decisions based on physical hunger and satiety cues. Accordingly, acceptance- and mindfulness-based cognitive behavioral therapies (e.g., dialectical behavior therapy, acceptance and commitment therapy) include methods that are in accordance with the intuitive eating approach, such as developing appetite awareness, adaptive emotion regulation skills and eating behaviors guided by hunger and satiety cues in order to treat disordered eating behaviors (Masuda & Hill, 2013). Consequently, essential behavior change processes of acceptance-based therapies, psychological flexibility and mindfulness can be used to promote intuitive eating behaviors.

1.3 Psychological flexibility and mindfulness

Psychological flexibility and mindfulness are often conceptualized as two related yet distinct adaptive regulation and coping processes that can be seen as opposites to experiential avoidance (Kashdan & Rottenberg, 2010). These two processes have been found to be related to a very wide range of behavioral changes (Bowlin & Baer, 2012; Hayes et al., 2006). Psychological flexibility refers to the ability to focus on the present moment and, depending on what the situation affords, to persist with or change one's behavior in the pursuit of goals and values (Hayes et al., 2006; Hayes, Strosahl, & Wilson, 1999). Psychological flexibility is often posited to include processes of mindfulness in relation to value-directed activities (i.e., commitment to actions). Mindfulness can be construed as an adaptive regulation process of enhanced attention to present moment experiences and a non-judgmental awareness of the present moment (Brown & Ryan, 2003; Chambers, Gullone, & Allen, 2009). Baer et al. (2006) presented evidence that mindfulness has five facets: 1) *non-reactivity* (perceiving thoughts/feelings without reacting); 2) *observing* (paying attention to internal and external sensations); 3) *acting with Awareness* (staying focused on the present-moment experience and acting deliberately); 4) *describing* (describ-

ing/labeling thoughts/feelings with words); and 5) *non-judging* (accepting thoughts/feelings without evaluating them).

Mindfulness and psychological flexibility add sensitivity to directly experiencing events and promote behavior regulation based on personal values rather than overregulating behavior via verbal relations (e.g., automatically reacting to thoughts and feelings or having rules governing behavior). Mindfulness has been posited as having four mechanisms of action: 1) self-regulation; 2) values clarification; 3) cognitive, emotional and behavioral flexibility; and 4) exposure to thoughts and emotions, which can be seen as potential mechanisms for other (well-being) outcomes (Shapiro, Carlson, Astin, & Freedman, 2006). All these mechanisms are also closely related to the process of psychological flexibility.

Since psychological flexibility and mindfulness promote the willingness to approach and experience emotions, they are likely to reduce experiential avoidance such as emotional eating, which can be perceived as an escape from experiencing negative emotions (Cochrane, Brewerton, Wilson, & Hodges, 1992). Mindfulness practice has been suggested to help individuals "connect" with their inner experiences (such as hunger), thereby attenuating their sensitivity to external or emotional cues to eat (Kristeller & Wolever, 2011). This was supported by the results of a recent study showing that mindfulness intervention diminished eating based on emotional and external cues (Alberts, Thewissen, & Raes, 2012). Through consciously bringing awareness and acceptance to experiences in the present moment, one may be better able to use a wider, more adaptive range of coping skills. Brown and Ryan (2003) demonstrated that people who scored higher on mindfulness reported significantly greater self-regulation of emotions and behaviors.

On a cognitive level, mindfulness has been proposed to reduce identification with thoughts about food, body and shape, thereby interrupting dysfunctional thinking patterns (Albers, 2011) that could predispose an individual to emotional or restricted eating. People who are high in dispositional mindfulness tend to observe their thoughts and feelings without reacting to them in maladaptive ways and therefore are better able to behave constructively even when unpleasant thoughts and feelings are present (Hayes et al., 1999). If a person is able to see a situation and her or his own internal reactions to it with greater clarity, she or he may be able to respond with greater freedom of choice (i.e., in less conditioned, less automatic ways).

The current research suggests an inverse relationship between mindfulness or psychological flexibility and disordered eating behavior. Psychological flexibility is found to be inversely associated with disordered eating cognitions such as the fear of weight gain, the perceived importance of being thin or attractive in order to be socially accepted, self-esteem based on controlled eating habits and weight gain (Masuda, Price, Anderson, & Wendell, 2010), as well as disordered eating symptoms (Rawal, Park, & Williams, 2010). Mindfulness practice has been found to decrease BMI in overweight adults (Tapper et al., 2009) as well as reducing food cravings (Alberts, Mulkens, Smeets, & Thewissen, 2010;

Alberts et al., 2012; Forman et al., 2007), dichotomous thinking, body-image concerns, emotional and external eating (Alberts et al., 2012), and binge eating (Kristeller & Hallett, 1999). Higher levels of mindfulness seem to be negatively associated with disordered eating-related cognitions (Masuda & Wendell, 2010). Furthermore, mindfulness has been found to moderate the association between disordered eating cognitions and disordered eating behaviors (Masuda, Price, & Latzman, 2012), and to partially mediate the link between disordered eating-related cognitions and psychological distress (Masuda et al., 2010; Masuda & Wendell, 2010). These findings suggest that mindfulness may attenuate the effects of harmful eating-related cognitions leading to destructive eating behaviors and psychological distress. All in all, this body of research suggests that psychological flexibility and mindfulness may promote a healthy and adaptive relationship to food and eating.

However, different facets of mindfulness may be differently associated with eating behaviors. Whereas most subscales have been inversely related to psychological symptoms, *observing* has also predicted more symptoms (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Lavender, Gratz, & Tull, 2011). Lattimore et al. (2011) found that observing was positively associated to uncontrolled eating and cognitive restraint of. Adams et al. (2012) found that *describing* and *non-judging* predicted lower symptoms of bulimia nervosa and lower body dissatisfaction, and *acting with awareness* was positively related to lower symptoms of anorexia nervosa and bulimia nervosa, whereas *observing* predicted higher anorexic symptoms. Besides, Lavender, Gratz and Tull (2011) found that *non-reactivity, acting with awareness* and *non-judging* each uniquely predicted lower levels of anorexic symptoms, whereas *describing* was related to higher levels of such symptoms. These results suggest that it is necessary to investigate different facets of mindfulness and psychological flexibility separately in relation to different eating behaviors.

1.4 Acceptance and commitment therapy (ACT)

Acceptance and commitment therapy (ACT; Hayes et al., 1999) is a modern cognitive behavior therapy that belongs to the group of acceptance-based therapies. These treatments differ from conventional cognitive behavioral therapies in that their goal is not to reduce the frequency of aversive experiences; rather, the aim is to foster the willingness to experience potentially aversive internal experiences while simultaneously promoting behavior that is consistent with one's desired goals and values (Hayes et al., 1999). An underlying assumption in ACT is that avoiding inner private experiences, such as thoughts, emotions and bodily sensations, can interfere with living a meaningful and healthy life. Thus, avoidance tendencies are problematic, specifically when they interfere with valued living.

From an ACT perspective, behavioral problems stem from verbal processes that maintain a narrow set of behaviors in contexts that occasion uncomfort-

able private events (Hayes et al., 1999). Here, verbal processes refers to *relational frames,* which are specific types of learned relational responses that can come under the control of arbitrary contextual cues, and not solely to the formal properties of events that are in a relational network or in direct experience with them (Hayes, Barnes-Holmes, & Roche, 2001). As an example, being concerned about another person's health and telling her or him, "You should lose weight," may get the person to think, "I am not good as I am; so, I am bad and not accepted." This idea might cause the person to avoid, for example, situations where she or he might be evaluated. ACT provides a way to target such over-regulation of behavior via verbal relations (cognitive fusion) and promotes developing one's sensitivity to directly experience events and regulate behavior based on personal values.

Cognitive fusion refers to situations in which behavior is excessively regulated by verbal rules and insensitive to direct experiences (Hayes et al., 2013). A person may think, "If I eat this cookie, I have failed this diet," which could then lead to uncontrolled eating. Fusion can lead to *experiential avoidance* when a person is unwilling to remain in contact with uncomfortable private events (i.e., thoughts, emotions, cravings). This often has paradoxical effects and may cause a person to disconnect from a direct experience with the present moment. Attempts to avoid uncomfortable private events can actually increase their occurrence (Barnes & Tantleff-Dunn, 2010; Geliebter & Aversa, 2003; Soetens & Braet, 2006) while simultaneously limiting what a person does as he or she attempts to avoid contexts that are likely to occasion psychological discomfort.

The acceptance-based approach is used to target cognitive fusion and experiential avoidance. Acceptance-based strategies are consistent with the notion that we are limited in our ability to suppress, distract from, or modify thoughts and urges, and that adaptive behavior depends on the ability to tolerate unpleasant internal experiences. The approach teaches strategies designed to increase tolerance in the service of goal-directed behavior, such as healthy eating. Analog laboratory studies and mediation analyses of outcome studies suggest that these strategies are effective in promoting adaptive behavior (Bond & Bunce, 2000, 2003; Gifford et al., 2004; Hayes et al., 2012; Levitt, Brown, Orsillo, & Barlow, 2004).

1.4.1 Six ACT processes

An ACT intervention usually includes six overlapping processes aimed at achieving psychological flexibility. Psychological flexibility thus refers to patterns of behavior that are regulated by six repertoire-expanding processes: *acceptance, defusion, contact with the present moment, self-as-context, values,* and *behavioral commitment* (Hayes et al., 2006).

Acceptance is taught as an alternative to experiential avoidance or control strategies. In essence, acceptance occurs when emotions are embraced with awareness and experienced as they are, without attempts to change them in frequency or form. This approach is not a passive coping strategy, but an active choice of non-judgmentally seeing thoughts as thoughts, emotions as emotions,

and so on. Studies confirm that the effects of exposure seem to work through tolerance (or willingness) to have the emotion rather than reducing emotion (Craske et al., 2008). Through acceptance interventions, participants learn to be aware of sensations, desires and cravings instead of automatically reacting to them. The aim of acceptance is to enhance behavioral flexibility when confronted with experiences that have previously narrowed behavior. (Hayes, Strosahl, & Wilson, 2011)

Cognitive defusion techniques attempt to alter the functions of uncomfortable private events by changing the verbal context in which they occur. ACT attempts to create a functional approach to thoughts, where thoughts may be seen as simply products of the mind and observed without reacting to them in a way which is unhelpful. Defusion helps the person to relate differently rather than attempt to replace thoughts with other thoughts or struggling with them. (Hayes, Barnes-Holmes, & Roche, 2001)

Contact with the present moment refers to a flexible and voluntary awareness of one's inner and outer reality as it is. The purpose of mindfulness interventions is to increase the ability to be consciously present in the moment without evaluating or judging. This focus is a form of awareness characterized by curiosity, openness and acceptance. This kind of awareness gives participants the opportunity to choose effective behaviors from moment to moment in different situations. (Hayes, Strosahl, & Wilson, 1999, 2011)

Self-as-context is an observation-based and perspective-taking sense of self. Thoughts, emotions and bodily sensations are seen as mere passing events, rather than aspects that define the self (Hayes et al., 1999, 2011).

Values are verbally constructed concepts of what is meaningful and important in life. 'Values clarification' can assist in making reinforcers more salient in the environment, which can then guide the individual to make more healthy choices. ACT attempts to increase the ability to experience uncomfortable private events if doing so is in the service of values-based life choices. ACT views values as directions, not outcomes. Life is seen as a process by which valued directions are not attained but rather serve to guide the person through a process of vital living. (Hayes et al., 1999; Hayes et al., 2011)

Commitment is an ongoing behavioral process of valuing and recommitting to behaviors in a chosen, valued direction (Hayes et al., 1999; Hayes et al., 2011). The person is encouraged to take steps toward a meaningful and healthy life. Everyday actions are encouraged to affect well-being and quality of life. This involves setting and working toward short- and long-term behavior-change goals while identifying and working through psychological barriers that show up along the way.

To sum up, the aim of ACT is to get the individual to live a more vital life based on chosen values and direct experiences. Thus, the person is encouraged to take actions and accomplish behavior changes that support values-based living. At the same time, experiential avoidance is targeted with acceptance and defusion methods in order to improve individuals' ability to be in contact with

their present-moment experience and to regulate their behavior in accordance with their personal values.

1.4.2 How to use ACT in weight control?

Eating behavior is largely regulated by relational stimulus control (e.g., verbal rules about eating). For example, one might limit particular food types in order to achieve a verbally ascribed weight goal that has been associated with a particular physique or health benefits. This process is advantageous in many ways and has greatly improved the longevity of humans. As long as individuals are able to respond directly to internal cues (e.g., hunger or satiety) and flexibly to rules, then there is a workable integration between these two types of stimulus control. Sometimes, however, verbal processes (i.e., relational conditioning) may contribute to behavioral or psychological inflexibility in regard to food, eating or one's body by way of decreased sensitivity to directly available information. As verbal relations are elaborated, eating behavior may become increasingly regulated by verbally constructed rules and contingencies, rather than directly experienced events (*cognitive fusion*).

ACT seeks to promote workable behavioral patterns consistent with stated values, while teaching mindfulness and acceptance skills to decrease behavior overregulation via verbal relations and increase behavioral commitment to values-based behavior. ACT can strongly encourage individuals to broaden the focus to what matters in their life beyond weight and body shape. Once values are clarified, behaviors inconsistent with values (e.g., overeating) are seen as ineffective ways of coping with unwanted private experiences and are addressed with acceptance and mindfulness strategies. Mindfulness can help raise awareness of common triggers (e.g., tiredness, self-judgment) causing unhealthy behavior (overeating), helping to signal moments in which to use acceptance-based strategies in order to persist with healthy behaviors. Additionally, acceptance-based work may allow the individual to notice weight-related stigma and concerns without causing him or her to avoid activities where related uncomfortable thoughts and feelings may show up (e.g., concern about being judged by others at the gym). This way ACT increases the behavioral repertoire related to health behaviors.

Many behavior patterns associated with unsuccessful weight loss, such as rigid dichotomous attitudes (Byrne et al., 2003), emotional eating and avoidance behaviors (Byrne et al., 2003; Elfhag & Rössner, 2005; Teixeira et al., 2010), can be conceptualized as forms of experiential avoidance, which is seen as a maintaining factor of problematic behaviors (Lillis, Levin, & Hayes, 2011). The function of these behaviors may be avoiding negative feelings (e.g., anxiety, shame, loss of control). Experiential avoidance seems to have a paradoxical effect, since avoidance seems to increase the strength of thoughts and emotions that are avoided (Barnes & Tantleff-Dunn, 2010; Geliebter & Aversa, 2003; Soetens & Braet, 2006). It has been shown that trying not to think about food has a rebound effect and actually increases food-related thinking (Soetens & Braet, 2006). The suppression of thoughts related to food predicts food cravings, binge

eating and other eating-disorder symptoms, such as overly concern with body shape (Barnes & Tantleff-Dunn, 2010; Geliebter & Aversa, 2003). Thus, in accordance with the intuitive eating style, a more accepting approach to food and eating could promote healthier eating behavior.

1.4.3 Support for using acceptance-based therapies in weight control

Randomized trials have consistently demonstrated that ACT can treat a variety of psychological and health problems by targeting experiential avoidance (Hayes et al., 2006). Weight control interventions have been slow to adopt these methods, but there is a growing body of literature indicating that ACT methods can be helpful in the area of weight control. Preliminary results suggest that ACT alone seems to promote greater functioning and quality of life among people with obesity (Lillis et al., 2009; Weineland, Arvidsson, Kakoulidis, & Dahl, 2012), and an ACT-enhanced weight-loss program promotes and maintains weight loss (Forman, Butryn, Hoffman, & Herbert, 2009; Forman et al., 2013). This research is briefly reviewed as follows.

Forman and colleagues (2013) randomized 128 overweight participants of a year-long, 40-session group-based standard behavioral treatment, or acceptance-based therapy. Prescriptions for calorie intake, physical activity and weight loss were identical across the conditions, and all core components of behavioral treatment were included in both conditions (e.g., psychoeducation about nutrition and physical activity, and self-monitoring of calorie intake/physical activity/weight). Weight loss at the 6-month follow-up measurement point was somewhat greater for those receiving acceptance-based therapy, but moderation analyses revealed that this advantage was especially powerful for participants with particular vulnerabilities, such as mood disturbance, elevated responsivity to food cues and high disinhibition (Forman et al., 2013).

Another randomized control trial (RCT) (Lillis et al., 2009) examined the efficacy of ACT for weight maintenance in a sample of participants who had recently completed a weight-loss program. Participants took part in a one-day ACT workshop or were assigned to a waiting list and asked to continue their current strategies for managing weight. The workshop included ACT methods focused on reducing experiential avoidance and increasing psychological flexibility. At the 3-month follow-up, the ACT participants had lost an additional 1.6% of their body weight (on average), whereas the control group gained 0.3%. Overall, a significantly higher proportion of the ACT participants had maintained or lost weight. The ACT group also showed significant improvements in quality of life and reductions in psychological distress and self-stigma (Lillis et al., 2009).

Other workshop studies have also demonstrated that exposing overweight persons to a relatively low number of hours of intervention can have surprisingly long-lasting, positive effects. Tapper and colleagues (2009) examined a one-time, 2-hour ACT workshop compared to a no-treatment control group of women who were already trying to lose weight. At six months, the workshop

participants engaged in significantly more physical activity than the control participants. Within the ACT group, participants who reported applying the principles taught in the workshop showed a significant decrease of 2.3 kg in weight compared to those who reported never applying the principles (Tapper et al., 2009). A weight gain prevention study that randomized 58 university students to 8 hours of acceptance-based therapy or an assessment-only control group reported a 0.47 kg/m^2 decrease in BMI for those receiving acceptance-based therapy, at the one-year follow-up measurement point, versus a gain of 0.74 kg/m^2 for the control group participants (Katterman, Goldstein, Butryn, Forman, & Lowe, 2013).

In the open trial of an acceptance-based behavioral intervention for weight loss using standard behavioral treatment strategies (e.g., diet and exercise targets, self-monitoring, stimulus control) as well as acceptance-based strategies, including distress tolerance, mindfulness and commitment enhancement, participants lost an average of 6.6% of their body weight from the baseline to post-treatment measurement and continued to lose weight from there to the end of a 6-month follow-up (9.6%) (Forman et al., 2009). Additionally, participants noted increases in weight-related quality of life during the 12-week program, which suggests that treatment benefits may have spilled over to other areas of their lives.

Another open trial (Niemeier, Leahey, Reed, Brown, & Wing, 2012) tested a 24-week standard behavioral treatment and ACT combined treatment for weight loss for participants with a high level of internal disinhibition (eating in response to thoughts and emotions). The intervention was comprised of both standard behavioral treatment (diet and exercise targets, self-monitoring, stimulus control, problem solving, assertiveness training, goal setting, and relapse prevention) and ACT components (acceptance, mindfulness, values). The research yielded strong findings for this population, which usually perform poorer than those without internal disinhibition struggles (Niemeier, Phelan, Fava, & Wing, 2007), with a mean weight loss of 12 kg at the end of the treatment (post) that increased to 12.1 kg by the end of the 3-month follow-up (Niemeier et al., 2012). In line with these results, it has been suggested that acceptance-based treatments are particularly effective for those who are the most susceptible to eating in response to internal and external cues (Lillis & Kendra, 2014). For example, regarding participants strongly impacted by food, Forman and colleagues (2007) found that coping strategies based on acceptance were more effective than those based on emotional control in dealing with food cravings.

In addition, there is empirical support for using ACT methods to also target other weight-related issues, such as body-image dissatisfaction (Pearson, Follette, & Hayes, 2012), disordered eating patterns (Juarascio, Forman, & Herbert, 2010), physical activity (Butryn, Forman, Hoffman, Shaw, & Juarascio, 2011), cognitions related to physical activity (Kangasniemi, Lappalainen, Kankaanpää, Tolvanen, & Tammelin, 2015), reactivity to food cravings (Alberts et al., 2010; Forman et al., 2007), and coping with bariatric surgery (Weineland et al., 2012).

Moreover, there are an increasing number of studies investigating also other mindfulness-based cognitive behavioural therapies (e.g., dialectical behavior therapy, mindfulness-based cognitive therapy, and mindfulness-based eating awareness training) for a range of disordered eating concerns. Preliminary findings suggest that mindfulness-based cognitive behavioural therapies, overall, are promising as treatment for bulimia nervosa, binge eating disorder and obesity (for the review, see Masuda & Hill, 2013). To sum up, the current research supports acceptance- and mindfulness-based treatments for weight-related issues, but evidence is still limited and there is a need to investigate the mechanisms of change across mindfulness-based interventions in addition to accumulating outcome data.

1.4.4 Processes of change in ACT interventions

In order to design effective psychological interventions, processes through which changes are considered to occur need to be investigated. The investigation of mechanisms serves two additional purposes. First, one is to see whether ACT is qualitatively distinct from other cognitive behavior therapies. Second, there is a considerable overlap across the different mindfulness-based cognitive behavior therapies (e.g., ACT, dialectical behavior therapy, mindfulness-based cognitive therapy, and mindfulness-based eating awareness training) and significant variation within ACT interventions. Using a mechanism-based treatment classification promotes our understanding of mindfulness- and acceptance-based approaches to treating unhealthy behaviors without unnecessarily increasing the number of new treatment labels.

The current state of evidence suggests that the concepts specified by the ACT model work very consistently as mediators across the wide range of problems targeted by ACT. Successful ACT mediators include general or specific measures of acceptance and psychological flexibility (Gifford et al., 2004; Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007; Lappalainen et al., 2007; Lillis & Hayes, 2007; Lundgren, Dahl, & Hayes, 2008), defusion (e.g.,Lundgren et al., 2008; Varra, Hayes, Roget, & Fisher, 2008; Zettle & Hayes, 1986), values (e.g., Lundgren et al., 2008), and mindfulness (Forman et al., 2007). As an example, mediation analyses indicated that changes in weight-specific psychological flexibility mediated changes in BMI, psychological distress, quality of life, and stigma (Lillis et al., 2009). Also, Weineland et al. (2012) found that weight-related psychological flexibility mediated the impact on quality of life, body dissatisfaction and disordered eating at follow-up in ACT intervention following bariatric surgery. Taken as a whole, ACT studies demonstrate that changes in important outcomes are mediated by changes in process variables such as reduced experiential avoidance (i.e., increased acceptance and flexibility) of thoughts and feelings related to the specific problem. However, the evidence related to processes of change in eating behavior and weight management is still very limited.

1.5 Aims of the research

The main purpose of the research was to study how behavioral and psychological flexibility are related to eating regulation and weight management in overweight adults.

Study I examined the effects of flexible and rigid restraint of eating on weight-loss maintenance and well-being, as well as their relations to psychological flexibility, in overweight adults participating in a weight-loss and maintenance intervention. It was hypothesized that an increase in flexible cognitive restraint of eating would be positively associated with better long-term weight management, whereas an increase in rigid cognitive restraint would be related to poorer long-term weight management. Second, it was hypothesized that a greater increase in flexible restraint would be positively correlated to higher self-efficacy, psychological flexibility and well-being, whereas rigid restraint would predict poorer self-efficacy, psychological flexibility and well-being.

Study II examined how mindfulness skills, psychological flexibility, intuitive eating and body mass index are related to each other in overweight adults. Better mindfulness skills were expected to be related to better psychological flexibility, and both were expected to be related to higher intuitive eating. Mindfulness skills, psychological flexibility and intuitive eating were expected to be negatively related to BMI. Second, it was examined to what extent the two behavior change processes—psychological flexibility and mindfulness—account for unique variance in intuitive eating. It was expected that although mindfulness and psychological flexibility are related constructs and would account for some of the same variance in intuitive eating, they would also each account for significant unique variances in eating behavior on their own. The purpose was to examine whether both concepts are needed to explain eating behavior and what different aspects they might explain. Both psychological flexibility and mindfulness promote the willingness to approach and experience inner experiences. However, whereas mindfulness concentrates more on sensing present-moment experiences, psychological flexibility involves acting according to one's values regardless of one's inner experiences.

Study III examined the role of acceptance and flexibility in the context of adaptive eating regulation by evaluating the mediation effects of mindfulness and psychological flexibility on intuitive eating and weight loss in ACT interventions. Two different ACT interventions were studied in order to investigate whether the same processes work consistently as mediators regardless of the form of the intervention. In addition, the mediating effects of psychological flexibility and mindfulness were investigated in comparison with sense of coherence, a variable less associated with ACT yet commonly used to explain health and well-being (Eriksson & Lindstrom, 2005). First, the effects of the two different ACT interventions were investigated, 1) face-to-face and 2) mobile, on intuitive eating, mindfulness and sense of coherence in comparison to each other and a control group. The face-to-face and mobile ACT interventions were ex-

pected to have similar effects on all measurements. Intervention effects on weight and psychological flexibility have been reported elsewhere (Kolehmainen et al., 2016).

Second, it was examined whether psychological flexibility, mindfulness skills and sense of coherence mediate the intervention effect on intuitive eating and weight in ACT interventions (face-to-face and mobile). Changes in psychological flexibility and mindfulness skills were expected to mediate the intervention effects similarly in both ACT interventions. Psychological flexibility and mindfulness were expected to be more important mediators in the ACT interventions (regardless of the form of the intervention) than the general well-being related process of sense of coherence.

It was posited that acceptance- and mindfulness-based strategies represent a particularly promising approach to weight control because the skills they build are a match for the capabilities that are necessary to achieve dietary goals within an obesogenic environment. In particular, acceptance- and mindfulness-based interventions focus on increasing the ability to tolerate distress, to achieve behavioral commitment toward better articulated values, and to be more aware of in-the-moment decision-making processes.

2 METHODS

This research included three studies. These studies consisted of a secondary analysis using existing data from two previously published intervention studies. The first study (Study I) was based on the sample of the ELIPA study (Foods for weight management: Satiety and long-term regulation of body weight and food intake). The data were gathered in 2008–2009. The ELIPA study aimed to investigate factors associated with weight management. Studies II and III were based on the data collected in the Elixir study in 2012–2013. The Elixir study was a randomized controlled trial (RCT), which aimed to investigate the effect of three low-intensity psychological interventions for metabolic syndrome risk factors, psychological flexibility and general well-being among overweight individuals experiencing stress.

2.1 Participants and procedure

2.1.1 Study I

Originally, 99 (28 male, 71 female) obese (inclusion criteria BMI 30–40 kg/m^2, 30–65 years of age) participants were recruited for the weight-loss and maintenance intervention study (WLM intervention; (Karhunen et al., 2012). The WLM intervention consisted of two phases. The first phase was a seven-week weight-loss period requiring the intake of only very low calorie diet products. During the weight-loss period, the participants were given dietary counseling in group sessions; specifically, seven times over the whole period. In the group sessions, different themes were discussed, like energy requirements and energy consumption, physical exercise, meal rhythm, and barriers to weight management.

In the second phase, after the weight-loss period followed by a 2-week transitional period, the participants were randomized into two diet groups, that is, a higher-satiety food group and a lower-satiety food group. The participants in the higher-satiety food group consumed test foods with a higher satiety val-

ue, whereas the participants in the lower-satiety food group consumed test foods having a lower satiety value. In this weight-management dietary program, all participants were instructed to maintain their weight loss but not to continue actively losing weight. The test foods aimed to cover about 30% of the individually estimated daily energy requirements. During this period of 24 weeks, the participants received the test foods every two weeks upon a visit, where the participants' body weight was measured and they were given written instructions about the use of the test foods as well as regarding the weight-management diet in general.

Altogether 82 participants completed the WLM intervention, and about 8–9 months after the end of the WLM intervention the participants were asked to take part in a follow-up assessment about which they had not been informed beforehand. The population of the present study consists of the individuals who participated in the follow-up assessment (n = 49; 60% of those who had completed the WLM intervention). There were no significant differences in the background variables (gender, age, education, BMI, or weight loss during the WLM) between those individuals who participated in the follow-up assessment (n = 49) and those who did not (n = 33).

The mean age of the participants (n = 49, 12 male, 37 female) was 51.4 ± 9.1 years (range 31–63), and the mean BMI at the time of the follow-up assessment was 31.2 kg/m^2 (SD = 3.3, range 24.9–39.8). The majority of the participants had an upper secondary education (59.1%) and 24.5% had a university degree.

Weight, cognitive restraint of eating (The Three-Factor Eating Questionnaire, TFEQ; Stunkard & Messick, 1985; Westenhoefer, Stunkard, & Pudel, 1999) and psychological well-being (General Health Questionnaire, GHQ-12; Goldberg, 1978) were measured at the three stages of the WLM intervention: pre (prior to the WLM intervention), post (immediately following the WLM intervention), and follow-up (the assessment that followed 8–9 months after the WLM intervention had ended). Psychological flexibility (The Acceptance and Action Questionnaire, AAQ-II; Bond, Hayes, Baer, Carpenter, Guenole, Orcutt, Waltz, & Zettle, 2011) and self-efficacy (Abu Sabha & Achterberg, 1997; Schwarzer & Renner, 2000) were measured in the follow-up assessment. The participants' body weight and height were measured at the laboratory visits; BMI was calculated. Changes in participants' weight were calculated as relative changes in percentages (e.g., Weight ^{pre} – Weight ^{post} / Weight ^{pre}).

2.1.2 Studies II and III

The data of Studies II and III stem from a large lifestyle intervention study (Lappalainen et al., 2014) that investigated the effects of three novel, low-intensity psychological interventions for metabolic syndrome risk factors, psychological flexibility and general well-being among overweight or obese individuals experiencing psychological distress (measured by GHQ). The participants were randomly divided into the following four groups: ACT face-to-face, ACT mobile, Web-based education (not included in Study III), and Non-treatment (control group). The participants were recruited through advertise-

ments in local newspapers and selected based on specific inclusion criteria: BMI 27–34.9 kg/m2, age 25–60 years, and reported symptoms of perceived psychological stress (at least 3 of 12 points in the GHQ; Makowska, Merecz, Moscicka, & Kolasa, 2002).

Altogether 306 participants (48 male, 258 female) completed an Internet-based survey at the baseline and comprised the study population of Study II. The mean age of the participants was 48.9 ± 7.8 years (range 24.0–60.8), and the mean BMI was 31.3 kg/m^2 (SD = 3.0, range 25.3–40.1). Around half (49%) of the participants had an upper secondary education and 44% had a university degree.

In Study III, the study population included 219 participants (34 male, 185 female) who completed all baseline measurements and were randomized into the ACT face-to-face intervention group (n = 70), ACT mobile intervention group (n = 78), or Non-treatment control group (n = 71).

Participants completed an internet-based survey, including self-report measures before (pre) and after the intervention (post, 10 weeks after the pre) and at follow-up (36 weeks after the pre). Body weight and height were measured at the participants' laboratory visits. Participants' BMI was calculated based on the collected height and weight data.

Interventions

ACT face-to-face intervention. The ACT face-to-face intervention consisted of six group sessions over an 8-week time period, with each session lasting about 90 minutes. The intervention program aimed to support lifestyle changes and to enhance well-being through committed actions based on participants' self-defined personally important values. Every session included experiential exercises based on the ACT model (such as mindfulness and acceptance exercises and individual activation with a values-oriented focus), pair and group discussions, and homework related to the topic of the session.

ACT mobile intervention. The participants in the ACT mobile intervention were invited to a group meeting that consisted of a brief overview of acceptance and commitment therapy (ACT) principles. In the meeting, the participants were given smartphones with a pre-installed, stand-alone mental-wellness training application (Ahtinen et al., 2013). They were instructed to use the application on their own for the upcoming eight weeks. The application contained short exercises that taught ACT skills to be applied in daily life. The mobile application delivered an ACT-based intervention program similar to that of the ACT face-to-face intervention.

Non-treatment control group. The participants randomized into the control group participated in all of the measurements but were not part of any intervention.

2.2 Measurements

Used variables and statistical methods are reported in Table 1.

Flexible and rigid restraint of eating. The Three-Factor Eating Questionnaire (TFEQ) was used to measure flexible and rigid control of cognitive restraint of eating (Westenhoefer et al., 1999). The original TFEQ including 51 questions was used (Stunkard & Messick, 1985). Of these 51 questions, 14 items were used to measure flexible and rigid control. Flexible cognitive restraint (7 items) is associated with low emotional and disinhibited eating, with a higher score indicating a graduated 'more-or-less' approach to eating and weight control (e.g., "When I have eaten my quota of calories, I am usually good about not eating any more"). Rigid cognitive restraint (7 items) is associated with a dichotomous 'all-or-nothing' eating pattern and with higher disinhibition (e.g., answering "Yes" to "Do feelings of guilt about overeating help you to control your food intake?" or "I count calories as a conscious means of controlling my weight").

Psychological well-being. The General Health Questionnaire (GHQ-12; Goldberg, 1978) was used to measure psychological well-being vs. distress. In this questionnaire, participants are asked to rate the frequency with which they experience common behavioral and psychological stressors (Banks et al., 1980). The 12 items assess somatic symptoms, anxiety, depression, and social dysfunction (e.g., "Have you enjoyed your normal activities?"), with higher scores indicating higher levels of psychological distress.

Self-efficacy. Perceived action and self-efficacy coping scales were used to measure self-efficacy in dieting (Abu Sabha & Achterberg, 1997; Schwarzer & Renner, 2000). Self-efficacy reflects a person's belief in his or her ability to overcome the difficulties inherent in performing a specific task in a particular situation (e.g., "I can manage to follow my aspirations, even though I am tired?"). The questionnaire consists of 13 items rated on a four-point Likert-type scale, where possible responses range from 1 (very certain I cannot) to 4 (very certain I can), with higher scores thus indicating higher levels of self-efficacy.

Intuitive eating. The Intuitive Eating Scale (IES; Tylka, 2006) is a 21-item instrument containing three subscales that assess the components of intuitive eating: 1) *unconditional permission to eat* (9 items; e.g., "If I am craving a certain food, I allow myself to have it"); 2) *eating for physical rather than emotional reasons* (6 items; e.g., "I stop eating when I feel full [not overly stuffed]"); and 3) *reliance on internal hunger and satiety cues* (6 items; e.g., "I trust my body to tell me how much to eat"). Participants rated items on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). Subscale items were averaged, with higher scores indicating higher levels of intuitive eating.

Mindfulness. The Five-Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006) is a 39-item measure of the general tendency of being mindful in daily life. This measure was derived from an exploratory factor analysis of several previously developed mindfulness questionnaires (Baer et al., 2006) and

measures the following five elements of mindfulness, as follows. 1) *Observing* includes noticing or attending to internal and external experiences, such as sensations, cognitions, emotions, sights, sounds and smells (e.g., "I notice how foods and drinks affect my thoughts, bodily sensations and emotions"). 2) *Describing* involves labeling internal experiences with words (e.g., "I'm good at finding words to describe my feelings"). 3) *Acting with awareness* represents attending to one's activities of the moment and can be contrasted with behaving mechanically or automatically while attention is focused elsewhere, often referred to as 'automatic pilot' (e.g., "I am easily distracted"). 4) *Non-judgment of inner experiences* represents taking a non-evaluative stance toward feelings and thoughts (e.g., "I tell myself I shouldn't be feeling the way I'm feeling"). 5) *Non-reactivity to inner experiences* is the tendency to allow thoughts and feelings to come and go without getting carried away by or caught up in them (e.g., "I perceive my feelings and emotions without having to react to them"). The items were rated on a 5-point Likert-type scale ranging from 1 (never or very rarely true) to 5 (very often or always true), with higher scores indicating higher levels of mindfulness.

Psychological flexibility. Psychological flexibility was assessed using the general Acceptance and Action Questionnaire (AAQ-II; Bond et al., 2011) and the Acceptance and Action Questionnaire for Weight (AAQW; Lillis & Hayes, 2008). The Acceptance and Action Questionnaire (AAQ-II; Bond et al., 2011) assesses the ability to accept aversive internal experiences and to pursue goals in the presence of these experiences. Some items target emotional acceptance or avoidance while others address the tendency to become entangled in thoughts, to take them literally, or, conversely, to see them simply as thoughts; still others ask about the ability to take values-based actions in the presence of difficult thoughts, or about the tendency to become behaviorally inactive or avoidant. The questions of the AAQ-II are based on statements like, "I worry about not being able to control my worries and feelings" and, "My thoughts and feelings do not get in the way of how I want to live my life." The items were rated on a 7-point Likert-type scale ranging from 1 (never true) to 7 (always true). A version including 10 items (Bond et al., 2011) was used in Study I, and a newer version including 7 items was used in Studies II and III. In the 10-item version, higher scores indicate higher levels of psychological flexibility, whereas in the 7-item version higher scores indicate lower levels of psychological flexibility, that is, higher levels of experiential avoidance.

The Acceptance and Action Questionnaire for Weight (AAQW; Lillis & Hayes, 2008) is a 22-item Likert-type scale that measures acceptance levels of weight-related thoughts and feelings and the degree to which they interfere with values-based actions (e.g., "I try hard to avoid feeling bad about my weight or how I look"). The items were rated on a 7-point Likert-type scale ranging from 1 (never true / not at all believable) to 7 (always true / completely believable), with higher scores indicating lower levels of psychological flexibility, that is, higher levels of experiential avoidance.

Sense of coherence. Sense of coherence was measured by the 13-item Orientation to Life Questionnaire (Antonovsky, 1987; Antonovsky, 1993), which measures how people manage stressful situations and stay well (Eriksson & Lindstrom, 2005). The scale consists of three dimensions: *comprehensibility* (5 items, e.g., "Does it happen that you have feelings that you would rather not feel?"), *manageability* (4 items, e.g., "How often do you have feelings that you're not sure you can keep under control?"), and *meaningfulness* (4 items, e.g., "Do you have the feeling that you don't really care about what goes on around you?"). The participants were asked to answer the questions on a 7-point semantic differential scale from 1 (never) to 7 (always), with higher scores indicating higher levels regarding the participants' sense of coherence.

The internal consistencies of applied measures were evaluated in Elixir study (Studies II and III) and they were high (Cronbach α = .70–.94; see Table 1).

TABLE 1 Summary of the measures and statistical methods used in Studies I–III

Sample	Measures	Statistical methods
Study I		
ELIPA n = 49	Flexible cognitive restraint (TFEQ) Rigid cognitive restraint (TFEQ) GHQ-12 Self-efficacy AAQ-II BMI	Repeated measures ANOVA Bonferroni corrections Effect size (ES); Cohen *d* Bivariate (Pearson) and partial correlations
Study II		
Elixir study n = 306	AAQ-II, α = .91 AAQW, α = .90 FFMQ: α = .91 a) Observe, α = .72 b) Describe, α = .94 c) Act with awareness, α = .89 d) Non-judgment of inner experiences, α = .90 e) Non-reactivity to inner experiences, α = .84 IES: a) Unconditional permission to eat, α = .70 b) Eating for physical rather than emo-tional reasons, α = .86 c) Reliance on internal hunger and satiety cues, α = .76 BMI	Hierarchical regression analysis using Cholesky decomposition in structural equation modeling (SEM)
Study III		
Elixir study n = 219	AAQ-II AAQW SOC-13, α =.87 FFMQ: f) Observe g) Describe h) Act with awareness i) Non-judgment of inner experiences j) Non-reactivity to inner experiences IES: α =.80 d) Unconditional permission to eat e) Eating for physical rather than emotional reasons f) Reliance on internal hunger and satiety cues BMI	Hierarchical linear model (HLM) Cohen's d Latent difference score (LDS) Mediation model Bootstrap confidence intervals

Note. TFEQ = Three-Factor Eating Questionnaire; GHQ = General Health Questionnaire; AAQ-II = Acceptance and Action Questionnaire; AAQW = Acceptance and Action Questionnaire for Weight; FFMQ = Five-Facet Mindfulness Questionnaire; IES = Intuitive Eating Scale, BMI = Body mass index; α = Cronbach α.

2.3 Statistical analyses

2.3.1 Study I

In order to test the hypothesis that 1) an increase in flexible cognitive restraint of eating would be positively associated with better long-term weight management as well as higher self-efficacy, psychological flexibility and well-being, whereas 2) an increase in rigid cognitive restraint would be related to poorer long-term weight management as well as poorer self-efficacy, psychological flexibility and well-being, the correlations between change scores of flexible and rigid restraint of eating, weight and various psychological measurements (GHQ-12, TFEQ, AAQ-II, self-efficacy) were calculated using bivariate (Pearson) and partial correlations. Partial correlations were used to calculate correlations between the change scores, while controlling for the pre-intervention levels of those variables. The correlation coefficient can be interpreted as a standardized regression coefficient, where the change score of flexible vs. rigid restraint explains change scores in weight and well-being.

2.3.2 Study II

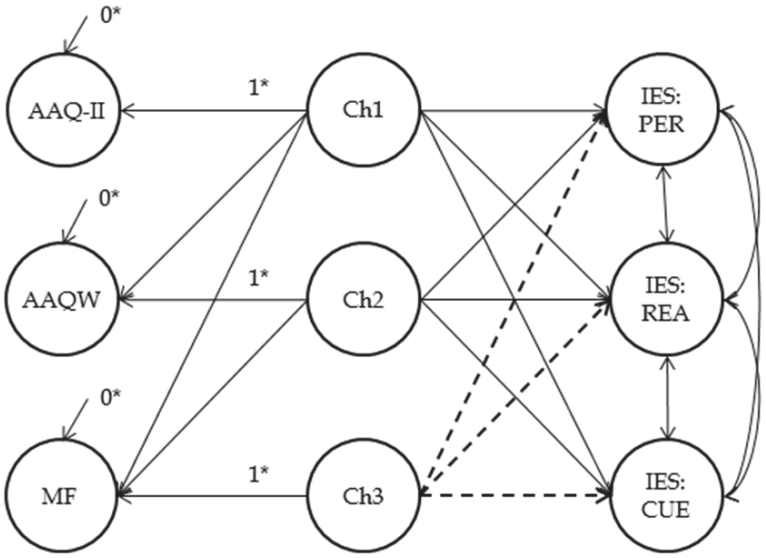
In order to test the hypothesis that 1) better mindfulness skills are related to better psychological flexibility, and both are related to higher intuitive eating, as well as that 2) higher levels of mindfulness skills, psychological flexibility and intuitive eating are related to lower BMI, the correlations among the study variables were examined.

Moreover, it was hypothesized that 3) mindfulness and psychological flexibility would account for some of the same variance in intuitive eating but that they would also account for unique significant variances on their own. The extent to which the two processes, psychological flexibility and mindfulness, accounted for any unique variance in intuitive eating was analyzed with a hierarchical regression analysis using Cholesky decomposition (de Jong, 1999) in structural equation modeling (SEM). Such an analysis can be used when the extra amount of variance accounted for in a dependent variable by a specific independent variable is the main focus of interest and the independent variables are highly correlated (Cohen, Cohen, West, & Aiken, 2013). The independent variables were entered in the regression equation in a prespecified order. This method separates the unique variance related to each variable after taking into account the previous ones, that is, it attempts to determine the degree of association between two variables that would exist if all influences of one or

more other variables were removed. Basically, two different orders were specified: 1. Psychological flexibility following mindfulness skills; 2. Mindfulness skills following psychological flexibility.

This model is presented in Figure 1. First, the Cholesky component (Ch1) was fixed to explain all variance in the AAQ-II and the related variance in the AAQW and mindfulness facet. Secondly, the Cholesky component (Ch2) was set to explain all remaining variance in the AAQW and mindfulness facet. And thirdly, the Cholesky component (Ch3) explained the residual variance in the mindfulness facet. After that, all three Cholesky components were set to explain intuitive eating factors.

The parameters were estimated using the full information maximum likelihood method (MLR estimation in Mplus), in which missing values are supposed to be missing at random (MAR). The fit of the models was evaluated using the following goodness-of fit measures provided by the Mplus software program (Muthén, 1998-2004): RMSEA (Root Mean Square Error of Approximation, with values of .06 or less indicating a good fit), SRMR (Standardized Root Mean Square Residual, with values less than .08 indicating a good fit), CFI (Bentler's Comparative Fit Index, with values of .95 or greater indicating a good fit), and TLI (Tucker–Lewis Index, with values greater than .95 indicating a good fit). The models provided either a good or reasonable fit with the data.



Note. AAQ-II = Acceptance and Action Questionnaire; AAQW = Acceptance and Action Questionnaire for Weight; MF = Mindfulness Facet; IES = Intuitive Eating Scale; PER = *Unconditional permission to eat;* REA = *Eating for physical reasons;* CUE = *Reliance on hunger and satiety cues;* Ch = Cholesky component.
*Fixed values. Other connections were estimated freely.

FIGURE 1 Hierarchical regression model explaining intuitive eating by psychological flexibility and mindfulness

2.3.3 Study III

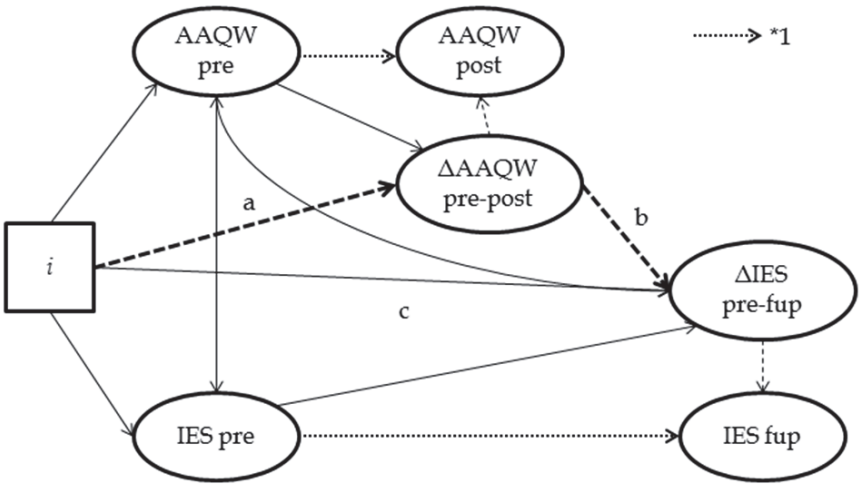
In order to test the hypothesis that 1) both face-to-face and mobile ACT interventions have similar (positive) effects on intuitive eating, mindfulness and sense of coherence, the effects of the interventions were analyzed by using the hierarchical linear model (HLM) and effect sizes. Intervention effects, as well as indirect effects, were analyzed by first comparing the ACT face-to-face and mobile interventions to each other. If no difference was observed over time between these two ACT intervention groups, then they were combined and together compared to the control group. If the ACT intervention groups showed different effects, then they were separately compared to the control group. The effect sizes were calculated by comparing the mean difference in change between the intervention and control groups. In the first measurement, the difference was divided by the pooled standard deviation. A *between-group effect size* of 0.2 was considered clinically small, 0.5 medium, and 0.8 large (Cohen, 1992).

In order to examine whether 2) psychological flexibility, mindfulness skills and sense of coherence mediate the intervention effect on intuitive eating and weight, the Latent difference score (LDS) mediation model (MacKinnon, 2008)

was used. Figure 1 shows the LDS model, where the effects of the interventions (i) on intuitive eating (change from pre to follow-up, ΔIES) were mediated by change of psychological flexibility during the interventions as assessed with the AAQW (ΔAAQW). The product of the *a* and *b* coefficients in the LDS model comprise the mediation effect. In the measurement model, three parcels (e.g., A1–A3) were used to estimate the latent factors representing the true score without measurement error. By constructing three measured indicators (parcels) for each latent variable (i.e., psychological flexibility and intuitive eating), the recommendation of Russell, Kahn, Spoth and Altmaier (1998) was followed.

The LDS model was chosen because the focus was on variance in within-individual changes in true scores and on mean intervention effects. The LDS approach made it possible to focus on change (e.g., ΔAAQW) in each construct rather than in the level (e.g., AAQW) alone. Thus, it was suggested that changes in behavioral processes (psychological flexibility, mindfulness skills, and sense of coherence) are more important than, for example, psychological flexibility per se.

In analysis of mediation, the recommendation of Zhao, Lynch and Chen (2010) was followed. They have presented that the only requirement to demonstrate mediation is a significant indirect effect $a \times b$. It may well be possible to establish an indirect effect despite no total effect. The product of *a* and *b* may be significant even if the coefficients on their own are not (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Mplus allows users to define any function of parameters ($a \times b$) as a model parameter and in addition provides bias-corrected bootstrap confidence intervals for such parameters. Confidence intervals are based on 1,000 bootstrap resamples. See Preacher and Hayes (Preacher & Hayes, 2008) for more information regarding the advantages of bootstrapping in mediation models. Indirect effects are deemed statistically significant at the .05 level, if the 95% confidence interval for the estimate of indirect effects does not include zero. The estimations and evaluations of the models were conducted similarly as in Study II.



Note. IES = Intuitive Eating Scale; AAQW = Acceptance and Action Questionnaire for Weight; pre = pre-intervention, post = post-intervention, fup = follow-up.

FIGURE 2 The Latent difference score (LDS) mediation model, where the intervention effect (i) on intuitive eating / BMI (change from pre to follow-up) was mediated by psychological flexibility for weight (change from pre to post) in the ACT interventions

3 SUMMARY OF THE RESULTS

3.1 Study I

Flexibility in weight management

The purpose of the Study I was to investigate the relationships between changes in flexible vs. rigid cognitive restraints of eating during weight management, as well as how changes in the cognitive restraint of eating were related to psychological flexibility and well-being. The data included information on 49 overweight persons who participated in an 8-month weight-loss and maintenance (WLM) intervention and a follow-up assessment after 8–9 months. The changes in weight, psychological distress (GHQ), and flexible and rigid restraint during the WLM intervention (from pre to post), as well as the relationships between them, have been reported previously elsewhere (Karhunen et al, 2012). The original contribution of this study was to explain weight loss maintenance during the non-treatment follow-up period (from post to follow-up), as well as to examine how changes in the cognitive restraint of eating were related to psychological flexibility and well-being.

The average weight loss during the WLM intervention was 11.9 ± 4.6% (range 1.1–22.4%), and the average increase in weight from the post-intervention to follow-up measurement was 3.3 ± 3.5%, ranging from 4.6% weight loss to 12.6% weight gain. Altogether 94% of the participants showed a clinically significant weight loss of 5% or greater from the pre- to post-intervention measurement, and 75% of the participants from the pre-intervention to follow-up measurement.

Correspondingly, both flexible and rigid control of eating restraint had significantly increased by the time of the post-intervention measurement and at the follow-up assessment. Flexible restraint reduced significantly from the post to follow-up measurement, whereas the change in rigid restraint was nonsignificant. The increases in rigid and flexible restraint were clinically large from pre to post, and from pre to follow-up the increase in rigid restraint was small

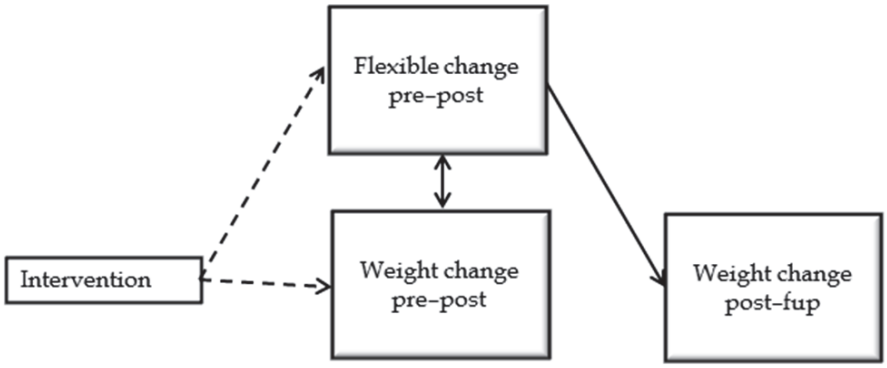
while the increase in flexible restraint was large. Subsequent pairwise comparisons showed no significant changes in psychological distress.

To examine the effects of flexible and rigid restraint of eating on weight-loss maintenance, the correlations between the levels (pre, post and follow-up) and change scores of flexible and rigid cognitive restraint of eating and weight were examined. Statistically significant findings are reported here. A Pearson correlation revealed that the change in flexible restraint from the pre- to post-intervention measurement was related to weight changes during all time periods, indicating that greater increases in flexible restraint were related both to greater weight loss and its maintenance. This result was confirmed by partial correlations, where pre-intervention levels of weight and flexible restraint were controlled for. The significant partial correlation between change in flexible restraint during the intervention and weight change from pre to post was –.37, and from pre to follow-up –.46. The significant partial correlation between change in flexible restraint during the intervention and weight change from post to follow-up was –0.30, when pre-intervention levels of weight and flexible restraint as well as weight change from pre to post were controlled for. By contrast, no significant correlations were seen between changes in rigid restraint and weight.

Figure 3 demonstrates the relationships between flexible restraint of eating and weight at the different time intervals. Increases in flexible restraint during the intervention were associated with weight loss and its maintenance.

To examine the effects of flexible and rigid restraint of eating on well-being, the correlations between the levels (pre, post and follow-up) and change scores of flexible and rigid cognitive restraint of eating and psychological distress (GHQ) were examined. In addition, the correlations between the levels (pre, post and follow-up) and change scores of flexible and rigid cognitive restraint of eating and the levels of psychological flexibility (AAQ-II) and self-efficacy at the follow-up measurement point were examined. Statistically significant findings are reported here. The partial correlation between change scores of flexible restraint and the GHQ-12 scores for psychological distress from pre to post, after having adjusted for pre-intervention levels ($r = –.35$), indicated that the more flexible restraint increased the more psychological distress decreased during the intervention. Contrastingly, a partial correlation between change scores of rigid restraint and psychological distress scores from the post-intervention to follow-up measurement times, after having adjusted for post-intervention levels, indicated that the more rigid restraint decreased the less psychological distress increased during the follow-up period ($r = .48$). Third, an analysis of partial correlations between changes in flexible restraint from post to follow-up and the level of self-efficacy at the follow-up measurement, after having adjusted for post-intervention levels of flexible restraint, revealed that a smaller reduction in flexible restraint from post to follow-up was related to better self-efficacy at the time of the follow-up assessment ($r = .37$). Unexpectedly, changes in flexible and rigid cognitive restraint were not related to psychological flexibility (AAQ-II).

To sum up, increases in flexible restraint of eating were related to greater weight loss and its maintenance as well as to increases in psychological well-being. Contrastingly, decreases in rigid restraint of eating were related to small reductions in psychological well-being during the follow-up period.



Note. pre = pre-intervention, post = post-intervention, fup = follow-up, Flexible = Flexible restraint of eating

FIGURE 3 Relationships between flexible restraint of eating and weight during the WLM intervention and follow-up

3.2 Study II

Psychological flexibility and mindfulness explain intuitive eating in overweight adults

Study II investigated whether mindfulness and psychological flexibility, independently and together, explain intuitive eating. The participants (n = 306) were persons with overweight or obesity who showed symptoms stress and enrolled in the psychological lifestyle intervention. Participants completed self-report measures of psychological flexibility (general and weight-specific), mindfulness (including the subscales *observe, describe, act with awareness, non-react,* and *non-judgment*), and intuitive eating (including the subscales *unconditional permission to eat, eating for physical reasons,* and *reliance on hunger and satiety cues*). The analyses in Study II are cross-sectional, using the baseline data of the Elixir intervention study.

Correlations indicated that better psychological flexibility (general and weight-specific) was related to better mindfulness skills, except for *observing,* and to higher levels of all intuitive eating factors. Also, better mindfulness skills, except for *observing,* were related to higher levels of all intuitive eating factors.

Observing correlated only with *reliance on hunger and satiety cues,* thus showing that persons who attend more to their internal and external experiences rely more on their body's hunger and satiety cues. BMI correlated (inversely) with all intuitive eating factors and the AAQW, indicating that persons who have a lower BMI eat more intuitively and have more psychological flexibility regarding their weight.

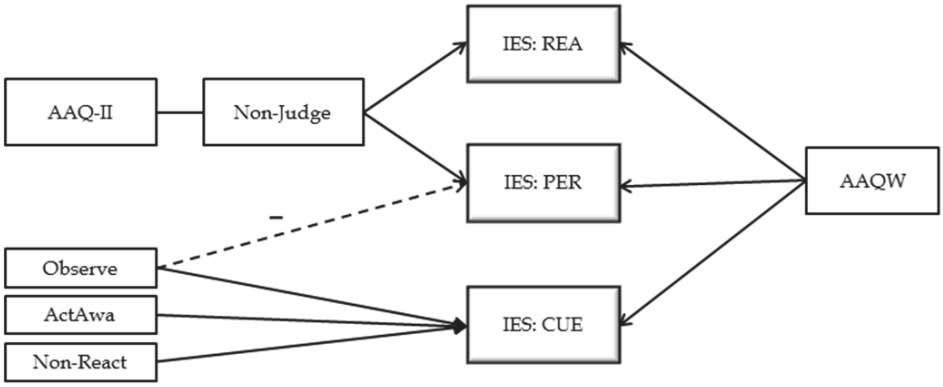
To study the extent to which psychological flexibility and mindfulness accounted for any unique variance in intuitive eating, it was conducted a hierarchical regression analysis involving Cholesky decomposition (see Figure 1). First, it was examined whether mindfulness skills explain intuitive eating (IES factors) when controlling for psychological flexibility (AAQ-II and AAQW). The results indicate that even though mindfulness skills seem to be related to all of the IES factors, mindfulness skills accounted for mainly the same variance as psychological flexibility in regard to *eating for physical reasons* and *unconditional permission to eat*. Only *observing* shared some additional variance with *unconditional permission to eat,* indicating that persons who observe their internal and external experiences more have less unconditional permission to eat. Furthermore, *acting with awareness, observing* and *non-reacting* explained *reliance on hunger and satiety cues,* indicating that these mindfulness skills involve features explaining intuitive eating that are not shared with psychological flexibility.

Second, it was examined whether psychological flexibility explains intuitive eating (IES factors) when controlling for mindfulness skills. This model was formed by setting all five mindfulness facets first, followed by the items of the AAQ-II and AAQW. When all five mindfulness skills were controlled for, the general psychological flexibility did not explain intuitive eating, but the AAQW explained all intuitive eating factors independently of mindfulness skills and the AAQ-II scores.

Third, to investigate the overlap between psychological flexibility and mindfulness skills in more detail, it was examined whether psychological flexibility explains intuitive eating (IES factors) when controlling for particular mindfulness skills. General psychological flexibility explained *unconditional permission to eat* and *eating for physical reasons* independently from single mindfulness facets, apart from *non-judgment*. General psychological flexibility (AAQ-II) did not explain *reliance on hunger and satiety cues* when any other mindfulness skill, apart from *observing,* was controlled for. Relationships between psychological flexibility (general and weight-specific), mindfulness facets and intuitive eating dimensions are summarized in Figure 4. It demonstrates which variables had an independent relationship with intuitive eating (IES factors) when other variables of the model were controlled for.

To sum up, better psychological flexibility and mindfulness skills were related to higher levels of intuitive eating. People with a lower BMI showed higher levels of intuitive eating (IES) and weight-related psychological flexibility (AAQW). Psychological flexibility and non-judgment were more highly associated with eating due to physical reasons (vs. emotional eating) and having a permissible attitude toward food, whereas mindfulness skills (observing, acting

with awareness, and non-reacting) were more highly associated with eating regulation based on hunger and satiety cues.



Note. AAQ-II = Acceptance and Action Questionnaire; AAQW = Acceptance and Action Questionnaire for Weight; ActAwa = *Act with awareness;* Non-Judge = *Non-judgment;* IES = Intuitive Eating Scale; PER = *Unconditional permission to eat;* REA = *Eating for physical reasons;* CUE = *Reliance on hunger and satiety cues.*

FIGURE 4 Independent relationships between intuitive eating dimensions and psychological flexibility, psychological flexibility for weight, and mindfulness facets

3.3 Study III

Weight-related psychological flexibility mediates changes in intuitive eating regulation in overweight adults

Study III investigated the effects of ACT interventions (face-to-face and mobile) on intuitive eating, mindfulness skills and sense of coherence. Besides this, it was examined whether psychological flexibility (general and weight-specific), mindfulness skills and sense of coherence mediate the intervention effect on intuitive eating and weight in the ACT interventions. The participants were persons who were overweight or obesity (n = 219) and reported symptoms of perceived stress. Intervention effects on psychological flexibility (general and weight-specific) and weight have been studied elsewhere (Kolehmainen et al., manuscript), and weight-related psychological flexibility was found to have increased in both ACT interventions.

Eating for physical rather than emotional reasons, a component of intuitive eating, increased significantly during both the ACT face-to-face and ACT mobile interventions compared to the control group. The interventions did not have significant effects on the other two subscales of intuitive eating (*uncondi-*

tional permission to eat and *reliance on internal hunger and satiety cues*), nor on the total score of the Intuitive Eating Scale or on weight in comparison to the control group.

As previously found (Kolehmainen et al., 2016), psychological flexibility relating to weight (AAQW) improved significantly in the ACT face-to-face and mobile groups during the respective interventions compared to the control group. In addition, the *observe* factor increased significantly in both ACT groups compared to the control group. Mindfulness skills (FFMQ total), as well as the subscales *acting with awareness* and *non-reacting,* improved more in the ACT mobile group than in the ACT face-to-face group. Subsequently, they were separately compared to the control group. In comparison to control group, there was a significant intervention effect on the FFMQ total in the ACT mobile group. Changes in *acting with awareness* and *non-reacting* were not significant in either of the ACT groups compared to the control group.

The 95% confidence intervals for indirect effects—via the AAQW—on 1) weight (BMI), 2) intuitive eating and its subscales, 3) *eating for physical rather than emotional reasons,* and 4) *reliance on internal hunger and satiety cues* did not include zero. Thus, the LDS models suggested that the effect of the ACT interventions on those variables (changes from pre to follow-up) was mediated by weight-related psychological flexibility (changes from pre to post in the AAQW) in the ACT face-to-face and mobile groups (see Figure 2).

The standardized estimates for statistically significant indirect effects ($a \times b$) ranged from .05 to .08, indicating small effects (effect size > .02; Cohen, 1992). There were no statistically significant direct effects c, when the indirect path (a and b) was included in the model, indicating indirect-only mediation (Zhao et al., 2010).

Mindfulness skills (FFMQ and its subscales), general psychological flexibility (AAQ-II) or sense of coherence (SOC) did not mediate any intervention effects on intuitive eating and weight. All LDS mediation models showed an excellent fit to the data.

To sum up, weight-related psychological flexibility (AAQW) mediated the intervention effects on intuitive eating and its subscales *eating for physical rather than emotional reasons* and *reliance on internal hunger and satiety cues,* as well as on weight, in the ACT interventions.

4 DISCUSSION

The main aim of this research was to examine the role of behavioral and psychological flexibility as well as experiential avoidance in eating regulation and weight management in overweight adults.

The first goal of the research was to examine the effects of flexible vs. rigid restraint of eating on weight-loss maintenance and well-being, as well as their relations to psychological flexibility and self-efficacy in participants of weight-loss and maintenance interventions. Previous studies have shown that rigid restraint is consistently associated with higher body mass index (BMI) and poorer weight loss, while flexible restraint is consistently associated with lower BMI and greater as well as more sustained weight loss (Meule et al., 2011; Westenhoefer, 2001; Westenhoefer et al., 2013). Also, it has been suggested that it is more generally behavioral flexibility that is the key predictor of weight maintenance (Byrne et al., 2003, 2004).

The second goal of the research was to examine whether psychological flexibility and mindfulness, independently and together, explain intuitive eating. Psychological flexibility and mindfulness are often conceptualized as two related yet distinct adaptive regulation and coping processes that can be seen as opposites to experiential avoidance (Kashdan & Rottenberg, 2010), and they both have been shown to be associated with eating behavior. It was expected that although mindfulness skills and psychological flexibility are closely related phenomena, there could be some distinct types of associations with eating behavior.

The third goal was to evaluate the mediating effects of mindfulness and psychological flexibility on enhancing intuitive eating and weight reduction in ACT interventions. Several studies have found support for increased mindfulness and acceptance (or decreased avoidance) in explaining ACT outcomes for health-related problems, including diabetes management (Gregg et al., 2007), smoking cessation (Gifford et al., 2004), and chronic pain (Dahl, Wilson, & Nilsson, 2004). However, there are only few studies examining these processes in regard to eating regulation and weight management.

4.1 Conceptual framework

Weight management is challenging in the current Western social environment, where food is always available, combined with our inherited biological characteristics that make us susceptible to internal and external cues for overeating. It has been suggested that people have an innate ability to respond to body signals and are thus able to adequately regulate their own food intake (Birch et al., 1991). However, this ability can be overridden by environmental pressure, individual experiences (Birch et al., 2003) and dieting (Herman & Polivy, 1983), which may habituate individuals to negate their body signals of hunger and satiety and consequently become less sensitive to bodily cues to eat but more responsive to signals to eat that are generated by other cues (i.e., food stimuli, desire for pleasure, emotional expressions). Research consistently shows that dieting is not a sustainable strategy for weight loss and may not promote a healthy lifestyle (Baird, Mcintyre, & Theim, 2007; Hawks, Madanat, & Christley, 2008; Konttinen, Haukkala, Sarlio-Lähteenkorva, Silventoinen, & Jousilahti, 2009; Peneau, Menard, Mejean, Bellisle, & Hercberg, 2013).

Psychosocial approaches to obesity have typically involved traditional cognitive and behavioral techniques (e.g., Anderson, Vichitbandra, Qian, & Kryscio, 1999; Brownell, 1987, 2000; Perri & Corsica, 2002). These weight-loss programs have shown modest short-term effectiveness (Wadden, Foster, & Letizia, 1994) and poor long-term maintenance (Wilson & Brownell, 2002). One possible explanation for this apparent failure is inadequate theory development and testing of behavior change mechanisms.

Cognitive behavioral interventions for obesity typically employ techniques designed to control or modify food cravings, such as increasing the structure of eating, removing palatable food from the home, creating mentally distraction, restructuring urge-related thoughts, and modifying dysfunctional beliefs about eating and self-image (e.g., Brownell, 2000). They do not directly address the component that enables knowledge and skills to be used effectively over the long term. Treatment component analyses of larger CBT programs have often failed to show support for cognitive interventions contributing to better outcomes (Jacobson et al., 1996; Longmore & Worrell, 2007; Teasdale et al., 2001). Moreover, there is limited evidence supporting the notion that changes in cognitive mediators lead to changes in relevant outcomes, and, in fact, there is growing evidence showing that cognitive mediators do not instigate symptom improvement (for a review, see Longmore & Worrell, 2007). This is of relevance for weight management programs, given that many interventions incorporate techniques built upon a theory of change with questionable support. Thus, there is a need for competing approaches that test theories and mechanisms of change.

Weight management requires long-term commitment, the ability to delay gratification (dealing with food urges), and the ability to successfully live with a variety of emotional states (boredom, sadness, anxiety) that may occasion the

desire to engage in avoidant coping (which could include eating). To improve long-term weight management, it is important to understand self-regulation in terms of how it explains adaptive eating behaviors, answering what makes it challenging and how it can be supported. Experiential avoidance vs. psychological flexibility seems to be one important process explaining self-regulation. ACT directly addresses patterns of avoidance and promotes acceptance. In addition, ACT promotes long-term behavioral commitment to chosen life values despite changes in emotion and cognition. Thus, ACT can be assumed to promote adaptive eating regulation and weight management through acceptance and flexibility.

4.2 Discussion of findings

The present results support the assumption that both behavioral and psychological flexibility play an essential role in eating regulation based on an individual's perception of physical hunger and satiety cues over emotional or environmental cues, as well as in weight management. An accepting relationship with one's own thoughts and feelings and flexible self-regulation in accordance with the demand of the situation, theorized to be a part of psychological flexibility (Hayes et al., 2006), seem to be important for understanding weight management and eating behavior associated to it.

4.2.1 Flexible vs. rigid control of eating

The distinction between flexible and rigid cognitive restraint seems to be relevant for understanding how cognitive efforts to restrict one's dietary intake can influence weight control. Flexible control involves a more gradual and relative understanding of a diet's impact on energy balance. The TFEQ items on flexible restraint concentrate on consciously eating smaller amounts and being more aware of what and how one is eating (i.e., "I consciously hold back at meals in order not to gain weight" and, "How likely are you to consciously eat less than you want?"). In turn, a rigidly restrained eater gives higher absolute value to restraining calorie intake. Items examining rigid restraint concentrate more on avoiding calories, situations and feelings of guilt (i.e., "I count calories as a conscious means of controlling my weight" and, "How frequently do you avoid stocking up on tempting foods?").

The increase in flexible cognitive restraint during the weight-loss and maintenance (WLM) intervention related both to greater weight loss and its maintenance, which is in accordance with earlier findings (Teixeira et al., 2010; Westenhoefer et al., 1999). By contrast, rigid control of eating behavior was not associated with success in weight loss or its maintenance. Also, psychological well-being was associated to flexible restraint of eating. The more flexible restraint increased during the WLM intervention, the more psychological well-being improved. At the same time, a greater reduction in rigid restraint during

the follow-up period was related to better maintenance of improved psychological health at the time of the follow-up. These results suggest that using more flexible instead of rigid strategies in weight management supports well-being, which in turn may contribute to positive lifestyle changes.

Moreover, successful weight-loss maintenance has been related to higher levels of self-efficacy (Byrne, 2002; Jeffery et al., 2000; Linde et al., 2006; Riebe et al., 2005). In line with that, the present results show that those who had better self-efficacy at the follow-up better maintained increased flexible restraint after the weight-loss intervention. This suggests that the relationship between self-efficacy and weight management could be explained by the ability to use flexible methods in eating regulation.

When interpreting these results, it is important to note that the participants were on a strict diet during the WLM intervention, which requested that they practice intense restraint of eating by following strict rules and counting food portions. Thus, the ability to give up rigid eating restraint after an active weight-loss phase seems to be conducive to well-being. Restraint of eating is also suggested to have different effects depending on weight status. Among the participants having obesity and current or past dieters, higher restraint of eating was related to lower adiposity, less uncontrolled and emotional eating as well as higher self-control, while the opposite was the case among normal-weight participants and those who had never been on a diet (Konttinen et al., 2009). These results suggest that restrained eating may be related to better weight control among those who need and are motivated to lose weight, while among others it may indicate problems with eating. Studies have also suggested that the relationship between weight control and cognitive restraint of eating may change over time (i.e., positively in the short term, but not necessarily in the long run) (Teixeira et al., 2010). The present results point out that it is important to also consider the quality of restraint. Flexible restraint seems to support weight management and well-being, whereas rigid restraint does not. On the other hand, a previous study indicated that flexible control may not be totally distinct from rigid control (as operationalized by Westenhoefer et al., 1999) and thus the promotion of flexible control may inadvertently promote rigid control as well. Flexible control was positively related to well-being and negatively related to psychological distress and BMI only when flexible control's sizeable conceptual overlap with rigid control was removed (Tylka, Calogero, & Daníelsdóttir, 2015). This suggests that the definition and measurements of flexible control in eating behavior need to be further developed.

Unexpectedly, changes in flexible and rigid cognitive restraint were not related to the level of general psychological flexibility (AAQ-II) at follow-up. It was expected that those having higher levels of psychological flexibility would be more able to adopt adaptive eating-regulation methods, that is, to increase flexible restraint. Psychological flexibility describes one’s ability to accept aversive internal experiences and to take values-based actions in the presence of difficult thoughts (as opposite to the tendency to become behaviorally inactive or avoidant), while flexible and rigid restraint describe strategies to control eat-

ing in order to manage one's weight. Thus, the ability to follow a strategy of rigid eating restraint may well be an indicator of higher psychological flexibility, especially when the aim is to lose weight. Restraint of eating may be a value-based, committed action that demands the ability to tolerate discomfort such as cravings and the deprivation of pleasure. Thus, the relationship between psychological flexibility and eating restraint may be dependent on the context (including personal goals and values) as well as on the time of the assessment. Besides, the weight-specific measure of psychological flexibility (AAQW), assessing the acceptance of weight-related thoughts and feelings and the degree to which these interfere with valued actions, might have been a more valid measure for this population.

4.2.2 Psychological flexibility and mindfulness explain intuitive eating

Intuitive eating is an adaptive style of eating that focuses on eating motivated by physical reasons, with an individual relying in his or her physical hunger and satiety cues rather than eating based on emotional or environmental motivators (Avalos & Tylka, 2006; Tylka, 2006). The purpose of Study II was to provide a preliminary understanding of the role of acceptance and flexibility in the context of adaptive eating behavior by investigating the relationships between psychological flexibility, mindfulness and intuitive eating within overweight individuals with health concerns.

Psychological flexibility and mindfulness are often conceptualized as two related yet distinct adaptive regulation and coping processes that can be seen as opposites to experiential avoidance (Kashdan & Rottenberg, 2010). Psychological flexibility can be theorized as an overarching regulation process of experiencing whatever one is experiencing non-judgmentally, without defense or judgment (i.e., mindfulness), while engaging in value-directed activities (i.e., commitment to actions). In line with this conceptualization, Study II suggests that mindfulness and psychological flexibility are related constructs that account for some of the same variance in intuitive eating, as well as accounting for significant unique variances in this type of eating behavior—especially when psychological flexibility is assessed with a targeted measure of weight-related thoughts and feelings.

Consistent with the hypothesis, better psychological flexibility and mindfulness skills were related to higher levels of intuitive eating. In addition, persons who had a lower BMI showed a higher degree of acceptance concerning weight-related thoughts and feelings, and they ate more intuitively, which is in accordance with previous research regarding female college students (Hawks et al., 2005; Smith & Hawks, 2006), early and middle-aged women (Augustus-Horvath & Tylka, 2011; Tylka, 2006), and young male and female adults (Denny, Loth, Eisenberg, & Neumark-Sztainer, 2013).

In the present research, general psychological flexibility was related to *unconditional permission to eat* and *eating for physical reasons* separately from other mindfulness skills but not independently of *non-judgment*. Thus, these findings suggest that the ability to take a non-evaluative stance toward feelings and

thoughts is particularly important in explaining a more flexible and accepting relationship with food as well as lower emotional eating.

General psychological flexibility (AAQ-II) was not related to *reliance on hunger and satiety cues* when any other mindfulness skill was controlled for, except *observing*. Instead, mindfulness skills – *acting with awareness*, *observing* and *non-reacting* – explained *reliance on hunger and satiety cues* independently from psychological flexibility (AAQ-II and AAQW). These results suggest that eating based on bodily cues could be enhanced by improving skills of observing one's thoughts and feelings in an accepting, non-reactive way and concentrating more on what one is doing.

Seen together, these results suggest that acceptance is more strongly related to *unconditional permission to eat* (e.g., a low tendency to have "forbidden" foods or to have self-imposed restrictions on eating behaviors) and *eating for physical reasons,* whereas mindfulness skills of being present in the moment with openness and curiosity seem to be especially relevant for explaining eating regulation based on bodily cues about hunger and satiety. This is in line with previous results showing that the individual degree of accurately perceiving one's interoceptive signals (i.e., heartbeat) predicted intuitive eating and especially the factors associated with the awareness of hunger and satiety cues and the willingness to eat to satisfy hunger rather than to eat for external and emotional reasons (Herbert et al., 2013). A significant overlap between the individual sensitivity of recognizing one's heartbeat and the sensitivity for feeling signs of hunger and satiety has been demonstrated using also other measurements (Herbert et al., 2012; Herbert, Muth, Pollatos, & Herbert, 2012). These results are underscored by research showing that intuitive eating (Hawks et al., 2004; Tylka, 2006; Tylka & Wilcox, 2006) as well as subjectively rated interoception related to hunger (Garner, Olmstead, & Polivy, 1983), and interoceptive sensitivity, measured by a heartbeat perception task (Pollatos et al., 2008), is impaired in eating disorders. To sum up, these results suggest that being aware of one's own bodily state supports healthy eating behavior.

The results regarding the *observe* item (i.e., its positive correlation to *reliance on hunger and satiety cues* and its negative correlation to *unconditional permission to eat,* when psychological flexibility was controlled for) suggest that individuals who are sensitive to noticing their present-moment experience are also sensitive to noticing when they are hungry or satiated, but they might have stricter rules that guide their eating and consequently make them feel guilty about eating "bad" foods. These findings, together with the notion that observing was not related to psychological flexibility, are consistent with previous findings showing that although most aspects of mindfulness predict better psychological outcomes, observing alone does not (Baer et al., 2006; Lavender et al., 2011). Lattimore et al. (2011) also found that observing was positively associated to uncontrolled eating and cognitive restraint of eating (Lattimore et al., 2011). Adams et al. (2012) found that *describing* and *non-judging* predicted lower symptoms of bulimia nervosa and lower body dissatisfaction, and *acting with awareness* was positively related to lower symptoms of anorexia nervosa and

bulimia nervosa, whereas *observing* predicted higher anorexic symptoms. Seen together, these results suggest that simply observing one's present-moment experience is not necessarily beneficial to healthy eating behavior unless it is combined with other aspects of mindfulness (i.e., a non-judgmental, non-reactive stance toward those experiences).

Even though general psychological flexibility (AAQ-II) overlapped with mindfulness skills in relation to intuitive eating, psychological flexibility regarding one's weight (AAQW) seems to involve features explaining intuitive eating that are not shared with mindfulness skills and general psychological flexibility. This observation supports the idea of modifying the general Acceptance and Action Questionnaire in order to target this specific area (Lillis & Hayes, 2008). In the context of the present research, the acceptance of weight-related thoughts and feelings and the degree to which these interfere with valued actions is probably a more valid issue than the aspect of struggling with aversive internal experiences in general. The AAQW contains questions that relate to a variety of ACT processes, including the acceptance of difficult emotions, the defusion from difficult cognitions, and the ability to take action despite the presence of uncomfortable private events. However, it is interesting that the general regulation processes of psychological flexibility and mindfulness also explain eating behavior.

4.2.3 Weight-related psychological flexibility mediates changes in intuitive eating regulation

Despite the promising results related to intuitive eating, few studies have attempted to explain the processes encouraging adaptive eating behavior. The implementation of intuitive eating strategies via intervention studies has been shown to positively impact psychological health outcomes, such as improving self-esteem and body image as well as reducing depressive symptoms (Bacon et al., 2005; Hawley et al., 2008; Provencher et al., 2009), and improving physical health indicators such as blood pressure and cholesterol levels (Bacon et al., 2005). It could be argued that intuitive eating is a natural way to eat for some (more lean) people, but not for others (overweight individuals). The present interventions (ACT face-to-face, ACT mobile) did not directly implement strategies of intuitive eating, but it was hypothesized that by improving psychological flexibility and mindfulness skills intuitive eating regulation would be promoted. Thus, the focus of Study III was to explore mechanisms of change in intuitive eating and weight in an acceptance-, mindfulness- and values-based intervention with overweight people.

The results showed that the ACT interventions increased *eating for physical rather than emotional reasons*. This result is in line with previous studies that have indicated that mindfulness practice reduces emotional and external eating (Alberts et al., 2012) as well as binge eating (Kristeller & Hallett, 1999). The present findings support the theoretical assumption that ACT reduces avoidance behavior such as emotional eating, and thus suggest that ACT-based interventions may have a positive impact on weight management and disordered eating.

However, it is important to note that the observed effect sizes were small, and the clinical significance of this observation is unclear.

As expected, the effect of the intervention on weight and intuitive eating behaviors, *eating for physical rather than emotional reasons* and *reliance on internal hunger and satiety cues,* was mediated by change in weight-related psychological flexibility (AAQW) in both of the ACT interventions (regardless of the form of the intervention). This is in accordance with the ACT model and previous research results that have shown, through population-specific measures, that psychological flexibility can be a significant mediator of change in many different areas, including in smoking cessation (Gifford et al., 2004), diabetes self-care (Gregg et al., 2007), prejudice (Lillis & Hayes, 2007), seizures and quality of life in epilepsy cases (Lundgren et al., 2008), adaptive functioning in chronic pain patients (McCracken, Vowles, & Eccleston, 2005; Vowles & McCracken, 2008; Wicksell, Ahlqvist, Bring, Melin, & Olsson, 2008), and weight-related issues (Lillis et al., 2009; Weineland et al., 2012). This body of evidence indicates that ACT produces favorable behavior changes by decreasing avoidance behavior and increasing flexibility.

The present findings about mediation processes support the idea that ACT interventions for lifestyle changes function as predicted: through enhanced ability to continue with valued activities when confronted with negative emotions and thoughts related to weight. The ACT interventions were able to produce changes in experiential avoidance of weight-related private events, and the changes in avoidance produced favorable outcomes. Thus, while the reduction in weight was small (Kolehmainen et al, 2016), the process of acceptance and flexibility appeared to play a major role and can be targeted in even a brief intervention. Mediation analysis allows us to identify fundamental processes underlying human behavior that are relevant across behaviors and contexts. Thus, information regarding change processes is considered central to further developing theories and more efficient interventions. The present research showed similar intervention effects and mediating processes for the stand-alone ACT mobile intervention with minimal contact as for the ACT face-to-face intervention, which supports the assumption that these particular behavioral processes are essential in supporting adaptive eating attitudes and weight management.

Taken together, intuitive eating, including eating based on physical reasons and guided by hunger and satiety cues, increased in both ACT interventions (face-to-face and mobile) when the acceptance of weight-related thoughts and feelings and response flexibility related to weight issues (AAQW) increased.

4.3 Limitations

The present research has several limitations. In Study I, psychological flexibility and self-efficacy were measured only at the follow-up assessment, and changes over time could not be investigated. Consequently, the research does not reveal whether increased flexible eating restraint improved self-efficacy or whether

greater self-efficacy enabled flexible restraint of eating to increase. Moreover, the participation in the follow-up assessment was voluntary and it is possible that some of the persons who did not take part in it may have experienced a different pattern of weight change after the intervention than the participants who attended the follow-up assessment, even though there was no difference in weight loss between these two groups during the intervention. Furthermore, longer follow-up periods are needed in lifestyle and weight management studies.

The generalizability of the results to the general population is limited. The participants of present studies were mostly middle-aged women who were obese or overweight and who were willing to make lifestyle changes. In a previous study by Augustus-Horvath and Tylka (2011), middle-aged women (40–65 years of age) reported lower intuitive eating (and higher BMI) than emerging adult (18–25 years of age) and early adult (26–39 years of age) women. In the present data, participants' level of intuitive eating was about the same as reported for middle-aged women, and lower than reported for younger (mostly normal weight) women in previous studies (Augustus-Horvath & Tylka, 2011; Herbert et al., 2013). Thus, compared to younger women, middle-aged women rely less on their internal hunger and satiety cues to guide their eating and grant themselves less permission to eat when hungry. Perhaps this is an attempt, albeit faulty, to compensate for weight gain that often accompanies aging. Accordingly, the age and gender of the participants should be considered more carefully in future studies.

Another significant limitation of this research is the use of self-report measurements to assess behaviors of interest. It should be noted that the self-report measurements measured cognition. In contextual behavioral science, cognition can be seen as a learned behavior influenced by its context (including inner experiences). Accordingly, the ACT interventions aimed to change the context in order to change the effect of inner experiences on behavior. However, we cannot be sure that observed changes in processes actually reflect "true" changes in target behaviors—they may simply reflect social demand or expectations of the treatment. It is also possible that individuals cannot accurately report the construct of interest, given problems with recall, bias and experimental demand. Reporting one's psychological functioning and eating-related behavior is difficult and can be affected by current mood and other contextual factors.

Different self-report measures (such as AAQ, FFMQ, and IES) may be parallel expressions of some common underlying cognition. It is also important to note that intuitive eating and eating restriction (flexible or rigid) are cognitive constructs that can be expected to be related to eating habits, but more studies are needed to verify that. The present results support these connections by showing simultaneous changes in eating restriction and weight. Also, in Study III, the effects of the intervention on both BMI and intuitive eating were mediated by changes in weight-related psychological flexibility (AAQW). Still, future studies should explore the use of laboratory-based behavioral tasks and physiological measures along with self-report measurements. One example of this

kind of study is a research study by Herbert et al. (2013) which indicated that interoceptive sensitivity, as measured by a heartbeat perception task, was positively related to the total IES score and specifically to *reliance on hunger and satiety cues* and *eating for physical reasons* in healthy young women. Besides, interoceptive sensitivity fully mediated the negative relationship of *reliance on hunger and satiety cues* as well as *eating for physical reasons* with BMI.

The most significant limitation of the mediation analysis is that the processes were measured partly in parallel. Thus, the temporal precedence of the mediator could not be established, making it difficult to separate cause and effect. Unfortunately, a lack of assessment points during the active treatment phase precluded a detailed examination of the directionality of change. Hence, the present research indicated that intuitive eating increased during the intervention and follow-up period with participants whose weight-related psychological flexibility increased during the ACT intervention. Accordingly, it is possible that intuitive eating and psychological flexibility increased at the same time during the intervention. However, determining the most suitable time span over which to measure a mediator and an outcome is important to ensure that the span of the research is sufficient for a mediation process to take place. In the present data, changes in outcome measures happened during the intervention period and were maintained or even increased during the follow-up period. Thus, in order to capture the changes in weight and intuitive eating factors, the time period from the pre-intervention measurement to the follow-up was chosen for the mediation model. However, the time periods of the research, about two months for the process measurements and eight months for the outcomes, may have been too short for some mediation effects to take place. For example, adopting mindfulness skills and utilizing them to improve eating behaviors and increase weight loss more significantly may need more time. Thus, in future studies, several assessment points during the active treatment phase are recommended to investigate which processes promote intuitive eating.

Moreover, it is important to note that even though indirect effects in mediation analysis were significant, they were small, and there may be other important variables mediating intervention effects on intuitive eating and weight. Studies II and III were designed to gain a preliminary understanding of the role of mindfulness and psychological flexibility in intuitive eating. It is important to note that there may be other factors that also explain intuitive eating.

4.4 Implications and future directions

The present research investigated mechanisms of change that accounted for positive outcomes in eating regulation and weight management. The contribution and importance of the research are best understood in the context of the development of the theory of adaptive eating regulation in weight management and its implications in practice.

Existing weight management interventions mostly address knowledge about low calorie diets and include techniques that are based on self-control and cognitive restraint of eating. Although cognitive restraint is considered to be a consistent predictor of weight loss (Elfhag & Rössner, 2005), it does not seem to work in long-term weight management (Linde et al., 2006; Teixeira et al., 2006; Teixeira et al., 2010). The present research shows the long-term benefits of increasing flexible over rigid restraint of eating in weight-loss maintenance. The results also suggest that rigid control strategies may negatively affect well-being in the long run and it therefore seems important to give up rigid control after a strict diet. This is in line with the field literature indicating that rigid avoidance behavior is related to poor psychological well-being and to many disordered behaviors (for a review, see Chawla & Ostafin, 2007). Thus, the goal of acceptance and commitment therapy (ACT) is to decrease experiential avoidance related to rigid behavioral patterns and to increase psychological and behavioral flexibility (Hayes et al., 2006).

Previous research has mainly concentrated on explaining disordered eating behaviors, and in the obesity literature, studies typically have adopted a cognitive control approach. Thus, the present research is novel in two ways. It represents one of the first attempts to investigate mediators of change in adaptive eating behavior, and further, this is one of the first attempts to target psychological flexibility in order to foster adaptive eating regulation and weight management. The results suggest that the efforts were successful. In the present research, changes in the proposed mediator (AAQW) accounted for changes in outcome variables, including intuitive eating factors, *eating based on physical reasons* and *reliance of hunger and satiety cues,* and weight loss. These effects were achieved with two differently formed ACT interventions (the stand-alone ACT mobile intervention with minimal contact and the ACT face-to-face group intervention), supporting the proposed mechanism of change regardless of social contact. This research thus supports the importance of flexibility in eating regulation and ACT as being relevant to weight management.

The results of the research fit the ACT model. Changes in the AAQW and FFMQ represent reduced experiential avoidance in the form of increased acceptance, cognitive defusion, self-as-context, and being present. Changes in intuitive eating and weight could reflect an increase in committed behavior to values. Besides, increases in *reliance on internal hunger and satiety cues* and *eating for physical rather than emotional reasons* could be said to be impossible without present-moment awareness and acceptance. Thus, the six overlapping processes of ACT can be useful in understanding and explaining eating behavior.

In line with the present research findings, previous research has indicated the importance of defusion and acceptance in dealing with cravings. Cognitive fusion refers to situations in which behavior is excessively regulated by verbal rules and insensitive to direct experiences. A person may have a list of 'forbidden' foods, which may paradoxically increase cravings for those foods and lead to uncontrolled eating. It has been shown that trying not to think about food has a rebound effect and actually increases food-related thinking (Soetens &

Braet, 2006). The suppression of thoughts related to food predicts food cravings, binge eating and other symptoms of disordered eating (Barnes & Tantleff-Dunn, 2010; Geliebter & Aversa, 2003). Moreover, food cravings are hypothesized to be further evoked by a monotonous diet (a diet with a limited number of foods), and some evidence shows that food cravings mediate the association between rigid dieting and weight gain (Meule et al., 2011). In line with this, Forman et al. (2007) found that coping strategies based on acceptance were more effective than those based on emotional control in dealing with food cravings in the case of individuals strongly impacted by food. Accordingly, it has been suggested that acceptance-based treatment is particularly effective for those who are the most susceptible to eating in response to internal and external cues (i.e., emotional eaters).

The present and previous research indicates that acceptance-based approaches with different formats can be used. The present results suggest that ACT alone, even without additional standard treatments (i.e., nutrition education), may be useful for weight loss and its maintenance. However, the primary goal of the present interventions was not weight loss, but healthy lifestyle changes more generally, and thus the achieved weight loss was small (Kolehmainen et al, 2016). In future, it would be useful to examine whether combining ACT with standard treatments—including, for example, diet and exercise recommendations, self-monitoring and goal setting—improves weight-loss outcomes. Weight loss and maintenance benefits would probably be improved by providing the individual the information and tools necessary to achieve their nutrition and exercise goals, and adding the ACT approach to target the underlying barriers while enhancing motivation for adherence. The current evidence suggests that ACT could be useful as an add-on treatment, or in a combined format, for improving long-term weight-loss outcomes (Forman et al., 2009; Lillis et al., 2009; Niemeier et al., 2012). Anyway, understanding the processes behind eating regulation and weight management enables the flexible use of behaviour change principles in different settings.

When combining ACT with standard treatments, some questions should be considered. First, in ACT, the overarching treatment goal is effective living, defined as behaving consistent with one's personal values. Healthy living often relates to the ability to engage in desired activities and weight loss can be one pathway to a valued objective. Given this, treatment would be organized around values-based actions and would focus on getting a client to engage in these desired activities immediately, as opposed to waiting for one's body shape to change. Second, ACT emphasizes the function more than the topography of behavior. As opposed to changing private experiences, the primary focus of treatment is to help change one's relationship to the experiences in such a way that the individual can pursue values-oriented living. Once values are clarified, behaviors inconsistent with values (e.g., overeating, excessive sedentary behavior) are seen as ineffective ways of coping with unwanted private experiences (e.g., stress, low mood, feeling bored) and are addressed with acceptance and mindfulness strategies. Broadly, it is important to consider the message

being delivered by a specific intervention. Are we fostering an avoidance agenda and self-judgments if we emphasize using a scale or counting calories and encourage motivation based on "getting rid of bad feelings, tiredness, poor self-confidence"? This could partially explain weight maintenance problems. An avoidant agenda may work well in the short term, but evidence suggests that it is harmful in the long run. Thus, the coherence between intervention methods should be considered and questioned as to whether they promote values-based living and acceptance of private experiences.

This research offers new approaches and methods for obesity and eating behavior researchers and clinical psychologists. According to the findings, the following approaches might be fruitful. Guide eating by using flexible regulation in accordance with the demands of the situation instead of having rigid rules about when and what to eat. Observe inner experiences and rely on internal hunger and satiety cues to guide eating. As opposed to trying to control thoughts or getting rid of the cravings or emotions, promote mindful awareness of them. Develop skills for people to be able to accept difficult emotional experiences and bodily sensations in order not to overreact to them. All in all, an accepting approach regarding one's own inner experiences, one that enables the individual to observe his or her experience without reacting to it, may be helpful in making more conscious decisions based on the direct experience (e.g., sensation of hunger and satiety) and personal values and goals.

More studies about intuitive eating with overweight populations are needed. The positive associations between higher levels of intuitive eating and better psychological flexibility as well as mindfulness skills, and also lower BMI, support intuitive eating as a healthy and workable approach to eating regulation. However, in combination with learned effects, there may be genetic and physiological factors explaining individual differences in people's sensitivity to eating regulation systems. Research suggests that "hunger" can be intensely experienced even in the absence of physiological need (Lowe & Butryn, 2007). It is possible that eating according to one's "internal cues" may be confused with more hedonically-driven signals, and that such signals may contribute to an elevated BMI in the first place (Lowe & Butryn, 2007; Stroebe, Papies, & Aarts, 2008). In such cases, for the more vulnerable individuals, eating-related decisions may need to be guided by other factors and methods (e.g., regular meal rhythms) in addition to the hunger and fullness cues. On the other hand, a permissible attitude toward all kinds of foods seems to be a workable approach even for overweight people and it may actually decrease food cravings and uncontrolled eating, whereas strict restrictions may indeed increase unwanted results (Barnes & Tantleff-Dunn, 2010; Meule et al., 2011). Findings have suggested that people who have a permissible attitude toward food and eating do not overindulge in it. For example, the *unconditional permission to eat* scores did not correlate with uncontrolled eating and there were no significant differences in *unconditional permission to eat* scores between non-overweight and overweight participants (Camilleri et al., 2015). Also, strong negative correlations between *unconditional permission to eat* and the dieting as well as the bulimia/food preoc-

cupation subscales of the Eating Attitude Test-26, assessing levels of eating disorder symptomatology, have been reported (Tylka & Wilcox, 2006). However, it is possible that the relationship between intuitive eating, or some of its subscales, and weight management depends on other issues, like biological susceptibility, environmental factors or diet history.

To sum up, preliminary evidence for the effectiveness of acceptance- and mindfulness-based interventions for eating behaviors as a whole is promising. Examining mechanisms of change in addition to outcomes while clearly elucidating participant characteristics would be crucial to successfully investigate whether acceptance- and mindfulness-based interventions contribute to treatment development for weight management as well as disordered eating. The present research highlights the importance of flexibility in adaptive eating and weight management. Flexible restraint of eating was related to better weight-loss maintenance and well-being in the contexts of the weight-loss programs, and psychological flexibility related to weight issues promoted intuitive eating and weight control in ACT interventions.

4.5 Conclusions

The results of this research indicate that enhanced acceptance and flexibility related to weight issues increase eating based on bodily cues and decrease emotional and external eating, as well as supporting weight management. The assessed ACT interventions decreased individuals' avoidance of weight-related private events (i.e., increased acceptance and flexibility), which mediated positive changes in their eating regulation and BMI. In addition, increased flexible restraint of eating was related to successful outcomes in weight-loss and maintenance (WLM) interventions, which may indicate possible mediation effect. This research is part of a growing body of literature supporting flexibility and acceptance processes as a means for treating eating and weight issues, as well as targeting patterns of avoidance as a mechanism of change for a wide range of behavioral concerns in general.

YHTEENVETO (SUMMARY)

Joustavuus syömisen säätelyssä ylipainoisilla aikuisilla

Pysyvä painonpudottaminen on haasteellista ympäristössä, jossa olemme jatkuvasti alttiita erilaisille ruokaan ja syömiseen liittyville vihjeille. Syömisen rajoittamiseen perustuvilla painonpudotusohjelmilla voidaan pudottaa onnistuneesti painoa, mutta useimmilla paino nousee takaisin. Taipumusta liialliseen syömiseen voidaan selittää muun muassa biologiaan perustuvalla alttiudella. Toisaalta, on ehdotettu, että ihmisillä on sisäinen kyky säädellä syömistään kehon viestien perusteella. Tämä kyky saattaa kuitenkin häiriintyä esimerkiksi jäykkään syömisen rajoittamiseen perustuvan laihduttamisen myötä, missä syöminen ei perustu sisäisiin vihjeisiin nälästä ja kylläisyydestä vaan ulkoapäin annettuihin sääntöihin. Myös taipumus reagoida syömällä sisäisiin kokemuksiin, kuten ajatuksiin ja tunteisiin, hankaloittaa syömisen säätelyä. Tämänkaltainen pyrkimys välttää sisäisiä kokemuksiaan (ts. kokemuksellinen välttäminen) on yhteydessä moniin käyttäytymisen ja hyvinvoinnin ongelmiin.

Tämän tutkimuksen tarkoituksena oli selvittää psykologisen joustavuuden yhteyttä syömisen säätelyyn ja painonhallintaan. Psykologinen joustavuus nähdään vastakohtana edellä kuvatulle kokemukselliselle välttämiselle. Psykologinen joustavuus tarkoittaa siten kykyä olla yhteydessä omiin sisäisiin kokemuksiin, ilman yritystä välttää tai kontrolloida niitä silloin, kun se mahdollistaa toimimisen omien arvojen ja tavoitteiden mukaisesti. Hyväksymis- ja omistautumisterapiassa (HOT) on tavoitteena lisätä psykologista joustavuutta ja sitä kautta edistää elämistä omien arvojen mukaisesti.

Ensimmäisessä osatutkimuksessa selvitettiin jäykän ja joustavan syömisen rajoittamisen yhteyttä painonpudotuksen ylläpitämiseen sekä psykologiseen joustavuuteen ja hyvinvointiin ylipainoisilla henkilöillä (n = 49), jotka osallistuivat painonpudotusinterventioon. Tulokset osoittivat, että syömisen joustavan rajoittamisen lisääntyminen oli yhteydessä sekä painonpudotukseen ja sen ylläpitämiseen että psykologisen hyvinvoinnin paranemiseen. Sen sijaan jäykän syömisen rajoittamisen lisääntyminen ei ennustanut painonpudotuksen onnistumista, mutta jäykän rajoittamisen väheneminen intervention päätyttyä oli yhteydessä paremman hyvinvoinnin ylläpitämiseen seurannassa.

Toisessa osatutkimuksessa selvitettiin psykologisen joustavuuden (yleisen ja painoon liittyvän) ja tietoisuustaitojen yhteyttä intuitiiviseen syömisen säätelyyn. Tutkittavat (n = 306) olivat ylipainoisia ja psyykkisesti kuormittuneita henkiöitä, jotka osallistuivat psykologisiin elämäntapainterventioihin: 1) HOT-ryhmäinterventioon, 2) HOT-mobiili-interventioon, 3) Edukatiiviseen verkkointerventioon tai 4) kontrolliryhmään. Psykologinen joustavuus ja tietoisuustaidot (mindfulness) kuvataan yleensä toisiinsa liittyviksi, mutta erillisiksi käyttäytymisen säätelyn prosesseiksi, jotka voidaan nähdä vastakohtana kokemukselliselle välttämiselle. Tässä tutkimuksessa tarkasteltiin, selittävätkö psykologinen joustavuus ja tietoisuustaidot intuitiivista syömistä toisistaan erillisinä prosesseina vai selittävätkö ne samaa vaihtelua syömiskäyttäytymisessä. Tulokset

osoittivat, että sekä suurempi psykologinen joustavuus että paremmat tietoisuustaidot olivat yhteydessä intuitiivisempaan syömisen säätelyyn sen kaikkien osa-alueiden osalta, jotka olivat 1) *ehdoton lupa syödä ilman, että ruokia jaotellaan kiellettyihin ja sallittuihin*, 2) *syöminen perustuen fyysisiin syihin tunnesyiden tai ulkoisten tekijöiden sijaan* ja 3) *luottamus kehon nälkä- ja kylläisyysvihjeisiin niiden kertoessa mitä, milloin ja kuinka paljon syödä.* Toiseksi psykologinen joustavuus ja eri tietoisuustaidot selittivät syömisen säätelyä osittain eri tavalla. Psykologinen joustavuus ja *hyväksyntä* olivat vahvemmin yhteydessä *ehdottomaan lupaan syödä* ja *syömiseen perustuen fyysisiin syihin*, kun taas *havainnointi*, *tietoinen toiminta* ja *reagoimattomuus ajatuksiin ja tunteisiin* selittivät *luottamusta nälkä- ja kylläisyysvihjeisiin* riippumatta yleisestä psykologisen joustavuuden tasosta. Painoon liittyvä psykologinen joustavuus, eli painoon liittyvien ajatusten ja tunteiden hyväksyntä ja kyky toimia arvojensa mukaisesti huolimatta negatiivisista painoon liittyvistä ajatuksista ja tunteista, selitti kaikkia intuitiivisen syömisen osioita riippumatta tietoisuustaidoista ja yleisestä psykologisesta joustavuudesta.

Kolmannessa osatutkimuksessa selvitettiin, välittävätkö psykologinen joustavuus, tietoisuustaidot ja koherenssin tunne muutoksia intuitiivisessa syömisessä ja painossa edellä kuvatuissa HOT-interventioissa (ryhmä- ja mobiili-interventiot, n = 219). Tulokset osoittivat, että painoon liittyvä psykologinen joustavuus välitti interventiovaikutusta painoon ja intuitiiviseen syömiseen, sekä sen kahteen alaosioon, *syömiseen perustuen fyysisiin syihin* ja *luottamukseen nälkä- ja kylläisyysvihjeisiin*, molemmissa HOT-interventioissa. Nämä tulokset ehdottavat, että hyväksyvä suhtautuminen painoon liittyviin ajatuksiin ja tunteisiin ja kyky toimia arvojensa mukaisesti huolimatta negatiivisista painoon liittyvistä ajatuksista ja tunteista välittävät interventiovaikutusta hyväksymis- ja omistautumisterapiaan perustuvissa, elämäntapojen muuttamiseen tähtäävissä interventioissa.

Yhteenvetona voidaan todeta, että joustavuudella näyttää olevan keskeinen rooli painonhallinnassa ja siihen liittyvässä syömisen säätelyssä. Kontrolloidussa painonpudotusohjelmassa joustavan syömisen rajoittamisen lisääntyminen ennusti painonpudotuksen onnistumista ja ylläpitämistä sekä parempaa hyvinvointia. Toiseksi, psykologinen joustavuus ja siihen sidoksissa olevat tietoisuustaidot olivat yhteydessä intuitiivisempaan syömisen säätelyyn, joka puolestaan oli yhteydessä alhaisempaan painoindeksiin. Kolmanneksi tutkimus osoitti, että intuitiivista syömistä ja painonhallintaa voidaan edistää hyväksymis- ja omistautumisterapian menetelmillä edistämällä psykologista joustavuutta.

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ORIGINAL PAPERS

I

FLEXIBILITY IN WEIGHT MANAGEMENT

by

Essi Sairanen, Raimo Lappalainen, Anja Lapveteläinen, Asko Tolvanen, & Leila Karhunen, 2014

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Flexibility in Weight Management

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Abstract

The purpose of the study was to investigate the relationships between changes in flexible vs. rigid restraints of eating during weight management, as well as how changes in the cognitive restraint of eating were related to psychological well-being and flexibility. The data includes information on 49 overweight persons who participated in a weight loss and maintenance (WLM) intervention and a follow-up assessment after 8–9 months.

An increase in flexible cognitive restraint during the weight loss intervention was related to better weight loss maintenance and well-being. The more flexible restraint increased during the WLM intervention, the more psychological distress decreased. Moreover, larger reduction of rigid restraint during the follow-up period (between the WLM intervention and the follow-up assessment) was related to a better maintenance of improved psychological well-being at the follow-up endpoint. These results suggest that increasing flexible control while reducing rigid control of eating after an active weight loss phase improves success in weight management and the psychological well-being of weight losers.

Keywords: flexible vs. rigid eating restraint, psychological flexibility, weight maintenance, psychological well-being, overweight

1. INTRODUCTION

Many people find it difficult to successfully regulate their eating behavior in the long term, which contributes to the current high rates of obesity. Weight management interventions usually include techniques that are based on behavioral or cognitive self-control models to improve self-efficacy and cognitive restraint of eating. Although cognitive restraint and dietary self-efficacy are considered consistent predictors of weight control (Elfhag & Rössner, 2005), both have been shown to correlate considerably better with short-term weight loss than with long-term weight loss maintenance (Linde, Rothman, Baldwin, & Jeffery, 2006; Teixeira et al., 2010; Teixeira et al., 2006). Previous studies have also suggested that the relationship between weight control and cognitive eating restraint may change over time: eating restraint may be positive in the short term, but not necessarily in the long run (Teixeira et al., 2010).

It has been shown that dietary restraint is not a homogeneous construct, but includes two distinct cognitive and behavioral styles: rigid control and flexible control of eating behavior (Westenhoefer, 2001). Rigid control is characterized by a dichotomous 'all or nothing' approach to eating and weight control, where periods of strict dieting alternate with periods without any weight control efforts. Flexible control, conversely, is characterized by a graduated 'more or less' approach to eating and weight control, which is understood as a long-term or even permanent task. Studies have shown that rigid restraint is consistently associated with higher body mass index (BMI) and poorer weight

loss, while flexible restraint is consistently associated with lower BMI and better as well as more sustainable weight loss (Meule, Westenhöfer, & Kübler, 2011; Westenhoefer, 2001; Westenhoefer et al., 2013). As an example, in a study by Teixeira et al. (2010), while dietary restraint (flexible or rigid) predicted short-term weight reduction during an obesity treatment program (after 1 year), only flexible dietary restraint was associated with positive follow-up outcomes (after 2 years).

The results suggest that it is a general non-dichotomous thinking style or behavioral flexibility, rather than dichotomous cognitions related specifically to food, weight and eating, that is the key predictor in weight maintenance (Byrne, Cooper, & Fairburn, 2003; Byrne, Cooper, & Fairburn, 2004). Weight loss was attributable to increased behavioral flexibility, and the more participants increased their behavioral flexibility, the more weight they lost (Fletcher, Hanson, Page, & Pine, 2011). Behavioral flexibility was also negatively related to pre-intervention BMI, indicating that heavier people are more habitual and constrained in the way they behave (Fletcher et al., 2011).

It has been suggested that, essential in weight loss maintenance is an ability to behave flexibly in accordance with one's personal goals or values (Hayes, Luoma, Bond, Masuda, & Lillis, 2006; Lillis, Hayes, Bunting, & Masuda, 2009). Research has shown that individuals who are unable to maintain weight loss tend to use avoidant (Byrne et al., 2003) or impulsive styles of coping (Fassino et al., 2002; Lillis & Hayes, 2008; Rydén et al., 2003) in response to stress or negative emotions, and frequently use eating to regulate emotions (Byrne et al., 2003). By contrast, those who successfully control their weight show more active, flexible and committed styles of adjustment (Westenhoefer, 2001). The growing body of evidence suggests that experiential avoidance is a central process in

the development of a range of mental health and behavioral health problems; meaning that, when confronted with difficult thoughts and feelings, some people tend to try and change or avoid these private experiences in an effort to regulate their behavior (Hayes et al., 2006; Lillis & Hayes, 2008). Cognitive rigidity, as well as rigid eating restraint, can be seen as this kind of coping strategy aimed at controlling private events.

As an opposite to experiential avoidance, psychological flexibility refers to an ability to focus on the present moment and, depending on what the situation affords, to persist with or change one's (even inflexible, stereotypical) behavior in the pursuit of goals and values (Hayes, Strosahl, & Wilson, 1999; Hayes et al., 2006). Consistent with conceptualization of psychological flexibility, there are now plenty of studies that show that this characteristic predicts outcomes such as mental and physical health (for the complete findings of this meta-analysis, see Hayes et al., 2006). Forman and colleagues (2007) found that coping strategies based on acceptance were more effective than those based on emotional control in dealing with food cravings for those who were strongly impacted by food. Moreover, increased psychological flexibility led to stigma reduction, weight loss, and improvements in the quality of life of obese weight losers participating in a one-day workshop concerning mindfulness and acceptance (Lillis et al., 2009).

In previous study of Karhunen and colleagues (2012), it was observed that behavioral and psychological factors rather than dietary factors played the main role in the success of individuals' weight management, which is in line with the review of the weight maintenance data that concluded that the issue of weight control should be viewed primarily from a psychological viewpoint (Elfhag & Rössner, 2005). More specifically, short-term (24 weeks) success in weight loss maintenance following a very low calorie

diet (VLCD) was associated with a greater increase in the flexible control of eating and a greater decrease in uncontrollable eating and psychological distress (Karhunen et al., 2012). The purpose of the present study was to further examine these psychobehavioral factors in weight management, especially the more long-term effects of flexible and rigid restraint of eating on weight loss maintenance and well-being, as well as their relations to psychological flexibility. The aim was to achieve an understanding about the mechanism of change during weight maintenance, especially related to control and flexibility.

Based on theory and prior research (Byrne et al., 2003; Fletcher et al., 2011; Hayes et al., 2006; Westenhoefer, 2001), it was hypothesized that an increase in flexible cognitive restraint of eating during a weight loss and maintenance program and a follow-up period of 8–9 months would be positively associated with better long-term weight management, whereas an increase in rigid cognitive restraint would be related to poorer long-term weight management. Moreover, based on previous literature (Bacon, Stern, Van Loan, & Keim, 2005; Lillis et al., 2009), it was hypothesized that a greater increase in flexible restraint during weight loss and maintenance periods would be positively correlated to higher self-efficacy, psychological flexibility and well-being during the follow-up period, whereas rigid restraint would predict poorer self-efficacy, psychological flexibility, and well-being.

2. METHODS

2.1 Participants and procedure

Originally 99 (28 males, 71 females) obese (inclusion criteria being body mass index (BMI) 30-40 kg/m^2, age 30-65 years) subjects were recruited into the weight loss and maintenance intervention study (WLM intervention; Karhunen et al., 2012). They were recruited by an announcement in a local newspaper and among the eligible subjects who had participated previously in the studies performed at the University of Kuopio, Finland (currently University of Eastern Finland).

The study design and the main results of the WLM intervention are described in detail by Karhunen et al. (2012). In brief, the WLM intervention consisted of two phases. First phase was a seven-week weight loss period requiring the intake of only very low calorie diet (VLCD) products. During the weight-loss period the subjects were given dietary counselling in group sessions, 7 times during whole period. In the group sessions, different themes were discussed, like energy requirements and energy consumption, physical exercise, meal rhythm and barriers for weight management.

In a second phase, after the weight loss period the subjects were randomized into two diet groups: Higher-Satiety Food group (HSF) and Lower-Satiety Food group (LSF). The subjects in the HSF consumed the test foods with higher satiety value, the subjects in the LSF the test foods with lower satiety value as a part of their weight-management diet, during which subjects were instructed to maintain their weight loss, but not to continue actively losing weight. The test foods aimed to cover about 30% of the individually

estimated daily energy requirements. During this period of 24 weeks, the subjects received the test foods in every two weeks in a visit, where the subjects' body weight was measured and they were given written instructions about the use of the test foods as well as the weight-management diet in general.

Altogether 82 subjects completed the WLM intervention, and about 8–9 months after the end of the WLM intervention, the participants were asked to take part in a follow-up assessment about which they had not been informed beforehand. The population of the present study consists of 60% of persons who completed the WLM intervention and participated in the follow-up assessment (*n=49*). There were no significant differences in the background variables (gender, age, education, BMI, or weight loss during the WLM) between those subjects who participated in the follow-up assessment (n = 49) and those who did not (n = 33) (data not shown).

The mean age of the participants was 51.4 ± 9.1 years (range 31–63), and the median of the BMI at the time of the follow-up assessment was 30.7 kg/m^2 (IQR= 28.7 - 33.4). All participants were of Finnish origin. The majority of the participants had an upper secondary education (59.1%) and 24.5% had a university degree.

The study was performed in accordance with the standards of the Helsinki Declaration. The Ethics Committee of the District Hospital Region of Northern Savo and Kuopio University Hospital approved the study plan, and all participants gave their written informed consent for their participation in the study.

2.2 Measurements

The Three-Factor Eating Questionnaire (TFEQ) was used to measure flexible and rigid control of cognitive eating restraint (Westenhoefer, Stunkard, & Pudel, 1999). The original TFEQ including 51 questions was used. Flexible cognitive restraint (7 items) is associated with low emotional and disinhibited eating, with a higher score indicating a more graduated 'more or less' approach to eating and weight control (e.g., "When I have eaten my quota of calories, I am usually good about not eating any more"). Rigid cognitive restraint (7 items) is associated with a dichotomous 'all or nothing' eating pattern and with higher disinhibition (e.g., answering *"Yes"* to "Do feelings of guilt about overeating help you to control your food intake?" or "I count calories as a conscious means of controlling my weight"). The Flexible and Rigid control subscales have been shown to have favorable psychometric properties and good predictive validity (Westenhoefer et al., 1999).

Psychological well-being vs. distress was evaluated using the General Health Questionnaire (GHQ-12; Goldberg, 1978), which measures overall psychological health or level of mental complaints. In this questionnaire, participants are asked to rate the frequency with which they experience common behavioral and psychological stressors (Banks et al., 1980). The items assess somatic symptoms, anxiety, depression, and social dysfunction. Recommended threshold scores range from >9 to >11 (Goldberg, 1978; Wright & Perini, 1987), depending on the relative emphasis on specificity or sensitivity. In present study, threshold score >9 indicating psychological distress were used. GHQ-12 has been widely validated and found to be reliable (Hardy, Shapiro, Haynes, & Rick, 1999; Werneke, Goldberg, Yalcin, & Üstün, 2000). Reliability coefficients of the questionnaire have ranged from 0.78 to 0.95 in various studies (Jackson, 2007).

Psychological flexibility was assessed using the Acceptance and Action Questionnaire (AAQ-II) (Boelen & Reijntjes, 2008), which is a 10-item Likert-type questionnaire that assesses the ability to accept aversive internal experiences and to pursue goals in the presence of these experiences. It contains a variety of different items, as its very name (acceptance and action) suggests. Some items target emotional acceptance or avoidance; others address the tendency to become entangled with thoughts, to take them literally, or, conversely, to see them simply as thoughts; still others ask about the ability to take value-based actions in the presence of difficult thoughts, or about the tendency to become behaviorally inactive or avoidant. The questions of the AAQ-II are based on statements like, "I worry about not being able to control my worries and feelings" and, "My thoughts and feelings do not get in the way of how I want to live my life." The Acceptance and Action Questionnaire has been shown to have good reliability and validity (Boelen & Reijntjes, 2008; Bond et al., 2011).

Perceived action and self-efficacy coping scales relating to nutrition were used to measure self-efficacy in dieting (AbuSabha & Achterberg, 1997; Schwarzer & Renner, 2000). Self-efficacy reflects a person's belief in his or her ability to overcome the difficulties inherent in performing a specific task in a particular situation. The questionnaire consists of four-item scales, where possible responses range from 1 ("very certain I cannot") to 4 ("very certain I can"). The psychometric properties of self-efficacy scales for nutrition have shown to be satisfactory (Schwarzer & Renner, 2000).

Weight, restraint of eating (TFEQ), and psychological well-being (GHQ-12) were measured at the 3 stages relating to the WLM intervention: pre (prior to the WLM intervention), post (immediately following the WLM intervention), and follow-up (the

assessment that followed 8–9 months after the WLM intervention had ended). Psychological flexibility and self-efficacy were measured in the follow-up assessment. Changes in participants' weight were calculated as relative changes in percentages (e.g., Weight ^{pre} - Weight ^{post} / Weight ^{pre}).

2.3 Statistical analysis

The scores for all measures at the three different time points were analyzed using a *repeated measures ANOVA* design. The detection of a significant main effect of *time* was followed by pairwise comparisons with Bonferroni corrections to maintain an overall alpha of .05.

The effect sizes (*ES;* Cohen's *d*) were calculated to measure clinically significant changes within groups. Effect size has been defined as a quantitative reflection of the magnitude of some phenomenon that is used for the purpose of addressing a question of interest (Kelley & Preacher, 2012). The *within-group effect sizes* were calculated by dividing the mean change from the pre- to post-intervention measurement and pre- to follow-up assessment by the pooled estimate of standard deviation (SD) across three measurement points (Cohen, 1988; Roth & Fonagy, 1996). A *within-group ES* of 0.5 was considered clinically small, 0.8 medium, and 1.1 large (Cohen, 1988; Roth & Fonagy, 1996).

Correlations between flexible and rigid eating restraint, weight and different psychological measurements (GHQ-12, TFEQ, AAQ-II, self-efficacy) were calculated using the bivariate (Pearson) and partial correlations. The partial correlations function

was used to calculate correlations between the change scores, while controlling for the pre-intervention levels of those variables. This way, mediational effects of flexible and rigid restrain to weight and well-being changes were examined. Correlation coefficient can be interpreted as a standardized regression coefficient between change scores in weight/well-being and flexible and rigid restraint. All statistical analyses were performed using the PASW, software program, version 19.0.

For the present data (n=49) the statistical power is greater than .70 when the Cohen's d is greater than .50 or when correlation coefficient is greater than .36. When the Cohen's d is greater than .60 or correlation coefficient is greater than .40 the statistical power is greater than .80.

3. RESULTS

TABLE 1

The scores for measures at the different time points are shown in Table 1. A significant effect of *time* was found in all variables ($p < .05$). Subsequent pairwise comparisons showed that weight and BMI had been significantly reduced by the time of the post-intervention measurement (weight: *Mdiff* = 11.3, $p < .001$; BMI: *Mdiff* = 4.1, $p < .001$) and at the follow-up assessment (pre-intervention vs. follow-up, Weight: *Mdiff* = 8.1, $p < .001$; BMI: *Mdiff* = 3.0, $p < .001$) compared to the pre-intervention levels. The change in BMI was clinically large from the pre to post measurement ($d = 1.40$), and medium from the pre to follow-up measurement ($d = 0.99$). However, there was a significant weight gain from the post to follow-up time point (post-intervention vs. follow-up, Weight: *Mdiff* = -3.2, $p < .001$; BMI: *Mdiff* = -1.1, $p < .001$). The average weight loss during the intervention (31 weeks) was 11.3 (sd = 4.8) kg, which is 11.9 (sd = 4.6) % (range 1.1–22.4%), and the average increase in weight from the post to follow-up measurement was 3.2 (sd = 3.5) kg, that is 3.3 (sd = 3.5) %, ranging from 4.6% weight loss to 12.6% weight gain. 94 % of participants had a weight loss of 5 % or greater from pre to post measurement and 75 % of participants from pre to follow-up measurement.

Correspondingly, subsequent pairwise comparisons showed that both flexible and rigid control of eating restraint had significantly increased by the time of the post-intervention measurement (Flexible Restraint: *Mdiff* = -2.7, $p < .001$; Rigid Restraint: *Mdiff* = -1.5, $p < .001$), and at the follow-up assessment (pre-intervention vs. follow-up, Flexible Restraint: *Mdiff* = -2.0, $p < .001$; Rigid Restraint: *Mdiff* = -1.1, $p < .001$).

However, there was a significant reduction in flexible restraint from the post to follow-up measurement (post-intervention vs. follow-up, Flexible Restraint: *Mdiff* = 0.7, $p < .001$). In contrast, a nonsignificant change was observed in rigid restraint from the post to follow-up measurement (post-intervention vs. follow-up, *Mdiff* = 0.4, $p = .113$). The average increase from pre to post was 2.70 (1.9) *points* (range -1.0–7.0) in flexible restraint and 1.5 (1.6) *points* (range -2.0–5.0) in rigid restraint. The average reduction from post to follow-up was 0.7 (1.4) *points* (range -3.0–4.0) in flexible restraint and 0.4 (1.3) *points* (range -4.0–3.0) in rigid restraint. The increases in rigid and flexible restraint were clinically large from pre to post (Rigid Restraint: $d = 1.14$; and Flexible Restraint: $d = 1.88$), and from pre to follow-up, the increase in rigid restraint was small ($d = 0.79$) and increase in flexible restraint was large ($d = 1.33$). Subsequent pairwise comparisons showed no significant changes in psychological distress. The average decrease in the GHQ-12's scores from pre to post was 1.5 (5.0) *points* (range -14.0–11.0), and the average increase from post to follow-up was 1.8 (5.8) *points* (range -17.0–21.0). Figure 1 shows the percentages of subjects being obese (BMI > 30 kg/m^2), and having GHQ-12's scores over 9, indicating psychological distress, at different time points.

At the follow-up assessment, the mean score for psychological flexibility (AAQ-II) was 55.1 ± 10.1, and for self-efficacy it was 2.9 ± 0.4.

FIGURE 1

TABLE 2

The correlations between flexible vs. rigid restraint of eating and weight are shown in Table 2. A Pearson correlation revealed that the change in flexible restraint from the pre-

to post-intervention measurement was related to weight changes in all time periods, indicating that greater increase in flexible restraint was related both to greater weight loss and its maintenance. This result was confirmed by partial correlations, where pre-intervention levels of weight and flexible restraint were controlled for. The partial correlation between change in flexible restraint from pre to post and weight change from pre to post was 0.37 (p = .011), and from pre to follow-up 0.46 (p = .001). The partial correlation between change in flexible restraint from pre to post and weight change from post to follow-up was -0.30 (p = .041), when pre-intervention levels of weight and flexible restraint as well as weight change from pre to post were controlled for. By contrast, there were no significant correlations between rigid restraint and weight changes.

Figure 2 demonstrates the relationships between flexible restraint of eating and weight at the different time intervals. Flexible restraint increases during the intervention and increase of flexible restraint is associated with (mediates the effect of intervention to) weight loss and its maintenance.

FIGURE2

TABLE 3

Second, we explored how changes in flexible and rigid restraint were related to different psychological variables (Table 3). Psychological distress and flexible restraint correlated negatively at the time of the post-intervention measurement, but not at the beginning of the intervention. Consequently, our calculations revealed a partial correlation between change scores of flexible restraint and the GHQ-12 scores for

psychological distress from pre to post, after having adjusted for pre-levels. There was a significant correlation (r = -.35, p = .015), indicating that the more flexible restraint increased, the more psychological distress decreased during the intervention, so from pre to post.

A partial correlation between change scores of rigid restraint and psychological distress scores from the post-intervention to follow-up measurement times, after having adjusted for post-levels , indicated that the more rigid restraint decreased, the less psychological distress increased during the follow-up period (r = .48, p = .001). Third, an analysis of partial correlations between changes in flexible restraint from post to follow-up and self-efficacy, after having adjusted for post-level of flexible restraint , revealed that a smaller reduction in flexible restraint from post to follow-up was related to better self-efficacy at the time of the follow-up assessment (r = .37, p = .009).

4. DISCUSSION

The purpose of the current study was to investigate the relationships between changes in flexible vs. rigid control of eating and weight management, as well as how changes in cognitive restraint of eating were related to markers of psychological well-being and flexibility.

The increase in flexible cognitive restraint during the weight loss intervention was related with both to greater weight loss and its maintenance, which is in accordance with earlier findings (Teixeira et al., 2010; Westenhoefer et al., 1999) as well as with the concept of flexible restraint in general. By contrast, rigid control of eating behavior was

not associated with success in weight loss or weight loss maintenance.

Psychological well-being was associated to flexible restraint of eating. The more flexible restraint increased during the WLM intervention, the more psychological distress decreased and thus well-being improved. In contrast, a greater reduction in rigid restraint during the follow-up period was related to better maintenance of improved psychological health at the time of the follow-up's assessment. The more rigid restraint decreased, the less psychological distress increased during the follow-up period. These results suggest that an increase in flexible control during weight loss and a reduction of rigid control after an active weight loss phase may enhance well-being. In other words, the ability to give up rigid eating restraints may be conducive to well-being. However, when interpreting these results it is important to note that the participants of this study were on a strict diet as part of the intervention in which they were encouraged to practice rigid eating restraint, following strict rules and counting food portions.

A smaller decrease in flexible restraint during the follow-up period was related to better self-efficacy. It is possible that the ability to maintain a flexible restraint of eating enhanced participants' self-efficacy, or those who had better self-efficacy were more able to maintain increased flexible restraint after the weight loss intervention. Anyhow, the finding is in line with earlier research showing that successful weight loss maintenance is related to higher levels of self-efficacy (Byrne, 2002; Jeffery et al., 2000; Linde et al., 2006; Riebe et al., 2005).

Unexpectedly, changes in flexible and rigid cognitive restraint were not related to psychological flexibility measured by the AAQ-II. Flexibility of cognitive eating restraint may signify different things than the flexibility measured by the AAQ-II. Measures of

flexible and rigid eating restraint assess ways of control; however, the AAQ-II assesses the ability to *accept* as opposed to *control* aversive internal experiences, and the ability to pursue goals as opposed to being inactive or exhibiting avoidant behavior in the presence of such experiences. In the kind of strict weight loss program that the participants in our study took part in, the participants who have better psychological flexibility may be more able to follow a strategy of rigid eating restraint when it is needed.

The AAQ-II is a broad measure, and the specific emotions addressed are anxiety and depression. A specifically adapted AAQ to assess weight-related difficulties could have been more suitable for measuring weight losers' psychological flexibility than the general AAQ (Lillis & Hayes, 2008). Previous research with health problems has found that the impact of psychological flexibility is better assessed by modifying the general AAQ to target the specific area being studied, such as smoking (Gifford et al., 2004) or Type II diabetes management (Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007). It is also important to note that the psychological flexibility was measured retrospectively. Participants' psychological flexibility may have changed during the weight loss intervention and follow-up period, and specifically the change in psychological flexibility could tell more about its meaning in this kind of context.

The present study suggests that successful weight loss maintenance is at least in part due to processes associated with flexibility. The distinction between flexible and rigid cognitive restraint seems to be relevant for understanding how cognitive efforts to restrict one's dietary intake can influence weight control. Flexible control involves a more gradual and relative understanding of a diet's impact on energy balance. The TFEQ's items on flexible restraint concentrate on consciously eating smaller amounts

and being more aware of what and how one is eating (i.e., “I consciously hold back at meals in order not to gain weight” and, “How likely are you to consciously eat less than you want?”). In turn, a rigidly restrained eater gives higher absolute value to restraining calorie intake. Items examining rigid restraint concentrate more on avoiding calories, situations and feelings of guilt (i.e., “I count calories as a conscious means of controlling my weight” and, “How frequently do you avoid stocking up on tempting foods?”). Accordingly, the rigid processes of categorization, evaluation, and avoidance-based behavior regulation theorized to be a part of low psychological flexibility (Hayes et al., 2006) may be important for understanding weight loss maintenance and well-being associated to it.

The present study has some limitations. In previous phase of this intervention study (Karhunen et al., 2012), it was observed that behavioral and psychological factors rather than dietary factors played the main role in the success of individuals’ weight management, thus psychological factors were measured more extensively at the follow-up. Therefore psychological flexibility and self-efficacy were measured only at the follow-up assessment, and changes over time could not be investigated. Consequently, our study does not reveal whether increased flexible eating restraint improved self-efficacy or whether greater self-efficacy enabled flexible restraint of eating to increase. In the future, it would be interesting to study how changes in these measures are related to changes in eating behavior.

Following points need to be considered when generalizing the results of the present study. First, for some correlations ($r < .36$) the statistical power is lower than .70, which decreases the generalizability of these results. Second, the participants of this

study were mostly middle-aged women who were obese and felt motivated to participate in a weight loss program, during which they followed a strict diet. It would be useful to study flexible and rigid eating management also in different populations, like in a normal weight population, or in different kinds of interventions, such as in those aiming to increase psychological flexibility. Moreover, the participation in the follow-up assessment was voluntary and it is possible that some of the persons who did not take part in it may have experienced a different pattern of weight change after the intervention than the participants of the present study, who attended the follow-up assessment, even though there was no difference in weight loss during the intervention between these two groups. Furthermore, longer follow-up periods are needed in weight management studies.

Despite these limitations, the present study shows the long-term benefits of increasing flexible over rigid restraint of eating. Instead of rigid restraint, it would be beneficial to encourage more flexible control strategies to improve weight losers' weight management and psychological well-being. Methods promoting consciousness about one's feelings and behaviors, could be useful instead of strict rules and strategies based on avoiding.

Studies have also suggested that the relationship between weight control and cognitive restraint of eating may change over time (i.e., positive in the short term, but not necessarily in the long run) (Teixeira et al., 2010). This may also be the case regarding well-being. Our results suggest that rigid control strategies may negatively affect well-being in the long run and it therefore seems important to give up rigid control after a strict diet. On the basis of these results, it can be concluded that successful long-term weight management is associated with the ability to move from strict dieting to a more

flexible control of eating as one's weight management progresses. These changing demands of different phases could be useful to take in to account in weight loss and maintenance interventions. Altogether, it seems worthwhile to continue to investigate the phenomenon of flexibility and methods to increase flexible behaviors in the area of weight loss maintenance.

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Table 1. *Means and standard deviations of weight, body mass index (BMI), flexible and rigid control of cognitive restraint of eating, and psychological well-being (GHQ-12) at pre-intervention (Pre), post-intervention (Post) and follow-up (Fup) assessments (n = 49)*

	Pre	Post	Pre-post *within d*	Follow-Up (Fup)	Pre-Fup *within d*	*F*-values
Weight, kg	94.7 (12.3)	83.4 (11.3)	0.93	86.6 (12.7)	0.67	$F(2, 96) = 139.15$**
BMI, kg/m^2	34.1 (2.7)	30.0 (2.8)	1.40	31.2 (3.3)	0.99	$F(2, 96) = 153.85$**
Flexible restraint	2.8 (1.4)	5.5 (1.4)	1.88	4.7 (1.5)	1.33	$F(2, 96) = 66.44$**
Rigid restraint	3.1 (1.4)	4.7 (1.4)	1.14	4.2 (1.4)	0.79	$F(2, 96) = 26.54$**
GHQ	10.5 (4.1)	9.1 (4.5)	0.31	10.9 (5.0)	0.09	$F(2, 96) = 3.41$*

BMI = Body mass index, GHQ = General health questionnaire (GHQ-12), * $p < .05$, ** $p < .01$.

Table 2. *Bivariate correlations (Pearson, n = 49) between levels and change scores of flexible and rigid cognitive restraint of eating and body weight/ % change in body weight*

	Weight pre	Weight post	Weight fup	Weight post-pre	Weight fup-post	Weight fup-pre
Flexibe ^{pre}	-.30*	-.18	-.13	.27	.15	.28
Rigid ^{pre}	-.12	-.11	-.15	-.00	.20	.11
Flexibe ^{post}	.12	-.01	-.08	-.33*	-.29*	-.40**
Rigid ^{post}	-.04	-.03	-.05	.02	-.09	-.04
Flexibe ^{fup}	-.06	-.09	-.13	-.09	-.22	-.19
Rigid ^{fup}	.15	.18	.19	.09	.09	.12
Flexible $^{post-pre}$	.31*	.12	.04	-.44**	-.32*	-.50**
Rigid $^{post-pre}$	.07	.07	.00	.02	-.25	-.13
Flexible $^{fup-post}$	-.18	-.08	-.05	.23	.05	.20
Rigid $^{fup-post}$	.18	.21	.24	.08	.19	.16

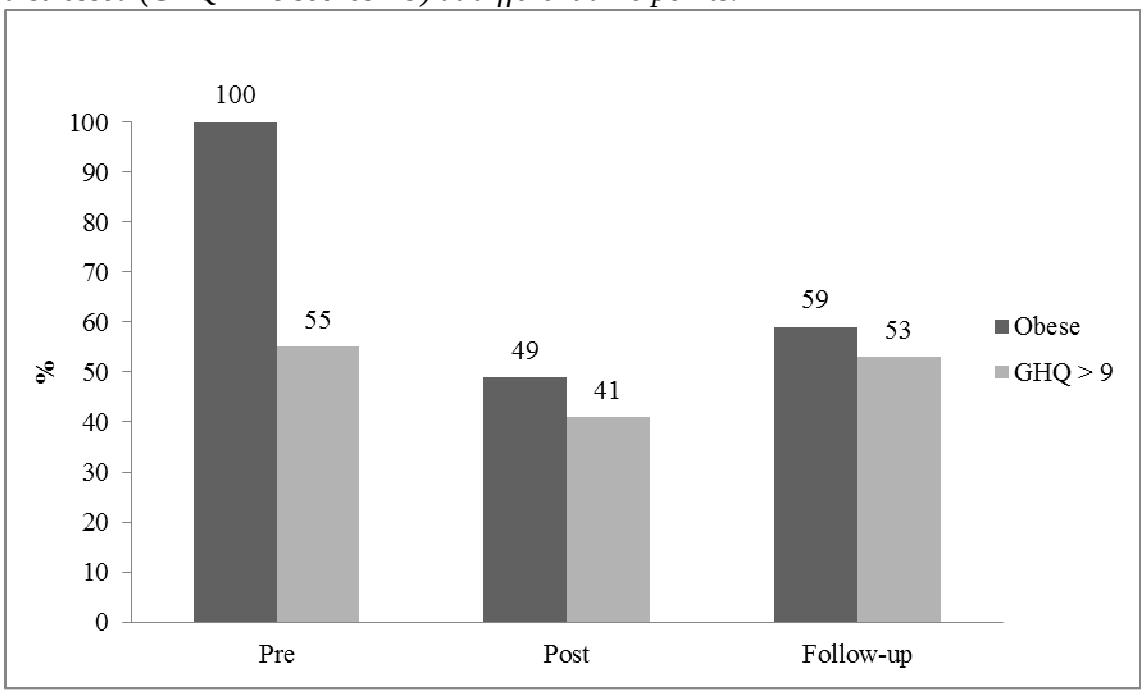
* $p < .05$, ** $p < .01$, pre = pre-intervention , post = post-intervention , fup = follow-up.

Table 3. *Bivariate correlations (Pearson, n =49) between levels and change scores of flexible and rigid cognitive restraint of eating and markers of psychological well-being*

	GHQ pre	GHQ post	GHQ fup	GHQ post-pre	GHQ fup-post	AAQ fup	Self-efficacy fup
Flexible ^{pre}	.02	-.06	.06	-.07	.09	-.01	.07
Rigid ^{pre}	.03	.00	.18	-.02	.15	-.09	.17
Flexible ^{post}	-.05	-.35*	-.01	-.28	.27	-.02	.15
Rigid ^{post}	-.07	-.06	-.07	.00	-.01	.00	-.07
Flexible ^{fup}	.02	-.33*	-.13	-.32*	.15	.17	.39**
Rigid ^{fup}	.12	-.02	.37**	-.12	.33*	-.07	.03
Flexible $^{post-pre}$	-.05	-.21	-.05	-.15	.12	-.00	.06
Rigid $^{post-pre}$	-.08	-.06	-.21	.02	-.13	.08	-.09
Flexible $^{fup-post}$	.07	.00	-.13	-.06	-.11	.19	.26
Rigid $^{fup-post}$	.19	.04	.44**	-.12	.34*	-.07	-.05

* GHQ = General Heath Questionnaire (GHQ-12), AAQ = Acceptance and Action Questionnaire (AAQ-II)
* $p < .05$, ** $p < .01$, pre = pre-intervention , post = post-intervention, fup = follow-up.

Figure 1. *The percentages of subjects being obese (BMI > 30 kg/m^2) and psychologically distressed (GHQ-12's scores >9) at different time points.*



BMI = Body mass index, GHQ = General health questionnaire (GHQ-12), pre = pre-intervention , post = post-intervention.

II

PSYCHOLOGICAL FLEXIBILITY AND MINDFULNESS EXPLAIN INTUITIVE EATING IN OVERWEIGHT ADULTS

by

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Psychological Flexibility and Mindfulness Explain Intuitive Eating In overweight adults

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Abstract

The current study investigated whether mindfulness and psychological flexibility, independently and together, explain intuitive eating. The participants were overweight or obese persons (N = 306) reporting symptoms of perceived stress and enrolled in a psychological lifestyle intervention study. Participants completed self-report measures of psychological flexibility, mindfulness including the subscales *Observe*, *Describe*, *Act with awareness*, *Non-react* and *Non-judgment*, and intuitive eating including the subscales *Unconditional permission to eat*, *Eating for physical reasons*, and *Reliance on hunger/satiety cues*. Psychological flexibility and mindfulness were positively associated with intuitive eating factors. The results suggest that mindfulness and psychological flexibility are related constructs that account for some of the same variance in intuitive eating, but they also account for significant unique variances in intuitive eating. The present results indicate that *non-judgment* can explain the relationship between general psychological flexibility and *unconditional permission to eat* as well as *eating for physical reasons*. On the other hand, mindfulness skills—*acting with awareness*, *observing*, and *non-reacting*—explained *reliance on hunger/satiety cues* independently from general psychological flexibility. These findings suggest that mindfulness and psychological flexibility are interrelated but not redundant constructs and that both may be important for understanding regulation processes underlying eating behavior.

Keywords: psychological flexibility, mindfulness, intuitive eating, obesity, overweight

INTRODUCTION

In the field of psychology, the study of eating behaviors and weigh management largely has been a pathology-focused endeavor because it has explored and identified correlates and predictors of disordered rather than adaptive eating. As a result, the study of eating behaviors is disjointed, and much remains unknown about positive eating behaviors. It could be useful to understand more of adaptive eating behaviors and how they could be promoted in individuals with weight concerns in an obesogenic environment. One adaptive form of eating that has recently gained recognition is ‘‘intuitive eating’’, defined as a style of eating that focuses on eating motivated by physical reasons, with an individual relying on their connection with and understanding of their body’s physical hunger and satiety cues rather than on emotional or environmental motivators (Avalos & Tylka, 2006; Tylka, 2006). Three central and interrelated components of intuitive eating have been identified: 1) *Unconditional permission to eat when hungry and what food is desired* (i.e., lack of restriction in eating); 2) *Eating for physical rather than emotional reasons;* and 3) *Reliance on internal hunger and satiety cues to determine when and how much to eat* (Tylka, 2006).

Each of these three intuitive eating components has been found to be inversely related to eating disorder symptomatology and positively to physical and psychological well-being (Tylka, 2006). For example, intuitive eaters have been found to show greater unconditional self-regard and body satisfaction, as well as lower levels of both depression and disordered eating behavior (Bacon & Aphramor, 2011; Bacon, Stern, Van Loan, & Keim, 2005; Polivy & Herman, 1992; Smith & Hawks, 2006; Tylka, 2006; Tylka & Wilcox, 2006). Intuitive eating is associated with several markers of improved physiological health, including lower body mass index, cholesterol and blood pressure, indicating lower cardiovascular risk (Augustus-Horvath & Tylka, 2011; Bacon & Aphramor, 2011; Bacon et al., 2005; Hawks, Madanat, Hawks, & Harris, 2005; Madden, Leong, Gray, & Horwath, 2012; Smith & Hawks, 2006; Tylka & Wilcox, 2006; Tylka, 2006). Despite the

promising growth of research on this construct, research has been mainly conducted with normal weight samples (Avalos & Tylka, 2006; Denny, Loth, Eisenberg, & Neumark-Sztainer, 2013; Hawks et al., 2005; Smith & Hawks, 2006; Tylka, 2006) and only few studies have attempted to explain processes creating this adaptive eating behavior. It is important to study intuitive eating also in individuals with weight concerns and try to understand processes creating this adaptive eating behavior in order to examine its usefulness in weight loss and maintenance. Avalos and Tylka's (Avalos & Tylka, 2006) original acceptance model highlighted the significance of perceiving unconditional acceptance of one's self and one's body by external others for promoting an intuitive eating style. In comparison to this more interpersonal conceptualization of acceptance, Schoenefeld and Webb (2013) suggested that a self-compassionate orientation may help foster acceptance of internal unwanted events that would facilitate greater engagement in this adaptive eating style. Adopting a self-compassionate stance toward difficult internal experiences related to one's body was related to eating more intuitively (Schoenefeld & Webb, 2013). Besides, psychological flexibility related to one's body image (body image acceptance and action) accounted for a strong positive link between self-compassion and intuitive eating (Schoenefeld & Webb, 2013). Schoenefeld and Webb (2013) further suggested that intuitive eating could be viewed as acting in accordance with one's values in the specific domain of food consumption even amidst experiencing negative thoughts and feelings about one's physical form.

Accordingly, the current study sought to provide a complementary perspective on the role of acceptance and flexibility in the context of this adaptive eating behavior by evaluating the role of mindfulness and psychological flexibility in intuitive eating. Psychological flexibility and mindfulness are often conceptualized as two related yet distinct adaptive regulation and coping processes that can be seen as opposites to experiential avoidance (Kashdan & Rottenberg, 2010). Psychological flexibility is defined as the ability to focus on the present moment and, depending on

what the situation affords, to persist with or change one's behavior in the pursuit of goals and values (Hayes, Strosahl, & Wilson, 1999; Hayes, Luoma, Bond, Masuda, & Lillis, 2006). It can be theorized as an overarching regulation process of experiencing whatever one is experiencing non-judgmentally, without defense or judgment (i.e., mindfulness), while engaging in value-directed activities (i.e., commitment to actions). Mindfulness, although its definition varies across researchers, can be construed as an adaptive regulation process of enhanced attention to and non-judgmental awareness of present-moment experiences (Brown & Ryan, 2003; Chambers, Gullone, & Allen, 2009). Although mindfulness can be cultivated through meditation and behavioral skill training (for a review, see Keng, Smoski, & Robins, 2011), mindfulness has also been conceptualized as a trait-like or dispositional characteristic that varies naturally in the general population, even without mindfulness training (Brown & Ryan, 2003). Baer et al. (2006) presented evidence that trait mindfulness has five facets: 1) *Nonreactivity* (perceiving thoughts/feelings without reacting), 2) *Observing* (paying attention to internal and external sensations), 3) *Acting with Awareness* (staying focused on present-moment experience and acting deliberately), 4) *Describing* (describing/labeling thoughts/feelings with words), and 5) *Nonjudging* (accepting thoughts/feelings without evaluating them).

Mindfulness promotes the willingness to approach and experience emotions and is therefore likely to reduce avoidance-based coping, such as emotional eating (Cochrane, Brewerton, Wilson, & Hodges, 1992). Practicing mindfulness has been suggested to help individuals to "connect" with their inner experiences (such as hunger), thereby attenuating sensitivity to external or emotional cues to eat (Kristeller & Wolever, 2011). This is supported by results showing that mindfulness intervention diminishes both emotional and external eating (Alberts, Thewissen, & Raes, 2012). It has been proposed that, on a cognitive level, mindfulness reduces identifying with thoughts about food, body and shape, thereby interrupting dysfunctional thinking patterns (Albers, 2011) that could

predispose someone to emotional or restricted eating. People who are high in dispositional mindfulness tend to observe their thoughts and feelings without reacting to them in maladaptive ways and therefore are more able to behave constructively even when unpleasant thoughts and feelings are present (Hayes, Strosahl, & Wilson, 1999).

To this day, only a relatively small number of studies have addressed the meaning and effectiveness of mindfulness and psychological flexibility in the domain of eating behavior. So far, the findings are promising and suggest an inverse relationship between mindfulness and disordered eating behavior. Practicing mindfulness has been found to reduce body mass in overweight adults (Tapper et al., 2009) and food cravings (Alberts, Mulkens, Smeets, & Thewissen, 2010; Alberts. et al., 2012; Forman et al., 2007), dichotomous thinking, body image concern, emotional eating, external eating (Alberts et al., 2012), and binge eating (Kristeller & Hallett, 1999). Moreover, higher levels of mindfulness seem to be negatively associated with disordered eating-related cognitions (Masuda & Wendell, 2010), and mindfulness has been found to partially mediate the link between disordered eating-related cognitions and psychological distress (Masuda & Wendell, 2010; Masuda, Price, Anderson, & Wendell, 2010) as well as moderating the association between disordered eating cognitions and disordered eating behaviors (Masuda, Price, & Latzman, 2012). However, different facets of mindfulness may be differently associated with eating behaviors. Whereas most subscales have been inversely related to psychological symptoms, *Observing* have also found to predict more symptoms (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Lavender, Gratz, & Tull, 2011). Lattimore et al. (2011) found that observing was positively associated to uncontrolled eating and cognitive restraint of eating (Lattimore, Fisher, & Malinowski, 2011). Adams et al. (2012) found that *describing* and *non-judging* predicted lower symptoms of bulimia nervosa and lower body dissatisfaction, and *acting with awareness* was positively related to lower symptoms of anorexia nervosa and bulimia nervosa, whereas *observing* predicted higher anorexic symptoms. Besides,

Lavender, Gratz, and Tull (2011) found that *Nonreactivity, Acting with Awareness,* and *Nonjudging* each uniquely predicted lower anorexic symptoms, whereas *Describing* was related to higher symptoms (Lavender et al., 2011).

Correspondingly, psychological flexibility has been found to be inversely associated with disordered eating cognitions (Masuda et al., 2010) and disordered eating symptoms (Rawal, Park, & Williams, 2010). Several studies have also found evidence supporting the effectiveness of acceptance-based interventions that improve both psychological flexibility and mindfulness skills, reporting their usefulness in managing weight and improving eating behaviors (Forman et al., 2013; Forman, Butryn, Hoffman, & Herbert, 2009; Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007; Lillis, Hayes, Bunting, & Masuda, 2009; Tapper et al., 2009). In the study of Lillis et al. (2009), three months after a 1-day work-shop, weight losers exposed to a 6-hour acceptance and commitment therapy condition improved significantly more than those on a waitlist on obesity-related stigma, quality of life, psychological distress, and body mass, as well as in distress tolerance, and both general and weight-specific acceptance and psychological flexibility. Mediational analyses indicated that changes in weight-specific psychological flexibility mediated changes in outcomes. Thus, both mindfulness and psychological flexibility seem to be associated with eating behavior. However, as pointed out earlier, different facets of mindfulness may be differently associated with eating behaviors. As a consequence, it could be argued that although mindfulness and psychological flexibility are closely related phenomenon there could be some distinct factors that are associated with eating behaviors. Previous research has also suggested that psychological flexibility specific to weight concerns and general psychological flexibility may be related but distinct processes affecting eating behaviors (Lillis & Hayes, 2008; Lillis et al., 2009). On the bases of this, more studies investigating simultaneously both general and weight specific psychological flexibility in relation to eating behavior (e.g. intuitive eating) are needed.

The objective of the present study was to investigate the relationships between psychological flexibility, mindfulness and intuitive eating among overweight persons experiencing health concerns. Although psychological flexibility and mindfulness are often theorized to be similar but distinct processes, evidence supporting this conceptual position is still limited. We were interested in whether mindfulness and psychological flexibility (general and weight specific) uniquely and separately account for intuitive eating or perhaps uniquely and separately account for variance in some forms of eating behavior but not others.

In line with this reasoning, the following research questions were posed and hypotheses formed:

Research Question 1: How are mindfulness skills, psychological flexibility, intuitive eating, and BMI related to each other?

Hypothesis 1: Better mindfulness skills were expected to be related to better psychological flexibility, and both were expected to be related to higher intuitive eating. Mindfulness skills, psychological flexibility, and intuitive eating were expected to be negatively related to BMI.

Research Question 2: To what extent do the two processes, psychological flexibility and mindfulness, account for unique variance in intuitive eating?

Hypothesis 2: Although mindfulness and psychological flexibility are related constructs and would account for some of the same variance in intuitive eating, they would also each account for significant unique variances in eating behavior on their own

METHODS

Participants

The data of the present study stem from the baseline measurements of a larger lifestyle intervention study (for details, see Lappalainen et al., 2014) that investigated the effects of three novel, low intensity psychological interventions for metabolic syndrome risk factors, psychological flexibility and general well-being among overweight or obese individuals experiencing stress. The study was a multi-center study conducted at three research centers in Finland: Jyväskylä, Kuopio and Helsinki. The participants for the study were recruited through advertisements in local newspapers and selected based on specific inclusion criteria: BMI 27–34.9 kg/m^2, age 25–60 years, and reported symptoms of perceived psychological stress (at least 3 of 12 points in the General Health Questionnaire; Makowska, Merecz, Moscicka, & Kolasa, 2002).

Altogether 306 participants (48 male, 258 female) completed an Internet-based survey and comprised the study population of the present study. The mean age of the participants was 48.9 ± 7.8 years (range 24.0–60.8), and the mean body mass index was 31.3 (*SD* = 3.0, range 25.3–40.1).The majority of the participants had an upper secondary education (49%) and 44% had a university degree.

The present study was approved by the ethics committee of the Central Finland Health Care District, and has been registered with ClinicalTrials.gov under the identification code NCT01738256. All participants gave their written informed consent for their participation in the study.

Measurements

Participants completed an Internet-based survey that included the requested self-report measures. Body weight and height were measured at a laboratory visit, at the three local research centers in Jyväskylä, Kuopio and Helsinki. Body weight was measured using the same type of calibrated electronic scale at each of the research centers. A height gauge was used for height measurement. The body mass index (BMI) was calculated based on the collected height and weight data.

Intuitive eating: The Intuitive Eating Scale (IES; Tylka, 2006) is a 21-item instrument containing three subscales that assess the components of intuitive eating: (a) *Unconditional permission to eat* (9 items; e.g., ”If I am craving a certain food, I allow myself to have it”); (b) *Eating for physical rather than emotional reasons* (6 items; e.g., “I stop eating when I feel full [not overly stuffed]”); and (c) *Reliance on internal hunger and satiety cues* (6 items; e.g., “I trust my body to tell me how much to eat”). Participants rated items on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). Subscale items were averaged, with higher scores indicating higher levels of intuitive eating.

Mindfulness: The Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006) is a 39-item measure of the general tendency of being mindful in daily life. This measure was derived from an exploratory factor analysis of several previously developed mindfulness questionnaires (Baer et al., 2006) and measures the following five elements of mindfulness. (a) *Observing*—includes noticing or attending to internal and external experiences, such as sensations, cognitions, emotions, sights, sounds, and smells. (b) *Describing*—involves labeling internal experiences with words. (c) *Acting with awareness*—represents attending to one’s activities of the moment and can be contrasted with behaving mechanically or automatically while attention is focused elsewhere (often called

automatic pilot). (d) *Non-judgment of inner experiences*—represents taking a non-evaluative stance toward feelings and thoughts. (e) *Non-reactivity to inner experiences*—is the tendency to allow thoughts and feelings to come and go without getting carried away by or caught up in them. The items were rated on a 5-point Likert-type scale ranging from 1 (never or very rarely true) to 5 (very often or always true), with higher scores indicating higher levels of mindfulness. These five facets have been shown to be internally consistent and correlated in expected directions with numerous other constructs in several samples. To a large extent, regression, mediation and confirmatory factor analyses have supported the construct validity of FFMQ scores (Baer et al., 2006; Baer et al., 2008). Exceptions have been seen with respect to the *Observing* scale, which has shown differential relationships with other variables in meditating and non-meditating sample populations. In student samples, *observing* has shown either positive or nonsignificant correlations with psychological symptoms, suggesting that people without meditation experience may tend to observe their internal experiences in a judgmental or reactive way that is not consistent with mindfulness (Baer et al., 2008).

Psychological flexibility: Psychological flexibility was assessed using the general Acceptance and Action Questionnaire (AAQ-II, Bond et al., 2011) and the Acceptance and Action Questionnaire for Weight (AAQW; Lillis & Hayes, 2008). The Acceptance and Action Questionnaire (AAQ-II; Bond et al., 2011) is a 7-item Likert-type questionnaire that assesses the ability to accept aversive internal experiences and to pursue goals in the presence of these experiences. Some items target emotional acceptance or avoidance while others address the tendency to become entangled in thoughts, to take them literally, or, conversely, to see them simply as thoughts; still others ask about the ability to take value-based actions in the presence of difficult thoughts, or about the tendency to become behaviorally inactive or avoidant. The questions of the AAQ-II are based on statements like, “I worry about not being able to control my worries and feelings” and, “My thoughts and feelings do

not get in the way of how I want to live my life." The items were rated on a 7-point Likert-type scale ranging from 1 (never true) to 7 (always true), with higher scores indicating lower levels of psychological flexibility, i.e., higher levels of experiential avoidance.

In previous research, it has been found that the mediation of specific acceptance and commitment therapy (ACT) protocols by ACT processes is better assessed by modifying the general AAQ to target the specific area (e.g., Gifford et al., 2004; Gregg et al., 2007). For that reason, the present study also used a targeted measure adapted from the original AAQ. The Acceptance and Action Questionnaire for Weight (AAQW; Lillis & Hayes, 2008) is a 22-item, Likert-type scale that measures acceptance levels of weight-related thoughts and feelings and the degree to which they interfere with valued actions (e.g., "I try hard to avoid feeling bad about my weight or how I look"). The items were rated on a 7-point Likert-type scale ranging from 1 (never true / not at all believable) to 7 (always true / completely believable), with higher scores indicating lower levels of psychological flexibility, i.e., higher levels of experiential avoidance.

The measures were written in Finnish. The Intuitive Eating Scale was translated and back translated by experts in nutrition and eating behavior. The other scales were translated by a group of researchers with long experience in acceptance-, mindfulness- and value–based interventions. The internal consistency of all the applied measures was high (Cronbach α = .70-.94, Table 1).

Statistical analysis

The statistical analyses were conducted using the Mplus (version 7) and SPSS (version 20) programs. The parameters were estimated using the full information maximum likelihood method (MLR estimation in Mplus), in which missing values are supposed to be missing at random (MAR).

The extent to which the two processes, psychological flexibility and mindfulness, accounted for unique variances in intuitive eating was analyzed with hierarchical regression analysis using Cholesky decomposition (de Jong, 1999) in structural equation modeling (SEM). Such an analysis can be used when the extra amount of variance accounted for in a dependent variable by a specific independent variable is the main focus of interest, and the independent variables are highly correlated (Cohen, Cohen, West, & Aiken, 2013). The dependent variables were entered into the regression equation in a prespecified order. This method separates the unique variance related to each variable after taking into account the previous ones, i.e., it attempts to determine the degree of association between two variables that would exist if all influences of one or more other variables were removed. Basically, two different orders were specified: 1. Psychological flexibility following mindfulness skills; 2. Mindfulness skills following psychological flexibility.

First, the Cholesky component (Ch1) was fixed to explain all variances of the AAQ-II and the related variance of the AAQW and mindfulness facet. Secondly, the Cholesky component (Ch2) was set to explain all remaining variances of the AAQW and mindfulness facet. And thirdly, the Cholesky component (Ch3) explained the residual variance of the mindfulness facet. After that, all three Cholesky components were set to explain intuitive eating factors.

The fit of the models was evaluated using the following goodness-of fit measures provided by the Mplus program (Muthén, 1998-2004): RMSEA (Root Mean Square Error of Approximation, with values .06 or less indicating a good fit), SRMR (Standardized Root Mean Square

Residuals, with values less than .08 indicating a good fit), CFI (Bentler's Comparative Fit Index, with values of .95 or greater indicating a good fit), and TLI (Tucker–Lewis Index, with values greater than .95 indicating a good fit).

RESULTS

Associations between psychological flexibility, mindfulness, intuitive eating and body mass index

Descriptive statistics and correlations among the study variables are shown in Table 1. Consistent with our hypothesis, the psychological flexibility scales were negatively correlated with mindfulness skills, except for *observing*, showing that better psychological flexibility was related to better mindfulness skills. Both psychological flexibility and psychological flexibility for weight correlated inversely with all factors of the IES, indicating that higher levels of psychological flexibility are related to higher levels of intuitive eating behavior. General psychological flexibility (AAQ-II) correlated stronger with mindfulness skills, whereas AAQW correlated stronger with intuitive eating factors. All facets of mindfulness, except for *observing*, showed a positive, albeit modest correlation with intuitive eating factors, indicating that better mindfulness skills are related to more intuitive eating behavior. *Observing* correlated only with *reliance on hunger and satiety cues*, excluding other mindfulness facets, thus showing that persons who attend more to their internal and external experiences rely more on their body's hunger and satiety cues. BMI correlated (inversely) with all intuitive eating factors and the AAQW, indicating that persons who have a lower BMI eat more intuitively and have more psychological flexibility regarding their weight.

Table 1.

Explaining variance in intuitive eating

The models provided either a good or reasonable fit with the data (data not shown).

To study the extent to which psychological flexibility and mindfulness accounted for unique variances in intuitive eating, we conducted a hierarchical regression analysis involving Cholesky decomposition. First, we examined whether mindfulness skills explain intuitive eating (IES factors) when controlling for psychological flexibility (AAQ-II and AAQW). The first row in Table 2 shows to what extent the AAQ-II explains the variance between the IES factors. The second row shows how the AAQW explains the variance between IES factors when the AAQ-II was controlled for. Finally, the third row shows how particular mindfulness skills explain the variance between IES factors when both the AAQ-II and AAQW were controlled for. The coefficient of determination (R^2) is the sum of the squares of the standardized regression coefficients and indicates to what extent these variables jointly explain the variance between the intuitive eating factors. For example, the AAQ-II, AAQW and the component *acting with awareness* explain 39.4% of the variance between the measure *unconditional permission to eat*, of which the AAQ-II explains 7.1% and the AAQW 32.3%.

These results indicate that even though mindfulness skills seem to be related to all of the IES factors, mindfulness skills accounted for mainly the same variance as psychological flexibility in regard to *eating for physical reasons* and *unconditional permission to eat*. Only *observing* shared some additional variance with *unconditional permission to eat*. When the levels of psychological

flexibility (AAQ-II and AAQW) were controlled for, *observing* showed an inverse relation to *unconditional permission to eat*, indicating that persons who observe their internal and external experiences more have less unconditional permission to eat. *Acting with awareness*, *observing* and *non-reacting* explained *reliance on hunger/satiety cues* when psychological flexibility and psychological flexibility for weight were controlled for, indicating that these mindfulness skills involve features explaining intuitive eating that are not shared with psychological flexibility.

Table 2.

Second, it was examined whether psychological flexibility explains intuitive eating (IES factors) when controlling for mindfulness skills. This model was formed by setting all five mindfulness facets first, followed by the items of the AAQ-II and AAQW (Table 3). In Table 3, row 6 indicates that when all five mindfulness skills were controlled for, the general psychological flexibility did not explain intuitive eating; but, as seen in row 7, the AAQW explained all intuitive eating factors independently of mindfulness skills and the AAQ-II.

Table 3.

Third, it was examined whether psychological flexibility explains intuitive eating (IES factors) when controlling for particular mindfulness skills (Table 4). In these models, row 2 shows how the AAQ-II explained the IES factors when particular mindfulness skills were controlled for, while row 3 shows how the AAQW explained IES factors when both particular mindfulness skills and the AAQ-II were controlled for. General psychological flexibility explained *unconditional permission to eat* and *eating for physical reasons* independently from single mindfulness facets, apart from

non-judgment, indicating that connections between general psychological flexibility and *unconditional permission to eat* as well as *eating for physical reasons* overlap with *non-judgment*. General psychological flexibility shared additional variance with *reliance on hunger/satiety cues* only after *observing* was controlled for, indicating that psychological flexibility (AAQ-II) did not explain *reliance on hunger/satiety cues* when any other mindfulness skill was controlled for.

Table 4.

DISCUSSION

The purpose of the present study was to provide a complementary understanding of the processes creating intuitive eating by investigating the relationships between psychological flexibility, mindfulness and intuitive eating within overweight individuals with health concerns. Consistent with our hypotheses, better psychological flexibility was related to better mindfulness skills, and higher levels of psychological flexibility and mindfulness were related to higher levels of intuitive eating. An exception to this was the mindfulness facet *observe*, which did not correlate on its own with any study variables other than *reliance on hunger and satiety cues*, showing that persons who attend more to their internal and external experiences rely more on their body's hunger and satiety cues. Body mass index correlated with the AAQW (but not with the general psychological flexibility, AAQ-II) and all intuitive eating factors, indicating that persons who had a lower BMI had higher acceptance of weight-related thoughts and feelings and they practiced more intuitive eating, which is in accordance with previous research in female college students (Hawks et al., 2005; Smith & Hawks, 2006), early and mid-age women (Augustus-Horvath & Tylka, 2011; Tylka, 2006) and young adults in both genders (Denny et al., 2013).

The current study contributes to the existing understanding of regulation processes underlying eating behavior by suggesting that mindfulness and psychological flexibility are related constructs that account for some of the same variance in intuitive eating, as well as accounting for significant unique variances in this type of eating behavior—especially when psychological flexibility is assessed with a targeted measure of weight-related thoughts and feelings.

The present results show that general psychological flexibility explains *unconditional permission to eat* and *eating for physical reasons* separately from single mindfulness skills, apart from *non-judgment*. This indicates that *non-judgment* can explain the relationship between general psychological flexibility and *unconditional permission to eat* as well as *eating for physical reasons*. Obviously, as the name *Acceptance and Action Questionnaire* indicates, acceptance (i.e., non-judgment) is an essential process of psychological flexibility. Anyhow, our findings suggest that the ability to take a non-evaluative stance toward feelings and thoughts is associated with a more flexible and accepting relationship with food and lower emotional eating.

The relationship between general psychological flexibility (AAQ-II) and *reliance on hunger/satiety cues* was overlapping with all other mindfulness skills except *observing*, indicating that general psychological flexibility does not explain *reliance on hunger/satiety cues* when any other mindfulness skill is controlled for. Instead, mindfulness skills—*acting with awareness*, *observing* and *non-reacting*—explained *reliance on hunger/satiety cues* independently from psychological flexibility (AAQ-II and AAQW). In other words, regardless of the level of psychological flexibility, the ability to attend to internal and external experiences *(observe)*, the ability to attend to one's activities in the moment *(acting with awareness)*, and the tendency to allow thoughts and feelings to freely come and go *(non-reacting)*, were related to reliance on internal hunger and satiety cues to

determine when and how much to eat. Seen together, these results suggest that acceptance is an important process that explains *unconditional permission to eat* and *eating for physical reasons*, whereas *acting with awareness*, *observing* and *non-reacting* better explain *reliance on hunger and satiety cues*. Thus, mindfulness skills seem to be especially relevant for intuitive eating based on sensing bodily cues and relying on them to determine when and how much to eat. This is in line with previous results showing that the individual degree of accurately perceiving one's interoceptive signals (e.g., heartbeat) predicted the total IES score and especially the results of the subscales associated with the awareness of hunger and satiety cues and the willingness to eat to satisfy hunger rather than to eat for external and emotional reasons (Herbert, Blechert, Hautzinger, Matthias, & Herbert, 2013).

Moreover, when psychological flexibility (AAQ-II and AAQW) was controlled for, the *observe* item was inversely associated with *unconditional permission to eat*, indicating that persons who observe their internal and external experiences more tend to show greater eating restraint. These results regarding the *observe* item (the positive correlation to *reliance on hunger and satiety cues* and the negative correlation to *unconditional permission to eat*) suggest that individuals who notice their present-moment experience more also notice when they are hungry or full, but might have stricter rules that guide their eating and consequently make them feel guilty about eating "bad" foods. These findings, together with the notion that observing was not related to psychological flexibility, are consistent with previous findings showing that although most aspects of mindfulness predict better psychological outcomes, observing does not (Baer et al., 2006; Lavender et al., 2011). Lattimore et al. (2011) also found that observing was positively associated to uncontrolled eating and cognitive restraint of eating (Lattimore et al., 2011). Adams et al. (2012) found that *describing* and *non-judging* predicted lower symptoms of bulimia nervosa and lower body dissatisfaction, and *acting with awareness* was positively related to lower symptoms of anorexia nervosa and bulimia

nervosa, whereas *observing* predicted higher anorexic symptoms. Seen together, these results suggest that simply observing one's present-moment experience is not necessarily beneficial to healthy eating behavior unless it is combined with other aspects of mindfulness (i.e., a non-judgmental, non-reactive stance toward those experiences).

Even though general psychological flexibility (AAQ-II) seems to overlap with mindfulness skills in relation to intuitive eating, psychological flexibility for weight (AAQW) seems to involve features explaining intuitive eating that are not shared with mindfulness skills and general psychological flexibility. This targeted measure of flexibility could explain eating behavior when controlling for more general processes (AAQ-II and FFMQ). This observation supports the idea of modifying the general Acceptance and Action Questionnaire in order to target this specific area (Lillis & Hayes, 2008). In the context of the present study, the acceptance of weight-related thoughts and feelings and the degree to which these interfere with valued actions is probably a more valid issue than the aspect of struggling with aversive internal experiences in general. However, it is interesting that the general regulation processes of psychological flexibility and mindfulness also explain eating behavior.

Clinically, the present study suggests that mindfulness and psychological flexibility play a role in promoting healthy eating behavior and considering this role can contribute to treating disordered eating behavior. The present findings suggest that interventions should not only target eating behavior but that it would be useful to also target potential underlying processes, such as psychological flexibility and mindfulness skills. Thus, the findings imply that further studies of interventions that target both mindfulness and psychological flexibility might be fruitful. Studies of this nature are essential to understanding the mechanisms by which mindfulness and psychological flexibility may promote more adaptive eating behavior in an obesogenic environment. According to

the present findings, the tendency to be conscious of one's internal and external experiences *(observing)* and attend to one's activities in the moment *(acting with awareness)*, as well as allowing thoughts and feelings to come and go without getting carried away by or caught up in them *(non-reacting)*, are related to the sensing of one's bodily cues and relying on them to know when, what and how much to eat. In contrast, our findings indicate that the ability to accept aversive internal experiences is related to unrestricted eating and eating for physical reasons instead of emotional reasons. These clinical implications are consistent with recent studies showing that intuitive eating (Tylka, 2006), mindfulness and psychological flexibility (Lavender, Jardin, & Anderson, 2009; Rawal et al., 2010) are inversely related to disordered eating behavior.

Limitations of the study

This study was designed to gain a preliminary understanding of the role of mindfulness and psychological flexibility in intuitive eating. It is important to note that there may be other factors that also account for the variance in intuitive eating. Therefore, this study is suggestive and limited in conceptual scope, and consequently any conclusions concerning the clinical significance and interpretation of the present findings should be made with caution.

Our sample predominantly consisted of women who were willing to make lifestyle changes. Therefore, the generalizability of the results to the general population is limited. Another limitation is the reliance on self-report measures. Researchers have taken a variety of approaches to the assessment of mindfulness, and debates about the issue of measuring this construct are ongoing (Bishop et al., 2004; Brown & Ryan, 2004). Thus, further research with other validated measures of mindfulness is recommended.

Readers should be aware of that different self-report measures (such as AAQ-II, FFMQ, and IES) may be parallel expressions of some common underlying construct. It is important to keep this in mind when interpreting the results. We hope that this study increases our knowledge of the common and different aspects of psychological flexibility, mindfulness and intuitive eating. It is also important to note that intuitive eating is cognitive constructs that may be related to eating, but more studies are needed to verify that. Future studies should explore the use of laboratory-based behavioral tasks and physiological measures along with self-report measurements. One example of this kind of study is a research of Herbert et al. (2013) indicating that interoceptive sensitivity (IS) as measured by a heartbeat perception task, was positively related to total IES score and specifically to *reliance on hunger and satiety cues* and *eating for physical reasons* in healthy young women. Besides, IS fully mediated the negative relationship between *reliance on hunger and satiety cues*, as well as *eating for physical reasons* and BMI.

Perhaps the greatest limitation of the current study was the reliance on a cross-sectional and correlational design. Longitudinal and experimental studies investigating the predictive value of mindfulness and psychological flexibility in regard to intuitive eating are warranted. The analytic strategy of the present study did not permit elucidating the direction of associations or making causal inferences about functional associations among the constructs of interest. Even though intuitive eating was inversely related to BMI in this sample, longitudinal research is needed to investigate whether intuitive eating style can be considered an adaptive eating strategy for overweight and obese individuals. For this population, it is possible that eating according to one's "internal cues" may be confused with more hedonically-driven signals, and this may have contributed to an elevated BMI in the first place (Lowe & Butryn, 2007; Stroebe, Papies, & Aarts, 2008).

Despite these limitations, the present study is important in showing that mindfulness and psychological flexibility make significant contributions to intuitive eating. The present findings suggest that mindfulness and psychological flexibility are interrelated but not redundant constructs and that both constructs are useful for understanding eating behavior.

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Table 1. Means, standard deviations, coefficient alphas, and correlations between mindfulness facets, psychological flexibility, psychological flexibility for weight, intuitive eating factors and BMI.

	1	2	3	4	5	6	7	8	9	10	11	12
1. FFMQ	-											
2. Observe	.47***	-										
3. Describe	.73***	.32***	-									
4. ActAware	.72***	.26**	.30***	-								
5. NonJudge	.68***	-.18*	.37***	.36***	-							
6. NonReact	.80***	.30***	.45***	.46***	.51***	-						
7. AAQ-II	-.67***	-.07	-.43***	-.41***	-.71***	-.66***	-					
8. AAQW	-.52***	-.07	-.29***	-.33***	-.60***	-.48***	.60***	-				
9. IES: Permission	.23**	-.15	.14*	.17*	.41***	.18*	-.26***	-.61***	-			
10. IES: Reasons	.28***	.07	.12*	.21**	.31***	.22***	-.29***	-.56***	.61***	-		
11. IES: Cues	.32***	.19*	.16*	.25***	.19**	.32***	-.16*	-.44***	.21**	.29***	-	
12. BMI	.00	.03	-.01	.082	-.034	-.036	.020	.261***	-.19**	-.14*	-.20**	-
Mean	132.4	26.1	29.5	26.0	28.5	22.3	20.2	86.4	3.1	2.5	3.2	31.3
SD	19.0	5.2	6.7	5.9	6.7	5.0	8.8	21.1	0.6	0.8	0.6	3.0
α	.91	.72	.94	.89	.90	.84	.91	.90	.70	.86	.76	

Note: FFMQ = Five Facet Mindfulness Questionnaire, AAQ-II = Acceptance and Action Questionnaire, AAQW = Acceptance and Action Questionnaire for Weight, IES = Intuitive Eating Scale, Permission = Unconditional Permission to Eat, Reasons = Eating for Physical Reasons, Cues = Reliance on Hunger/Satiety Cues, BMI = Body Mass Index. *p < .05. **p < .01. ***p < .001. Means, standard deviations and correlations are calculated using Mplus software with full information maximum likelihood estimates for the parameters.

Table 2. *Standardized Regression Coefficients of Hierarchical Modeling Between IES Factors and Independent Factors In Examining Whether Mindfulness Facets Explain Intuitive Eating Factors when Controlling for Psychological Flexibility*

Model	IES: Unconditional Permission to Eat	IES: Eating for Physical Reasons	IES: Reliance on Hunger/Satiety Cues
1. AAQ-II	-.266***	-.296 ***	-.167 *
2. AAQW	-.568***	-.476 ***	-.424 ***
3. ActAware	-.001	.044	.150 *
R^2	.394	.316	.231
1. AAQ-II	-.263 ***	-.294 ***	-.166 *
2. AAQW	-.570 ***	-.478 ***	-.424 ***
3. Observe	-.178 **	.038	.169 *
R^2	.426	.316	.236
1. AAQ-II	-.271 ***	-.299 ***	-.169 *
2. AAQW	-.566 ***	-.474 ***	-.423 ***
3. Describe	.001	-.016	.096
R^2	.393	.314	.217
1. AAQ-II	-.270 ***	-.300 ***	-.171 *
2. AAQW	-.565 ***	-.473 ***	-.423***
3. Non-React	-.093	-.035	.222 **
R^2	.401	.316	.257
1. AAQ-II	-.269 ***	-.296 ***	-.167 *
2. AAQW	-.566 ***	-.476 ***	-.424 ***
3. Non-Judge	.123	-.009	-.015
R^2	.408	.314	.208

Note. AAQ-II = Acceptance and Action Questionnaire; AAQW = Acceptance and Action Questionnaire for Weight; IES = Intuitive Eating Scale.
* $p < .05$, ** $p < .01$, *** $p < .001$

Table 3. *Standardized Regression Coefficients of Hierarchical Modeling Between IES Factors and Independent Factors In Examining Whether Psychological Flexibility Explains Intuitive Eating Factors when Controlling for All Mindfulness Facets.*

Model	IES: Unconditional Permission to Eat	IES: Eating for Physical Reasons	IES: Reliance on Hunger/Satiety Cues
1. ActAware	.167*	.210**	.249***
2. Observe	-.184*	.033	.143
3. Describe	.144*	.062	.071
4. Non-React	.283***	.266***	.151*
5. Non-Judge	-.016	.009	.148*
6. AAQ-II	-.011	-.088	.110
7. AAQW	-.520***	-.441***	-.363***
R^2	.433	.322	.276

Note. AAQ-II = Acceptance and Action Questionnaire; AAQW = Acceptance and Action Questionnaire for Weight; IES = Intuitive Eating Scale.

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

Table 4. *Standardized Regression Coefficients of Hierarchical Modeling Between IES Factors and Independent Factors In Examining Whether Psychological Flexibility Explains Intuitive Eating Factors when Controlling for Individual Mindfulness Facets.*

Model	IES: Unconditional Permission to Eat	IES: Eating for Physical Reasons	IES: Reliance on Hunger/Satiety Cues
1. ActAware	.167*	.210**	.249***
2. AAQ-II	-.217**	-.217**	-.072
3. AAQW	-.565***	-.468***	-.405***
R^2	.394	.316	.231
1. Observe	-.146	.069	.191*
2. AAQ-II	-.271***	-.290***	-.157*
3. AAQW	-.575***	-.476***	-.418***
R^2	.426	.316	.236
1. Describe	.137*	.129*	.175**
2. AAQ-II	-.235***	-.270***	-.106
3. AAQW	-.565***	-.474***	-.418***
R^2	.393	.314	.217
1. Non-React	.168*	.221***	.323***
2. AAQ-II	-.212**	-.206**	.055
3. AAQW	-.573***	-.474***	-.387***
R^2	.401	.316	.257
1. Non-Judge	.396***	.306***	.200**
2. AAQ-II	.014	-.113	-.037
3. AAQW	-.500***	-.456***	-.408***
R^2	.408	.314	.208

Note. AAQ-II = Acceptance and Action Questionnaire; AAQW = Acceptance and Action Questionnaire for Weight; IES = Intuitive Eating Scale.

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

III

WEIGHT-RELATED PSYCHOLOGICAL FLEXIBILITY MEDIATES CHANGE IN INTUITIVE EATING REGULATION IN OVERWEIGHT ADULTS

by

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Weight-Related Psychological Flexibility Mediates Change in Intuitive Eating Regulation in Overweight Adults

ABSTRACT

This study investigates the effects of two Acceptance and Commitment Therapy (ACT) interventions—face-to-face (in a group) and mobile (individually)—on intuitive eating. The study investigates whether psychological flexibility, mindfulness skills and sense of coherence mediated the interventions' effect on intuitive eating and weight. The participants were overweight or obese (N = 219), reporting symptoms of perceived stress.

The effect of the interventions on the participants' 1) BMI, 2) intuitive eating and its subscales, 3) eating for physical rather than emotional reasons, and 4) reliance on internal hunger and satiety cues were mediated by changes in weight-related psychological flexibility in both ACT groups. These findings suggest that ACT interventions aiming for lifestyle changes mediate the intervention effects through the enhanced ability to continue with valued activities even when confronted with negative emotions and thoughts related to weight.

Keywords: psychological flexibility, mindfulness, intuitive eating, obesity, overweight, acceptance and commitment therapy

Weight-Related Psychological Flexibility Mediates Change in Intuitive Eating Regulation in Overweight Adults

INTRODUCTION

Weight-loss programs based on restricted eating are becoming more and more popular in social contexts where being slim is perceived as ideal but being overweight is more common. The long-term benefits of such programs are questionable as the majority of individuals eventually regain the weight they lose (Jeffery et al., 2000; Mann et al., 2007). Previous research examining the success of dieting has concluded that diets lead to short-term weight loss, usually 5–10% of body weight, but this weight loss is not maintained long-term by the majority of people (Garner & Wooley, 1991; Jeffery et al., 2000; Mann et al., 2007). It has been estimated, that about 20% of overweight individuals are successful at long-term weight loss, when defined as losing at least 10% of one's initial body weight and maintaining the loss for at least one year (Wing & Phelan, 2005). Most weight-loss diets are only successful as long as people rigidly control consumption. However, poor long-term results suggest that the majority of overweight persons cannot sustain rigid control. Control-based approaches to eating regulation do not appear to provide the hoped-for results in the long run.

In contrast to controlled eating, intuitive eating is a style of eating that follows the natural contingencies of an individual's perception of physical hunger and satiety cues rather than emotional or environmental cues (Avalos & Tylka, 2006; Tylka, 2006). Three central and interrelated components of intuitive eating have been identified: 1) *Unconditional permission to eat when hungry and what food is desired* (i.e., lack of restrictions in eating); 2) *Eating for physical rather than emotional reasons;* and 3) *Reliance on internal hunger and satiety cues to determine when and how much to eat* (Tylka, 2006). Each of these three intuitive eating components are related to the absence of eating disorder symptoms and to better physical and

psychological well-being (Augustus-Horvath & Tylka, 2011; Avalos & Tylka, 2006; Bacon & Aphramor, 2011; Bacon, Stern, Van Loan, & Keim, 2005).

Overeating in response to emotional experiences and external cues (e.g., presence of palatable food) can be understood as a failure in self-regulation (Forman & Butryn, 2015). It has been suggested that dieting may habituate individuals to negate their body signals of hunger and satiety, resulting in becoming less sensitive to bodily cues but more responsive to various environmental factors (Herman & Polivy, 1983). Responsiveness to food stimuli, such as the sight or smell of food, and eating in response to positive and negative emotional states have consistently correlated with obesity and higher energy intake as well as with poorer success in weight loss (Bryant, King, & Blundell, 2008). Studies have indicated that persons with obesity who have difficulty losing or keeping off weight more often use food as a source of comfort and satisfaction (Castelnuovo-Tedesco & Schiebel, 1975), eat after difficult interpersonal situations (Hockley, 1979), and eat in response to negative emotions (Hudson & Williams, 1981). Consequently, the primary function of emotional eating appears to be affect reduction (Ganley, 1989), and thus it is related to experiential avoidance (EA). Attempts to avoid private experiences (thoughts, feelings, sensations) is defined as experiential avoidance, which is a central process in the development of a range of mental health and behavioral health problems (Hayes, Luoma, Bond, Masuda, & Lillis, 2006; Lillis & Hayes, 2008) including eating-related difficulties (Forman et al., 2007; Hooper, Sandoz, Ashton, Clarke, & McHugh, 2012; Lillis, Hayes, Bunting, & Masuda, 2009). Accordingly, *third wave* behavior therapies, such as Acceptance and Commitment Therapy (ACT), focus on helping individuals to relate flexibly to interfering private events and stay on track (Hayes, Strosahl, & Wilson, 1999).

More precisely, ACT seeks to improve individuals' functioning and quality of life by increasing their psychological flexibility and mindfulness skills. Psychological flexibility and mindfulness are adaptive regulation and coping processes that can be seen as opposites to experiential avoidance (Kashdan & Rottenberg, 2010). Psychological flexibility is defined as the ability to act effectively in accordance with one's personal values in the presence of interfering thoughts, emotions and bodily sensations (Hayes et al., 2006). Mindfulness can be described as an adaptive regulation process involving enhanced attention and non-judgmental awareness concerning present-moment experiences (Brown & Ryan, 2003; Chambers, Gullone, & Allen, 2009). The current state of evidence suggests that the concepts specified by the ACT model work very consistently as mediators across the wide range of problems targeted by acceptance and commitment therapy. Successful ACT mediators include general or specific measures of acceptance and psychological flexibility (Gifford et al., 2004; Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007; Lappalainen et al., 2007; Lillis & Hayes, 2007; Lundgren, Dahl, & Hayes, 2008), defusion (e.g., Lundgren et al., 2008; Varra, Hayes, Roget, & Fisher, 2008; Zettle & Hayes, 1986), values (e.g., Lundgren et al., 2008), and mindfulness (Forman et al., 2007). For example, Weineland et al. (Weineland, Hayes, & Dahl, 2012) found that individuals' weight-related psychological flexibility mediated the intervention effect on their quality of life, body dissatisfaction and disordered eating at the follow-up of an ACT intervention following bariatric surgery. Accordingly, we suggest that ACT could promote an intuitive eating style by increasing psychological flexibility and mindfulness skills.

Psychological flexibility and mindfulness promote the willingness to approach and experience emotions and are therefore likely to reduce experiential avoidance, such as emotional eating. Mindfulness practice has been suggested to help individuals "connect" with

their inner experiences, such as hunger, thereby attenuating their sensitivity to external or emotional cues to eat (Alberts, Thewissen, & Raes, 2012; Kristeller & Wolever, 2011). On a cognitive level, mindfulness has been proposed to reduce identification with thoughts about food, body and shape, thereby interrupting dysfunctional thinking patterns (Albers, 2011) that could predispose someone to emotional or restricted eating. Thus, psychological flexibility and mindfulness could offer a new approach to affecting eating regulation and weight management.

The current study is based on a recent randomized controlled trial comparing three psychological lifestyle interventions aimed at improving the well-being of overweight adults experiencing psychological stress: 1) an ACT-based face-to-face group intervention, 2) an ACT-based mobile intervention, and 3) a web-based education intervention (for details of the design, see Lappalainen et al., 2014). Kolehmainen and colleagues (manuscript) examined the effects of the interventions on the overall well-being of overweight adults. They found that psychological flexibility related to weight issues improved in ACT intervention groups. The current study sought to further examine the effects of the ACT lifestyle interventions on psychological processes and adaptive eating behavior and to provide a complementary perspective on the role of acceptance and flexibility in the context of intuitive eating by evaluating the mediating effects of mindfulness and psychological flexibility on intuitive eating and weight in terms of improvements. The mediating effects of psychological flexibility and mindfulness are investigated in comparison with *sense of coherence* (SOC), a variable less associated with ACT yet commonly used to explain health and well-being (Eriksson & Lindstrom, 2005). Sense of coherence was selected for comparison to psychological flexibility and mindfulness since SOC is an important contributor to the development and maintenance of people's health, especially mental health, but does not alone

explain overall health (Eriksson & Lindstrom, 2005). The aim of the present study is described in detail as follows.

First, we investigated the effects of the ACT interventions—face-to-face (in a group) and mobile (individually)—on intuitive eating, mindfulness and sense of coherence in comparison to each other and a control group. The face-to-face and mobile ACT interventions were expected to have similar effects on all measurements. Intervention effects on weight and psychological flexibility have been reported elsewhere (Kolehmainen et al., see manuscript) and are presented as descriptive statistics in this paper.

Second, we examined whether (1) psychological flexibility (general and weight-specific), (2) mindfulness skills, and (3) sense of coherence mediate the intervention effect on intuitive eating and weight in ACT interventions. The changes in psychological flexibility and mindfulness skills were expected to mediate the intervention effects similarly in both ACT interventions. Psychological flexibility and mindfulness were expected to be more important mediators in the ACT interventions than was sense of coherence.

METHODS

Participants

The data of the present study stem from a larger lifestyle intervention study (Lappalainen et al., 2014) that investigated the effects of three low-intensity psychological interventions concerning metabolic syndrome risk factors, psychological flexibility and general well-being among overweight and obese individuals experiencing stress. The study design and

interventions of the larger study are described in detail elsewhere (see Lappalainen et al., 2014), and briefly here. The participants for the study were recruited through advertisements in local newspapers and selected based on specific inclusion criteria: BMI 27–34.9 kg/m^2, age 25–60 years, and reporting symptoms of perceived psychological stress (scored at least 3 of 12 points on the General Health Questionnaire; Makowska, Merecz, Moscicka, & Kolasa, 2002).

In the larger study, altogether 298 participants completed the baseline measurements and were randomly divided into an ACT face-to-face intervention group (n = 70), ACT mobile intervention group (n = 78), web-based education intervention group (n = 79), and non-treatment control group (n = 71). The participants of both ACT interventions (face-to-face and mobile) and the non-treatment control group comprised the study population of the present study (N = 219; 34 male, 15.5%; 185 female, 84.5%). The mean age of the participants of this study was 49.5 ± 7.4 years (range 26.6–60.8 years), and the mean body mass index was 31.3 ± 2.9 kg/m^2 (range 25.7–40.1 kg/m^2). Around half of the participants had an upper secondary education (51.6%) and 45.7% had a university degree.

The present study was approved by the Ethics Committee of the Central Finland Health Care District and has been registered with ClinicalTrials.gov under the identification code NCT01738256. All participants gave their written informed consent for their participation in the study.

Interventions

ACT face-to-face group intervention

The ACT face-to-face group intervention consisted of six group sessions during an 8-week period, with each session lasting around 90 minutes. The intervention program aimed to support lifestyle changes and to enhance well-being through committed actions based on personally important values. The topics of the six sessions were: (1) my life here and now, (2) values and mindful living, (3) value-based actions and barriers, (4) the observing self and acceptance, (5) mindful eating, (6) summary and reflection. Every session included experiential exercises based on the ACT model (such as mindfulness and acceptance exercises and individual activation through value work), pair and group discussions, and homework related to the topic of the session (for a more detailed description of these interventions, see Lappalainen et al., 2014).

ACT mobile intervention

The participants in the ACT mobile intervention were invited to a group meeting that consisted of a brief overview of the Acceptance and Commitment Therapy (ACT) principles. In the meeting, the participants were given smartphones that were pre-installed with a stand-alone mental wellness training application (Ahtinen et al., 2013). They were instructed to use the application on their own during the 8-week intervention period. The application contained short exercises (n = 41) that teach ACT skills to be applied in daily life. It included four categories: (1) mindfulness, (2) acceptance and defusion, (3) clarification of values, and (4) value-based actions. The mobile application delivered an ACT-based intervention program similar to that of the face-to-face group.

Control group

The participants randomized into the control group participated in all of the measurements but were not part of any intervention.

Measurements

Participants completed an Internet-based survey at the pre, post (10 weeks after the pre), and follow-up (36 weeks after the pre) measurement points of the study. The survey included self-report measures. Body weight and height were measured at pre, post and follow-up laboratory visits. The body mass index (BMI) was calculated based on the measured weight and height data.

Intuitive eating. The Intuitive Eating Scale (IES; Tylka, 2006) is a 21-item instrument containing three subscales that assess the components of intuitive eating: (a) *Unconditional permission to eat* (9 items; e.g., ”If I am craving a certain food, I allow myself to have it”); (b) *Eating for physical rather than emotional reasons* (6 items; e.g., “I stop eating when I feel full [not overly stuffed]”); and (c) *Reliance on internal hunger and satiety cues* (6 items; e.g., “I trust my body to tell me how much to eat”). Participants rated the items on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). The subscale items were averaged, with higher scores indicating higher levels of intuitive eating.

Mindfulness. The Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) is a 39-item measure of being mindful in daily life. This measure was derived from an exploratory factor analysis of several previously developed mindfulness questionnaires (Baer et al., 2006) and measures the following five elements of mindfulness: (a) *Observing* (8 items)—includes noticing or attending to internal and external

experiences such as sensations, cognitions, emotions, sights, sounds and smells; (b) *Describing* (8 items)—involves labeling internal experiences with words; (c) *Acting with awareness* (8 items)—represents attending to one's activities of the moment and can be contrasted with behaving mechanically or automatically while attention is focused elsewhere (often called 'automatic pilot'); (d) *Non-judgment of inner experiences* (8 items)—represents taking a non-evaluative stance toward feelings and thoughts; (e) *Non-reactivity to inner experiences* (7 items)—is the tendency to allow thoughts and feelings to come and go without getting carried away by or caught up in them. The items were rated on a 5-point Likert-type scale ranging from 1 (never or very rarely true) to 5 (very often or always true), with higher scores indicating higher levels of mindfulness.

These five facets have been shown to be internally consistent and correlated in expected directions with numerous other constructs in several samples. To a large extent, regression, mediation and confirmatory factor analyses have supported the construct validity of FFMQ scores (Baer et al., 2006; Baer et al., 2008). Exceptions have been seen with respect to the *Observing* scale, which has shown differential relationships with other variables in meditating and non-meditating sample populations. In student samples, *observing* has shown either positive or non-significant correlations with psychological symptoms, suggesting that people without meditation experience may tend to observe their internal experiences in a judgmental or reactive way that is not consistent with mindfulness (Baer et al., 2008).

Psychological flexibility. Psychological flexibility was assessed using the general Acceptance and Action Questionnaire II (AAQ-II; Bond et al., 2011) and the Acceptance and Action Questionnaire for Weight (AAQW; Lillis & Hayes, 2008). The AAQ-II is a 7-item Likert-type questionnaire that assesses the ability to accept aversive internal experiences and

to pursue goals in the presence of these experiences. Some items target emotional acceptance or avoidance while others address the tendency to become entangled in thoughts, to take them literally, or, conversely, to see them simply as thoughts; still others ask about the ability to take value-based actions in the presence of difficult thoughts, or about the tendency to become behaviorally inactive or avoidant. The questions of the AAQ-II are based on statements like, "I worry about not being able to control my worries and feelings" and, "My thoughts and feelings do not get in the way of how I want to live my life." The items were rated on a 7-point Likert-type scale ranging from 1 (never true) to 7 (always true), with higher scores indicating lower levels of psychological flexibility and thus higher levels of experiential avoidance.

In previous research, it has been found that the mediation of specific ACT protocols by ACT processes is better assessed by modifying the general AAQ to target the specific area (e.g., Gifford et al., 2004; Gregg et al., 2007). For that reason, the present study also used a targeted measure adapted from the original AAQ. The Acceptance and Action Questionnaire for Weight (AAQW; Lillis & Hayes, 2008) is a 22-item Likert-type scale that measures acceptance levels of weight-related thoughts and feelings and the degree to which they interfere with valued actions (e.g., "I try hard to avoid feeling bad about my weight or how I look"). The items were rated on a 7-point Likert-type scale ranging from 1 (never true / not at all believable) to 7 (always true / completely believable), with higher scores indicating lower levels of psychological flexibility and thus higher levels of experiential avoidance.

Sense of coherence. Sense of coherence (SOC) was measured with the 13-item Orientation to Life–Questionnaire (SOC-13; Antonovsky, 1987; Antonovsky, 1993). The scale consists of three dimensions: Comprehensibility (5 items, e.g., "Do you have very mixed-up feelings and ideas?"), Manageability (4 items, e.g., "How often do you have feelings that you're not

sure you can keep under control?"), and Meaningfulness (4 items, e.g., "How often do you have the feeling that there's little meaning in the things you do in your daily life?"). The participants were asked to answer the questions on a 7-point semantic differential scale from 1 (never) to 7 (always), with the total sum ranging from 13 (lowest SOC) to 91 (highest SOC). The SOC scale has been shown to be a reliable, valid and cross-culturally applicable instrument measuring how people manage stressful situations and stay well (Eriksson & Lindstrom, 2005).

The measures were written in Finnish. The SOC-13 has been indicated to have good validity, in Finnish studies (Suominen, Blomberc, Helenius, & Koskenvuo, 1999; Suominen, Helenius, Blomberg, Uutela, & Koskenvuo, 2001). The Intuitive Eating Scale was translated and back-translated by experts in nutrition and eating behavior. The AAQ-II, AAQW and FFMQ were translated by a group of researchers with long-term experience in acceptance-, mindfulness- and value-based interventions. The internal consistency of all the applied measures and subscales was high (Cronbach α = .70–.94).

Statistical analysis

The statistical analyses were conducted using Mplus (Version 7) and SPSS (Version 20). The parameters were estimated using the full information maximum likelihood method (MLR estimation in Mplus). In the data, missing values (0–12.8%) were assumed to be missing at random (MAR).

Intervention effects were analyzed by using the hierarchical linear model (HLM) and effect sizes. Intervention effects, as well as indirect effects, were analyzed by first comparing the

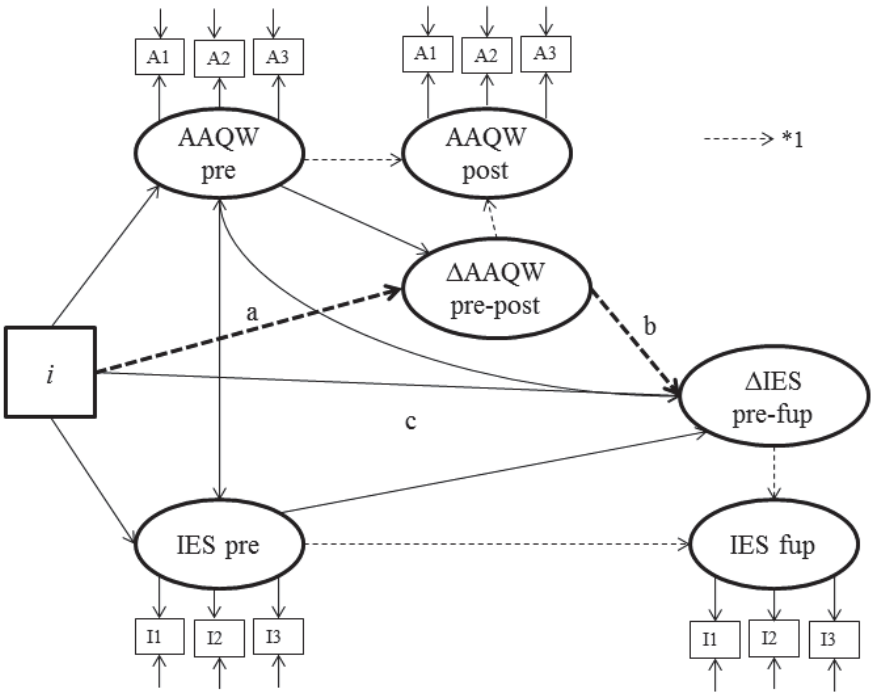
ACT face-to-face and mobile interventions to each other. If no difference was observed over time between these two ACT intervention groups, then they were combined and together compared to the control group. If the ACT intervention groups showed different effects, then they were separately compared to the control group. The effect sizes (ES) were calculated by comparing the mean difference in change ($d_i - d_c$) between the intervention groups and the control group, using the equation:

$$Cohen's\ d = \frac{d_i - d_c}{\frac{1}{3}\sum_{j=1}^{3} sd_j};\ d_x = (\bar{y}_{fup} - \bar{y}_{pre}).$$

In the first measurement, the difference was divided by the pooled standard deviation. A *between-group ES* of 0.2 was considered clinically small, 0.5 medium, and 0.8 large (Cohen, 1992).

The mediation analyses were conducted using the Latent Difference Score (LDS) mediation model (MacKinnon, 2008). Figure 1 shows the LDS model, where the effects of the interventions (i) on intuitive eating (change from pre to follow-up, ΔIES) are mediated by the change in psychological flexibility during the interventions as assessed with the AAQW (ΔAAQW). The product of the *a* and *b* coefficients in the LDS model comprises the mediation effect. In the measurement model, three parcels (e.g., A1–A3) were used to estimate the latent factors representing the true score without measurement error. By constructing three measured indicators (parcels) for each latent variable (i.e., psychological flexibility and intuitive eating), we followed the recommendation of Russell, Kahn, Spoth and Altmaier (1998).

Figure 1. The Latent Difference Score (LDS) mediation model, where the intervention effect on the IES (change from pre to follow-up) is mediated by the AAQW (change from pre to post).



Note. *i* = 0, for control group; *i* = 1-2, for interventin groups.
IES = Intuitive Eating Scale; AAQW = Acceptance and Action Questionnaire for Weight; pre = pre-intervention, post = post-intervention, fup = follow-up.

The LDS model was chosen because the focus was on variance in *within-individual* changes in true scores and on mean intervention effects. The LDS approach made it possible to focus on change (e.g., ΔAAQW) in each construct rather than only in levels (e.g., AAQW). Thus, we are suggesting that changes in behavioral processes (psychological flexibility, mindfulness skills, and sense of coherence) are more important than, for example, psychological flexibility per se.

We followed the recommendation of Zhao, Lynch and Chen (2010) in the analysis of mediation. They have presented that the only requirement to demonstrate mediation is a significant indirect effect ($a \times b$). It may be possible to establish an indirect effect despite no

total direct effect (Zhao, Lynch, & Chen, 2010). The product of *a* and *b* may be significant even if the coefficients on their own are not (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Mplus allows users to define any function of parameters ($a \times b$) as a model parameter and in addition provides bias-corrected bootstrap confidence intervals for such parameters. Confidence intervals are based on 1,000 bootstrap resamples. See Preacher and Hayes (Preacher & Hayes, 2008) for more information regarding the advantages of bootstrapping in mediation models. Indirect effects are deemed statistically significant at the .05 level, if the 95% confidence interval (CI) for the estimate of indirect effects does not include zero.

The fit of the models were evaluated using the following goodness-of-fit measures provided by the Mplus program (Muthén, 1998–2004): RMSEA (Root Mean Square Error of Approximation, with values of .06 or less indicating a good fit), SRMR (Standardized Root Mean Square Residuals, with values less than .08 indicating a good fit), CFI (Bentler's Comparative Fit Index, with values of .95 or higher indicating a good fit), and TLI (Tucker–Lewis Index, with values higher than .95 indicating a good fit) (Hu & Bentler, 1999).

RESULTS

Intervention effects

Changes in intuitive eating and weight during the interventions and at the 6-month follow-up measurement point are described in Table 1. *Eating for physical rather than emotional reasons,* a component of intuitive eating, increased significantly in the ACT face-to-face and

mobile groups compared to the control group (p = .003). The increase was significant from the pre- to post-intervention measurement (p = .001), and it was maintained from the post-intervention to follow-up measurement (there was no difference in comparison to the control group during the follow-up period, p = .718). The *between-group* effect sizes (Cohen's *d*) at the follow-up measurement point were .36 for the ACT face-to-face group and .24 for the ACT mobile group, indicating small effects compared to the control group (Cohen, 1992). The interventions did not have significant effects on the other two subscales of intuitive eating (*Unconditional permission to eat* and *Reliance on internal hunger and satiety cues*), nor on the total score of the Intuitive Eating Scale or on weight in comparison to the control group.

Table 1.

Changes in process measurements during the interventions and their follow-up are described in Table 2. As previously found (Kolehmainen et al., see manuscript), psychological flexibility for weight (AAQW) improved significantly in the ACT face-to-face and mobile groups during the respective interventions as compared to the control group (p=.000). In addition, participants' tendency to *observe* increased significantly in both ACT groups in comparison to the control group (p=.002), with effect sizes of .24 for the ACT face-to-face group and .16 for the ACT mobile group.

Table 2.

Mindfulness skills (FFMQ total) and its subscales *Acting with awareness* and *Non-reacting* improved more in the ACT mobile group than in the ACT face-to-face group (p = .018, .021, .043, respectively). The differences in change scores were significant during the intervention period (from pre to post; FFMQ total, p = .005; *Acting with awareness, p* = .015; *Non-*

reacting, p = .012), but not during the follow-up period (from post to follow-up; FFMQ total, *p* = .265; *Acting with awareness, p* = .617; *Non-reacting, p* = .271). Accordingly, they were separately compared to the control group. There was a significant intervention effect on the FFMQ total in the ACT mobile group, greater than in the control group (*p* = .009), with an effect size of .13. Changes in *acting with awareness* and *non-reacting* were not significant in either of the ACT groups compared to the control group.

Mediation analysis

We were interested in whether changes in process variables (AAQ-II, AAQW, SOC, FFMQ and its subscales) during the active intervention period (from pre to post) mediate the long-term changes (from pre to follow-up) in intuitive eating and weight. All LDS mediation models showed an excellent fit to the data (RMSEA = 0.00–0.072, SRMR = 0.030–0.072, CFI = 0.974–1.0, and TLI = 0.959–1.014).

The estimates and 95% confidence intervals (CI) of standardized indirect effects (a × b) in the Latent Difference Score (LDS) models are described in Table 3 (see Figure 1). There were no significant differences in indirect effects between the ACT face-to-face group and the ACT mobile group; subsequently, the ACT groups were compared jointly to the control group. The 95% CIs for indirect effects—via the AAQW—on 1) weight (BMI), 2) intuitive eating and its subscales, 3) *eating for physical rather than emotional reasons,* and 4) *reliance on internal hunger and satiety cues* did not include zero. Thus, the LDS models suggested that the effect of the ACT interventions on those variables was mediated by the change in weight-related psychological flexibility (AAQW) in the ACT face-to-face and ACT mobile groups. The unstandardized regression coefficients (*a, b,* and *c*) of the significant mediation models are

presented in Table 4. There were no statistically significant direct effects (*c; p* < .05; see Figure 1) when the indirect path (*a* and *b*) was included in the model, indicating indirect-only mediation concerning all significant indirect effects (Zhao et al., 2010). The estimates for statistically significant indirect effects ranged from .05 to .08, indicating small effects (ES > .02; Cohen, 1992).

Mindfulness skills (FFMQ and its subscales), general psychological flexibility (AAQ-II) and sense of coherence (SOC) did not mediate any intervention effects on intuitive eating and weight.

Table 3.

Table 4.

DISCUSSION

This study is one of the first studies to examine processes of change in psychological approaches to adapting eating behavior and weight management. Despite the promising results related to intuitive eating, few studies have attempted to explain the processes encouraging adaptive eating behavior, and previous studies on intuitive eating have been mainly cross-sectional in nature. Thus, the focus of the present study was on exploring mechanisms of change in intuitive eating and weight in the ACT-oriented intervention groups comprised of overweight people. Mediation provides important information regarding the treatment processes and theoretical models related to specific treatment approaches. According to previous research on the ACT model, it was expected that psychological flexibility and mindfulness would function as mediators in interventions applying acceptance-, mindfulness- and value-based methods.

First, the present results indicate that *eating for physical rather than emotional reasons* increased more in the ACT-based intervention groups than in the control group. Several studies have shown that mood and emotions are involved in eating and that they play an important role in eating disorders (e.g., Vögele & Gibson, 2010). The present findings support the theoretical assumption that ACT reduces avoidance behavior, such as emotional eating, and thus suggest that ACT-oriented interventions can have a positive impact on weight management and disordered eating. These results are in line with previous studies that have indicated that mindfulness practice reduces emotional and external eating (Alberts et al., 2012), as well as binge eating (Kristeller & Hallett, 1999). In the present study, the ACT mobile intervention also improved mindfulness skills (FFMQ total), and both ACT interventions enhanced *observing*.

Second, the mediation analysis indicated that the intervention effects on weight (BMI), intuitive eating behaviors, *eating for physical rather than emotional reasons* and *reliance on internal hunger and satiety cues* were mediated by change in weight-related psychological flexibility (AAQW) in the ACT interventions (face-to-face and mobile). In contrast, weight-related psychological flexibility was not found to mediate the interventions' effect on *unconditional permission to eat.* Even though there was not a significant intervention effect on the intuitive eating total, *reliance on internal hunger and satiety cues* and BMI, significant indirect effects indicated that the ACT interventions increased psychological flexibility (AAQW), which in turn promoted weight loss and increased intuitive eating, including *eating for physical rather than emotional reasons* and *reliance on internal hunger and satiety cues*. There was no statistically significant direct effect (c) when the indirect effect ($a \times b$) was

significant. Thus, we can conclude that the identified mediator (AAQW) was consistent with the hypothesized theoretical framework (see Zhao et al., 2010).

Accordingly, these findings support the idea that the ACT interventions for lifestyle changes functioned as predicted, improving the ability to continue with valued activities when confronted with negative emotions and thoughts related to weight. In accordance with this, population-specific measures of psychological flexibility have been significant mediators in many different areas, including with respect to smoking cessation (Gifford et al., 2004), diabetes self-care (Gregg et al., 2007), prejudice (Lillis & Hayes, 2007), seizures and quality of life in epilepsy cases (Lundgren et al., 2008), adaptive functioning in chronic pain patients (McCracken, Vowles, & Eccleston, 2005; Vowles & McCracken, 2008; Wicksell, Ahlqvist, Bring, Melin, & Olsson, 2008), and weight-related issues (Lillis et al., 2009; Weineland et al., 2012).

Mindfulness skills (FFMQ) and sense of coherence (SOC), as well as the general measure of psychological flexibility (AAQ-II), were not found to mediate changes in weight or intuitive eating behavior. This might imply that change processes associated with weight management and eating regulation are better assessed by specific measures, such as the AAQW, targeted to describe specific weight-related thoughts, feelings and actions. Further, the fact that weight-specific psychological flexibility mediated weight change and intuitive eating might suggest that interventions should target weight-specific behavioral patterns (such as the avoidance of feelings related to weight and body image), and they should include specific exercises or skill training aimed at dealing with these patterns.

The promise of mediation analysis is that it can identify fundamental processes underlying human behavior that are relevant across behaviors and contexts. The present study found similar intervention effects and mediating processes for the ACT mobile stand-alone intervention (minimal contact) as for the ACT face-to-face group intervention, which supports the assumption that these particular behavioral processes are essential in supporting adaptive eating attitudes and weight management. In regard to affecting psychological flexibility and mindfulness skills, these results also suggest that skill training plays a more important role than face-to-face coaching.

Limitations

The most significant limitation of this study is that the processes were measured partly in parallel. Thus, the temporal precedence of the mediator cannot be established, making it difficult to separate cause and effect. Unfortunately, a lack of assessment points during the active treatment phase precluded a detailed examination of the directionality of change. However, determining the most suitable time span over which to measure a mediator and an outcome is important to ensure that the span of the study is sufficient for a mediation process to take place. In the present data, changes in outcome measures happened during the intervention period and were maintained or even increased during the follow-up period. Thus, in order to capture changes in weight and intuitive eating factors, the time period from the pre-intervention measurement point through to the conclusion of the follow-up was most appropriate for the mediation model. However, the time periods of the present study, about two months for the process measurements and eight months for the outcomes, may have been too short for some mediation effects to take place. For example, adopting mindfulness skills

and utilizing them to improve eating behaviors and increase weight loss more significantly may need more time.

Another significant limitation of our study is the use of self-report measures to assess the psychological constructs of interest. Thus, we cannot be sure that observed changes in processes actually reflect "true" changes in target constructs—they may simply reflect social demand or expectations of the treatment. It is also important to note that intuitive eating is a cognitive construct that may be related to eating habits, but more studies are needed to verify that. The present results support this connection by showing similar mediation effects on both BMI and intuitive eating. Still, future studies should aim to include behavioral, experimental, and observer-rated processes of acceptance/experiential avoidance and eating behavior. Also, a variety of approaches have been proposed for the assessment of mindfulness and there have been debates about the issue of measuring this construct (Bishop et al., 2004; Brown & Ryan, 2004). Thus, further research using other validated measures of mindfulness is recommended.

Moreover, it is important to note that the observed effect sizes of the intervention effects as well as the indirect effects were small, and thus the clinical significance of the observations is unclear. There are possibly also other important variables mediating intervention effects on intuitive eating and weight. Finally, it is important to note that our sample predominantly consisted of overweight women experiencing psychological stress, who were willing to make changes to improve their lifestyle. The participants were also relatively highly educated. Therefore, the generalizability of the results to the general population is limited.

In conclusion, our research provides evidence that ACT-oriented interventions might improve overweight persons' skills in dealing with emotions related to eating. Our data also imply that

weight-related psychological flexibility mediates changes in weight and intuitive eating, especially in *eating based on physical reasons* and *reliance on hunger and satiety cues,* in overweight persons experiencing psychological stress. Thus, these findings support the idea that ACT-oriented interventions for lifestyle changes improve individuals' ability to continue with valued activities even when confronted with negative emotions and thoughts related to weight, and this process mediates changes in eating regulation and weight. More generally, the present results suggest that one way to increase adapting eating behavior is to enhance psychological flexibility related to weight issues.

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Table 1. *Changes in Outcome Measurements for Intervention (Face-to-Face and Mobile) and Control Groups. Between–Group Effect Sizes and Between–Group Analyses Compare ACT Interventions to the Control Group.*

Variable	**Means (SD)**				**Within-group analysis (*p*-value)**		**Between-group effect sizes, Cohen's *d***	**Between-group analysis: ACT (face+mobile) vs. control (*p*-value)**
IES total		Pre	Post	Fup	Pre-Post	Post-Fup	Pre-Fup	
	Face-to-Face	2.9 (0.4)	3.0 (0.5)	3.1 (0.5)	.013*	.006**	.43	.109
	Mobile	2.9 (0.5)	3.1 (0.4)	3.1 (0.5)	.000***	.932	.43	
	Control	3.0 (0.5)	3.0 (0.5)	3.0 (0.5)	.723	.100		
IES: Permission		Pre	Post	Fup				
	Face-to-Face	3.0 (0.5)	3.0 (0.5)	3.1 (0.5)	.511	.172	.18	.820
	Mobile	3.1 (0.6)	3.2 (0.6)	3.1 (0.7)	.225	.142	.00	
	Control	3.1 (0.6)	3.0 (0.7)	3.1 (0.6)	.649	.684		
IES: Reasons		Pre	Post	Fup				
	Face-to-Face	2.4 (0.8)	2.6 (0.7)	2.8 (0.9)	.000***	.041*	.36	.003**[a]
	Mobile	2.4 (0.8)	2.6 (0.8)	2.7 (0.8)	.000***	.214	.24	
	Control	2.6 (0.9)	2.6 (0.8)	2.7 (0.8)	.920	.131		
IES: Cues		Pre	Post	Fup				
	Face-to-Face	3.2 (0.6)	3.3 (0.7)	3.4 (0.6)	.104	.030*	.15	.970
	Mobile	3.2 (0.7)	3.3 (0.6)	3.4 (0.6)	.079	.423	.15	
	Control	3.2 (0.7)	3.3 (0.6)	3.3 (0.7)	.178	.130		
Weight (kg)		Pre	Post	Fup				
	Face-to-Face	86.1 (10.2)	85.3 (10.1)	84.4 (11.0)	.017*	.008**	-.10	.177
	Mobile	88.4 (10.3)	88.0 (10.4)	87.2 (11.0)	.075	.036*	-.06	
	Control	88.3 (11.4)	88.2 (11.6)	87.7 (11.8)	.429	.034*		

BMI		Pre	Post	Fup				
	Face-to-Face	31.0 (3.1)	30.7 (3.2)	30.3 (3.4)	.024*	.006**	-.17	.145
	Mobile	31.6 (2.7)	31.5 (2.8)	31.1 (2.9)	.059	.038*	-.10	
	Control	31.2 (2.8)	31.1 (2.8)	31.0 (3.0)	.349	.047*		

Note. IES = Intuitive Eating Scale; Permission = Unconditional Permission to Eat; Reasons = Eating for Physical Reasons; Cues = Reliance on Hunger/Satiety Cues; BMI = Body Mass Index.
*$p < .05$; **$p < .01$; ***$p < .001$.
[a]Difference in change scores from pre to post at the significance level $p < .05$.
[b]Difference in change scores from post to follow-up at the significance level $p < .05$.
Means and standard deviations are calculated using Mplus software with full information maximum likelihood estimates for the parameters.

Table 2. *Changes in Process Measurements for Intervention (Face–to–Face and Mobile) and Control Groups. Between–Group Effect Sizes and Between–Group Analyses Compare ACT Interventions to the Control Group.*

Variable	**Means (SD)**				**Within–group analysis (*p*–value)**		**Between–group effect sizes, Cohen's *d***	**Between–group analysis: ACT (face+mobile) vs. control (*p*–value)**
AAQ–II		Pre	Post	Fup	Pre–Post	Post–Fup	Pre–Fup	
	Face-to-Face	20.2 (8.5)	18.1 (8.4)	17.0 (7.6)	.000***	.108	-.12	.233
	Mobile	20.3 (9.1)	18.6 (9.0)	16.0 (8.4)	.006**	.001**	-.25	
	Control	21.5 (9.2)	20.4 (9.7)	19.4 (8.9)	.428	.110		
AAQW		Pre	Post	Fup				
	Face-to-Face	85.4 (19.2)	78.0 (19.0)	73.0 (21.1)	.000***	.001**	-.44	.000**[a]
	Mobile	88.2 (21.2)	80.9 (19.9)	80.5 (22.7)	.000***	.716	-.20	
	Control	87.3 (20.1)	86.0 (22.4)	83.7 (23.2)	.585	.037*		
FFMQ total		Pre	Post	Fup				
	Face-to-Face	134.7 (17.0)	134.0 (19.5)	139.0 (18.8)	.886	.007**	.06	.967[F]/.009**[aM]
	Mobile	131.7 (19.1)	137.3 (19.3)	139.7 (21.5)	.000***	.144	.13	
	Control	131.1 (20.4)	131.4 (21.0)	134.3 (19.5)	.990	.030*		
Observe		Pre	Post	Fup				
	Face-to-Face	26.2 (5.1)	27.3 (3.8)	28.0 (5.0)	.037*	.189	.24	.002**[a]
	Mobile	26.0 (5.0)	27.2 (5.4)	27.4 (6.4)	.001**	.790	.16	
	Control	26.0 (5.0)	25.6 (5.6)	26.6 (5.3)	.167	.026*		
Describe		Pre	Post	Fup				
	Face-to-Face	29.4 (6.5)	30.0 (7.0)	30.6 (5.6)	.135	.345	.15	.128
	Mobile	29.8 (6.8)	31.0 (6.8)	30.4 (7.0)	.012*	.091	.06	
	Control	30.2 (6.7)	29.8 (6.6)	30.4 (6.3)	.483	.236		

ActAware		Pre	Post	Fup				
	Face-to-Face	27.7 (5.9)	26.2 (5.8)	27.3 (5.3)	.009**	.115	-.10	.107[F]/.251[M]
	Mobile	25.3 (5.6)	25.8 (6.3)	27.0 (6.8)	.393	.028*	.26	
	Control	25.1 (5.9)	25.2 (6.5)	25.3 (6.1)	.994	.637		
NonJudge		Pre	Post	Fup				
	Face-to-Face	28.9 (6.1)	28.3 (6.1)	30.0 (5.3)	.522	.009**	-.03	.389
	Mobile	28.6 (6.2)	29.9 (5.3)	31.6 (5.4)	.010*	.003**	.26	
	Control	28.1 (7.2)	28.6 (7.0)	29.4 (7.2)	.464	.144		
NonReact		Pre	Post	Fup				
	Face-to-Face	22.2 (4.3)	22.2 (4.6)	23.0 (4.8)	.756	.182	-.02	.631[F]/.161[M]
	Mobile	21.9 (5.2)	23.4 (4.6)	23.3 (5.3)	.001**	.792	.10	
	Control	21.7 (5.5)	22.1 (5.4)	22.6 (5.0)	.325	.160		
SOC–13		Pre	Post	Fup				
	Face-to-Face	53.1 (5.1)	62.6 (11.7)	63.8 (11.0)	.000***	.337	.14	.525
	Mobile	51.9 (5.3)	61.6 (11.0)	63.6 (11.6)	.000***	.019*	.32	
	Control	51.1 (6.3)	59.6 (12.0)	61.0 (12.7)	.000***	.145		

Note. FFMQ = Five Facet Mindfulness Questionnaire, AAQ–II = Acceptance and Action Questionnaire, AAQW = Acceptance and Action Questionnaire for Weight, SOC–13 = Sense of Coherence.
*$p < .05$; **$p < .01$; ***$p < .001$.
[a]Difference in change scores from pre to post at the significance level $p < .05$.
[b]Difference in change scores from post to follow–up at the significance level $p < .05$.
[F]Between–group analysis comparing ACT face-to-face to the control group.
[M]Between–group analysis comparing ACT mobile to the control group.
Means and standard deviations are calculated using Mplus software with full information maximum likelihood estimates for the parameters.

Table 3. *Estimates [and 95% Confidence Intervals] for Standardized Indirect Effects (a×b) from the Latent Difference Score Models, where ACT Interventions (Face-to-Face and Mobile) are Compared to the Control Group*

Mediator (Pre-Post)	**Outcome (Pre–Fup)**				
	BMI	IES total	IES: Permission	IES: Reasons	IES: Cues
AAQ	-.02 [-.05, .02]	.04 [-.02, .09]	.02 [-.03, .06]	.02 [-.02, .06]	.05 [-.02, .12]
AAQW	-.08 [-.14, -.02]*	.07 [.00, .13]*	.06 [-.02, .14]	.05 [.00, .11]*	.08 [.01, .14]*
FFMQ	.00 [-8.06, 8.06]	.03 [-.01, .06]	-.00 [-.04, .04]	.02 [-.01, .05]	.05 [-.00, .10]
Observe	-.02 [-.09, .06]	.03 [-.06, .12]	-.09 [-.02, .04]	.07 [-.01, .15]	.08 [-.01, .18]
Describe	-.01 [-.05, .03]	.02 [-.03, .07]	-.00 [-.05, .05]	.00 [-.04, .05]	.05 [-.01, .11]
ActAware	-.00 [-.02, .01]	-.00 [-.02, .02]	-.00 [-.02, .02]	.00 [-.01, .01]	-.00 [-.03, .02]
NonJudge	-.00 [-.02, .02]	.01 [-.03, .04]	.00 [-.02, .02]	.01 [-.03, .05]	.01 [-.03, .05]
NonReact	-.00 [-.03, .02]	.02 [-.02, .06]	.01 [-.03, .04]	.00 [-.02, .03]	.02 [-.03, .07]
SOC-13	.00 [-.02, .02]	-.00 [-.03, .03]	.00 [-.03, .02]	-.00 [-.02, .02]	-.00 [-.05, .04]

Note. IES = Intuitive Eating Scale; Permission = Unconditional Permission to Eat; Reasons = Eating for Physical Reasons; Cues = Reliance on Hunger/Satiety Cues; BMI = Body Mass Index; FFMQ = Five Facet Mindfulness Questionnaire; AAQ-II = Acceptance and Action Questionnaire; AAQW = Acceptance and Action Questionnaire for Weight; SOC-13 = Sense of Coherence.
*Indirect effects are deemed statistically significant at the .05 level if the 95% CI for the estimate of indirect effects does not include zero.

Table 4. *The Unstandardized Regression Coefficients a, b, and c (/p–values) of the Mediation Models in which the AAQW (Pre-Post) Mediated the Effect of the ACT Interventions on the Outcome Variables*

Outcome variable (Pre–Fup)	***a***	***b***	***c***
BMI	-2.369 / .000	0.091 / .000	-0.086 / .591
IES total	-2.391 / .000	-0.125 / .015	0.201 / .510
IES: Reasons	-2.350 / .000	-0.042 / .021	0.122 / .264
IES: Cues	-2.393 / .000	-0.065 / .003	-0.111 / .461

Note. IES = Intuitive Eating Scale; Reasons = Eating for Physical Reasons; Cues = Reliance on Hunger/Satiety Cues; BMI = Body Mass Index; AAQW = Acceptance and Action Questionnaire for Weight.