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THE ROLE OF DEPRESSIVE SYMPTOMS IN THE RELATION BETWEEN DIETING MOTIVATION AND WEIGHT CHANGE

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In general, a high level of dieting motivation is associated with successful weight loss. However, this may not be equally true for everyone. The goal of the current longitudinal study was to test the interactive effect of dieting motivation and depressive symptoms on weight change in a sample of 142 participants (*M* age = 46.7; 112 females). Height and weight were measured twice: at baseline and after a year. Some evidence was found for the hypothesized interactive effect of dieting motivation and depressive symptoms on weight change. The BMI of participants without depressive symptoms decreased with increasing motivation, whereas the BMI of participants with depressive symptoms increased with increasing motivation. Taken together, these data suggest that depressive symptoms should be taken into account in weight-loss treatments because they may interfere with weight loss goals.

Many people attempt to lose weight, either on their own or in a treatment setting (Ackard, Croll, & Kearney-Cooke, 2002; French, Jeffery, & Murray, 1999; Jeffery, Adlis, & Forster, 1991). Unfortunately, most

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dieting attempts are not successful (Mann et al., 2007). After failing to lose weight on one particular dieting program, people often eagerly await the next hot dieting program for their next attempt. They are convinced that they will be able to lose weight when on the right type of diet (Polivy, 2001).

However, research has shown that the type of diet does not determine its success. Sacks and colleagues (2009) found that the macronutrient composition of a diet did not influence the degree of weight loss. Four diets, which varied in carbohydrate, fat, and protein content, all led to the same amount of weight loss over the course of two years. Interestingly, dieting commitment did show a strong relationship with weight loss: the stronger the commitment, the more weight was lost. In a similar vein, it was reported that successful dieting attempts are characterized by greater commitment as compared to unsuccessful attempts (Klem, Wing, McGuire, Seagle, & Hill, 1997). Among other behavioral characteristics of successful weight losers (for a review, see Elfhag & Rössner, 2005), motivation and commitment have been shown to be important predictors of successful weight loss. The focus of the current study is on the relation between dieting motivation and weight loss, and how this relation is moderated by depressive symptoms.

Although overall motivation has a positive effect on dieting and weight loss, this effect may not be equally strong for everyone, and for some people even be reversed. Indeed, it was found among depressed people, that restrained eaters (Herman & Polivy, 1980)—that is, those with a chronic intention to lose weight—reported to have gained weight since their diagnosis of depression, whereas unrestrained eaters reported to have lost weight since their diagnosis of depression (Polivy & Herman, 1976). These data suggest that depression can undermine the goal of restrained eaters to lose weight. Though these results confirmed the authors' hypothesis and are highly suggestive, limitations of that study are that the sample size was small (n = 12) and that all data were based on self-reports. A more recent longitudinal study in which obese people in a weight-loss trial were followed during 18 months, showed that female participants high in emotional distress lost less weight at 6 months and gained more weight at 18 months as compared to female participants low in emotional distress (Langer et al., 2009). Moreover, it was found that a high level of depression was associated with weight regain after initial successful weight loss (McGuire, Wing, Klem, Lang, & Hill, 1999).

Experimental laboratory studies provide converging evidence. It was found that dieters ate more during a so-called taste-test than did nondieters after the induction of a depressed mood, whereas dieters ate less than did nondieters in a neutral control condition (Baucom & Aiken, 1981). Similarly, restrained eaters in a negative mood consumed more M&Ms than those in an elated or neutral mood, and than low restrained eaters in a negative mood (Frost, Goolkasian, Ely, & Blanchard, 1982). Similar findings were observed in obese binge dieters, although the interaction with restraint just missed significance (Chua, Touyz, & Hill, 2004). Finally, it was shown that overweight participants—often motivated to lose weight—who scored high on negative affect, but not those scoring low on negative effect, overate in response to two typical triggers of overeating: a negative mood induction and exposure to palatable high caloric food (Jansen, Vanreyten, et al., 2008).

Additionally, an observational study has shown that naturalistic dieting (i.e., self-directed weight loss attempt) led to a decrease in bulimic symptoms only in participants with low levels of depressive symptoms (Presnell, Stice, & Tristan, 2008). Similarly, it was found that the relationship between dieting and increased binge eating was stronger for participants scoring high on negative affect as compared to those scoring low on negative affect (Stice, Akutagawa, Gaggar, & Agras, 2000).

In sum, a negative mood and depressive symptoms seem to moderate the relationship between dieting motivation on the one hand and consumption and weight change on the other hand. Like anxiety (Herman & Polivy, 1975), ego-threat (Wallis & Hetherington, 2004), and cognitive load (Ward & Mann, 2000), depressive symptoms may disrupt self-regulatory behavior. That is, depressive symptoms may disinhibit eating behavior that is normally suppressed in those motivated to lose weight, whereas these symptoms have an opposite effect on people unconcerned with weight loss: appetite is inhibited and weight is lost (Polivy & Herman, 1976; Robinson, McHugh, & Folstein, 1975).

A model that may explain these diverse moderating effects is the ego-depletion model (Baumeister, Bratslavsky, Muraven, & Tice, 1998). According to this model, generally a dieting attempt will succeed if a person is not ego-depleted, has sufficient self-regulatory resources available. A more general way to frame this would be to assume that a person needs sufficient cognitive resources to be able to successfully lose weight. If a person has other things on his or her

mind that take up cognitive resources (e.g., suffers from depressive symptoms), a failure of the dieting attempt is more likely. In other words, the depressive symptoms may constitute a more immediate concern, thereby relegating the dieting intentions to the background. If cognitive resources become really low, food consumption may even increase beyond what the person normally consumes (i.e., disinhibited eating behavior). So, it can be predicted that when a person who is motivated to diet does not suffer from depressive symptoms, he or she will succeed in losing weight, as the availability of cognitive resources is sufficient. If on the other hand a diet-motivated person suffers from depressive symptoms, these depressive symptoms are thought to take up the cognitive resources that were directed at controlling eating behavior and thereby lead to a failure of the dieting attempt and possibly even weight gain.

The main goal of the current longitudinal study was to test the interactive effect of dieting motivation and depression on objectively measured weight change over the course of a year in a reasonably large sample. Instead of measuring dieting concerns with a restraint questionnaire, which was done in most of the preceding studies, we attempted to specifically assess dieting motivation, as this better fits the construct of commitment that was highlighted by Sacks et al. (2009). It was expected that depressive symptoms would interfere with the normally observed negative relationship between dieting motivation and BMI change (i.e., more weight loss with a stronger dieting motivation). If evidence were found for the interfering role of depressive symptoms, this would suggest that it might be beneficial to advice people with depressive symptoms to postpone their dieting attempt until they have recovered, or to address depressive symptoms in obesity treatments.

METHOD

PARTICIPANTS

Participants were 142 employees (112 females) of the Maastricht Academic Hospital, the Netherlands. See Table 1 for participant characteristics. The current sample participated in the Heart Attack Prevention Program for You (HAPPY). HAPPY consists of a mass screening and communication intervention to decrease the 10-year heart-attack risk in the general population. Participants for the cur-

TABLE 1. Participant Characteristics (Means with SD in Parentheses) for Whole Sample and Per Group (High Versus Low Depressive Symptoms on the Beck Depression Inventory—BDI) and t-Tests Comparing the Means Per Group

		BDI Group		
	Whole Sample (n = 142)	BDI Low (n = 114)	BDI High (n = 28)	t (140)
Age	46.7 (9.8)	47.6 (9.7)	43 (9.2)	2.26*
BMI at pretest[a]	25.2 (3.8)	25.2 (3.8)	25.3 (4.0)	0.06
Motivation score	2.56 (1.2)	2.5 (1.2)	2.7 (1.3)	0.95
BDI total score	5.5 (6.0)	3.1 (2.9)	15.3 (5.7)	10.92[b]**
DEBQ emotional eating	2.1 (0.8)	2.0 (0.8)	2.7 (0.8)	4.09**

Note. DEBQ = Dutch eating behavior questionnaire. [a]One extreme outlier (4.6 *SD* > *M*) was replaced with the score of the participant with the next most extreme score on that variable (see Wilcox, 2001; 3.0 *SD* > *M*). [b]Adjusted degrees of freedom (30.47) due to unequal variances. *$p < .05$; **$p < .001$

rent study were recruited through the online HAPPY-newsletter, in which they were asked to fill out some extra questionnaires about eating and mood. Current pregnancy was an exclusion criterion (n = 1).

PROCEDURE

Participants of HAPPY were invited in a digital newsletter to take part in an online survey on eating and mood. Half a year before and half a year later their height and weight were objectively measured during one of the HAPPY measurement sessions. Weight was measured with a Seca (model 888) digital balance. This balance is highly accurate and robust, and can measure weights up to 160 kg. Participants were weighed in normal clothing while shoes were removed. To calculate BMI change, the difference in BMI between the two HAPPY measurement sessions was computed. The questionnaire was administered online and lasted approximately 20 minutes. The study was approved by the ethical committee of the Faculty of Psychology and Neuroscience of Maastricht University, the Netherlands.

QUESTIONNAIRE

The questionnaire was administered online, and included measurements of depressive symptoms, emotional eating, and dieting motivation.

Depressive Symptoms. Depressive symptoms were assessed with the Beck Depression Inventory II (BDI-II; Beck, Steer, & Brown, 1996; Dozois, Dobson, & Ahnberg, 1998). The BDI-II is a 21-item inventory, with each item being rated on a 4-point Likert scale ranging from 0 to 3. Total scores on this inventory range from 0–63, with higher scores reflecting more depressive symptoms. The measure has high internal consistency and adequate validity (Beck et al., 1996; Dozois et al., 1998).

Self-Reported Emotional Eating. Self-reported emotional eating was measured with the Emotional Eating subscale of the Dutch Eating Behavior Questionnaire (DEBQ). This Emotional Eating subscale consists of 13 items that ask whether desire to eat or actual eating increase during the experience of diverse negative emotions. Each item is scored on a 1–5 scale and the Emotional Eating subscale score is calculated by averaging over the items. Higher scores are indicative of increased emotional eating. The subscales of the DEBQ have a high internal consistency and adequate factorial validity (Van Strien, Frijters, Bergers, & Defares, 1986).

Dieting Motivation. Four questions measuring dieting motivation were averaged into one motivation score. (1) The intention to diet on a scale from 1 (no, absolutely not) to 5 (yes, definitely), (2) Importance of weight loss on a scale from 1 (not important at all) to 5 (very important), (3) How much effort on dieting on a scale from 1 (no extra effort at all) to 5 (as much effort as possible), and (4) How determined to lose weight on a scale from 1 (not determined at all) to 5 (very determined). The dieting motivation score ranges from 1 to 5, with higher values reflecting more motivation. Missing values on items 3 and 4 (28.9%), which occurred due to a technical error in the online administration of the questionnaire, were replaced by the predicted value from a linear regression with as predictors items 1 and 2, and sex and age. For complete cases, the correlation between the sum score of items 1 and 2 and the sum score of items 3 and 4 was very high ($r = .84$, $p < .001$), and the internal consistency (Cronbach's α) of the total dieting motivation scale was 0.89, with item-total correlations ranging from .68 to .86 for complete cases.

ANALYSIS

Data were analyzed with linear regression, including in all three models (see specifications below) as predictors: sex, age, depressive

symptoms, dieting motivation, and the interaction between depressive symptoms, and dieting motivation. The predictors age, sex, depressive symptoms, and dieting motivation were centered before they were entered into the model. The dependent variable was the BMI change score. To reduce their effects on the results, five outliers on BMI change, as identified by both a box plot and a relatively high value for Cook's distance, were replaced with the nearest BMI change score in the total sample (see Wilcox, 2001).

In a first regression model, depressive symptoms and dieting motivation were both entered as continuous predictors. In a second regression model, the factor depressive symptoms was dichotomized, resulting in a healthy group (coded 0) and a group with complaints (coded 1). This model tested the possibility that the effect of dieting motivation on BMI change may not change gradually and linearly with increasing BDI scores. The 20% of participants (n = 28) scoring the highest on the BDI-II were characterized as having depressive symptoms, though symptoms in this group were mild. These participants had a score of 10 or higher (see Jansen, Havermans, Nederkoorn, & Roefs, 2008) on the BDI-II. All other participants (n = 114) were classified as not having depressive symptoms. A third regression model included all predictors of model 1, as well as the predictor emotional eating (centered) and its interactions with the factors dieting motivation and depressive symptoms. This third regression model was included to test whether emotional eating moderates the effects of depressive symptoms and of dieting motivation.

RESULTS

In the first regression model, no support was found for the hypothesized dieting motivation × depressive symptoms interaction (p = .26), nor were any of the other effects significant. See Table 2 for relevant statistics. In the second regression model,[1] in which the variable depressive symptoms was dichotomized, the hypothesized motivation × depressive symptoms interaction was significant (p =

1. In view of the age difference between the high and low BDI group (see Table 1), the addition of the age × dieting motivation interaction to model 2 was tested, to correct the interaction of interest (dieting motivation × depressive symptoms) for possible confounding. This interaction was not significant (p = .78), and did not substantially change the interaction of interest (dieting motivation × depressive symptoms, p = .047). The age × dieting motivation term was therefore dropped from all further analyses.

TABLE 2. Hierarchical Multiple Regression Analyses Predicting BMI-Change From Depressive Symptoms and Dieting Motivation

	ΔR^2	*B*	*SE B*	95% CI
Step 1	.03			
Constant		-0.03	0.08	-0.18–0.13
Age		-0.00	0.01	-0.02–0.01
Sex		-0.03	0.04	-0.11–0.06
Dieting motivation		-0.06	0.07	-0.20–0.08
Depressive symptoms (BDI)		0.02	0.01	-0.00–0.05
Step 2	.01			
Constant		-0.04	0.08	-0.20–0.11
Age		-0.00	0.01	-0.02–0.01
Sex		-0.02	0.04	-0.10–0.06
Dieting motivation		-0.06	0.07	-0.19–0.08
Depressive symptoms		0.02	0.01	-0.01–0.05
Dieting motivation × depressive symptoms		0.01	0.01	-0.01–0.03

Note. The dieting motivation scale ranged from 1 to 5, and the BDI (Beck Depression Inventory) ranged from 0 to 63.

.048). See Table 3 for relevant statistics and Figure 1 for an effect plot. The BMI of participants without depressive symptoms decreased with increasing motivation, whereas the BMI of participants with depressive symptoms increased with increasing motivation. Subsequent simple slope analyses,[2] including the same predictors as in the second regression model, failed to show a significant effect of dieting motivation in either group, however (group without depressive symptoms: $p = 0.14$; group with depressive symptoms: $p = .15$). This may be due to a type II error, as the significant interaction between depression and motivation implies that the simple slopes are not equal, and so at least one slope must be non-zero. A third regression model included the predictors of model 1, as well as the predictor emotional eating and its interactions with depressive symptoms and with dieting motivation. None of the effects involving emotional eating were significant (all ps $> .25$), implying that emotional eating does not predict BMI change, and does not moderate the effects of depressive symptoms or dieting motivation.

2. Simple slopes were tested by the effect of motivation in Table 3, which is the motivation effect if depression = 0, and then repeating the analysis with reversed coding of depression.

TABLE 3. Hierarchical Multiple Regression Analyses Predicting BMI-Change from Depressive Symptoms (Dichotomized Into a Healthy Group and a Group with Complaints) and Dieting Motivation

	ΔR^2	*B*	*SE B*	95% CI
Step 1	.01			
Constant		-0.07	0.09	-0.24–0.11
Age		-0.00	0.01	-0.02–0.01
Sex		-0.02	0.04	-0.10–0.06
Dieting motivation		-0.04	0.07	-0.18–0.09
Depressive symptoms		0.20	0.20	-0.20–0.60
Step 2	.03*			
Constant		-0.07	0.09	-0.24–0.10
Age		-0.00	0.01	-0.02–0.01
Sex		-0.01	0.04	-0.09–0.07
Dieting motivation		-0.11	0.08	-0.26–0.04
Depressive symptoms		0.15	0.20	-0.24–0.55
Dieting motivation × depressive symptoms		0.32*	0.16	0.00–0.64

Note. The dieting motivation scale ranged from 1 to 5. The variable depressive symptoms was dummy-coded (0 = healthy group; 1 = group with complaints). For simple slope analysis of the motivation effect the present model was re-run after recoding depressive symptoms as 0 = group with complaints, 1 = healthy group).
*$p < .05$

Adding the predictors involving emotional eating did not lead to problems with collinearity, with all VIFs < 1.59 in model 3.

DISCUSSION

The goal of the current study was to test the interactive effect of depressive symptoms and dieting motivation on BMI change. Some evidence in support of this hypothesis was found. Specifically, when the predictor depressive symptoms was dichotomized, the hypothesized interaction was observed, whereas there was no evidence for this interactive effect when the factor depressive symptoms was entered as a continuous predictor. This suggests that the effect of dieting motivation on BMI change does not change gradually and linearly with increasing depressive symptoms. For participants without depressive symptoms, dieting motivation was related to weight loss, whereas for participants with depressive symptoms, dieting motivation was related to weight gain.

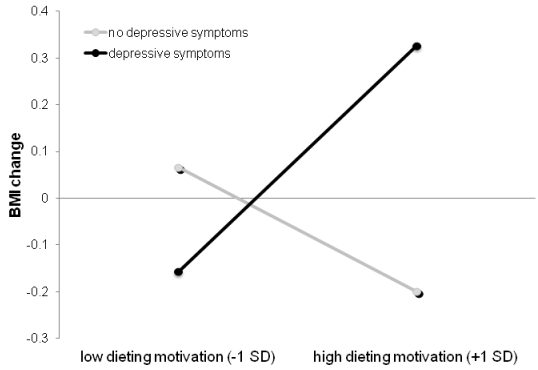

FIGURE 1. BMI change as a function of dieting motivation and depressive symptoms.

One proposed mechanism by which depressive symptoms may interfere with weight loss could be that these depressive symptoms take up cognitive resources that were directed at controlling eating behavior. Experimental studies in which a high cognitive load (Ward & Mann, 2000) and distraction (Boon, Stroebe, Schut, & Ijntema, 2002) were found to lead to increased consumption specifically in restrained eaters, provide some evidence in support of this possibility. Moreover, impaired executive cognitive functioning is associated with obesity-related behavior such as the intake of high-fat food (Riggs, Spruijt-Metz, Chou, & Pentz, 2012), and a lack of response inhibition is associated with decreased treatment success in obese children (Nederkoorn, Jansen, Mulkens, & Jansen, 2007). Crucially, on its turn, depression is also associated with deficient cognitive functioning (Murrough, Iacoviello, Neumeister, Charney, & Iosifescu, 2011). Thus, the missing step is to show that the moderating effect of depressive symptoms on the motivation-weight change association is mediated by impaired executive functioning.

Though participants with depressive symptoms overall scored higher on emotional eating, emotional eating was not predictive of BMI change and did not moderate effects of dieting motivation or depressive symptoms on BMI change. The finding that participants with depressive symptoms scored higher on emotional eating is in line with the finding that a negative mood induction leads to higher levels of self-perceived emotional eating (Bekker, Van de Meerendonk, & Mollerus, 2004). However, as no evidence for a relation-

ship between emotional eating, either as a main effect or in interaction with depressive symptoms or dieting motivation, and weight change was found, emotional eating does not seem to be a determinant of actual weight change (for a similar argument regarding external eating see Jansen et al., 2011).

So, though emotions (i.e., depressive symptoms) are of relevance in predicting weight change, and therefore likely eating behavior, it seems that a self-report measure of emotional eating does not actually reflect eating behavior in response to emotions. This argument was convincingly made by Adriaanse, de Ridder, and Evers (2011). They showed that self-reported emotional eating as assessed by the DEBQ emotional eating scale did not predict snacking behavior. In addition, they found that emotional eating was related to personal concerns about eating. Adriaanse and colleagues concluded that self-reported emotional eating does not really reflect the tendency to eat when emotional, but rather beliefs people may have about the relation between emotions and eating.

Relevant in this discussion as well is that there is also considerable evidence for a relationship between depression and obesity (Blaine, 2008; Luppino et al., 2010), albeit not for a simple one. A recent prospective study showed that the association is bidirectional (Pan et al., 2012). In addition, several potential moderating factors have been identified, which include: gender, binge eating disorder status, social economic status, genotype, severity of depression and obesity, and adverse childhood experiences (Faith, Matz, & Jorge, 2002; Stunkard, Faith, & Allison, 2003). As depressive symptoms constitute a risk factor for obesity (e.g., Pan et al., 2012) and seem to frustrate dieting attempts, as shown in the current study, it seems important to take depressive symptoms into consideration in treatments for overweight and obesity. It has for example been reported that participants with greater increases in depressive symptoms in the year preceding weight gain were less able to recover from relapse (Phelan, Hill, Lang, Dibello, & Wing, 2003). In addition, the dropout rate in a very-low-calorie-diet trial was larger with increasing levels of depressive symptoms (Clark, Niaura, King, & Pera, 1996). Interestingly, adding cognitive therapy in the treatment of obesity did not only prevent relapse in a sample of overweight participants, but it was also shown to be specifically effective for a subsample of participants with depressive symptoms (Werrij et al., 2009).

It should be noted that a limitation of the current study is that the objective pre-measurement of BMI preceded the administration of

the questionnaire on eating and mood. So, we cannot exclude the possibility that any weight change that took place between the BMI pre-measurement and questionnaire administration affected the answers on the questionnaire and the BMI post-measurement. We chose to base our analyses on the objectively measured BMI instead of the self-reported BMI that was also obtained in the questionnaire, because of the unreliability of self-reported weight (Gorber, Tremblay, Moher, & Gorber, 2007), which is especially true for overweight and obese people (Keith, Fontaine, Pajewski, Mehta, & Allison, 2011; Nyholm et al., 2007). Though self-reported BMI on the questionnaire and the objective BMI pre-measurement correlated highly in the current study ($r = .95$, $p < .0001$), the objective BMI pre-measurement was 0.6 BMI-points higher than the self-reported BMI that was obtained half a year later. In addition it should be noted that the results were obtained in a predominantly female sample, which was recruited in a hospital. It remains for further research to study whether these findings generalize to other samples.

In sum, the results of the current study suggest that dieting motivation is related to weight loss in the absence of depressive symptoms, whereas it is related to weight gain in the presence of depressive symptoms. It is suggested that this moderating effect of depressive symptoms may be mediated by executive cognitive functioning, but this hypothesis awaits further research. The current results do underline the importance of taking into account depressive symptoms in weight loss treatments.

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