The association between depression and eating styles in four European countries: The MooDFOOD prevention study

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ABSTRACT

Objective: Depression, one of the most prevalent and disabling disorders in Europe, is thought to be associated with unhealthy eating styles. As prevalence of depression and eating styles potentially differ across Europe, the current study aimed to investigate in a large, European sample, the associations of history of major depressive disorder and depression severity with unhealthy eating styles.
Methods: Baseline data of the MooDFOOD prevention study was used. The current analysis included 990 participants of four European countries (The Netherlands, United Kingdom, Germany, Spain). Analyses of Covariance and linear regression analyses were performed with depression history or depression severity as determinants, and emotional, uncontrolled, and cognitive restrained eating (Three Factor Eating Questionnaire Revised, 18 item) as outcomes.
Results: Depression history and severity were associated with more emotional and uncontrolled eating and with less cognitive restrained eating. Mood, somatic, and cognitive symptom clusters were also associated with more emotional and uncontrolled eating, and with less cognitive restrained eating. The somatic depressive symptoms "increased appetite" and "increased weight" were more strongly associated to unhealthy eating styles compared to other symptoms. No differences in associations between depression and unhealthy eating were found between European countries.
Conclusion: Our results suggest that depression is related to more unhealthy eating styles. Diminishing unhealthy eating styles in subthreshold depressed persons could potentially reduce adverse health consequences like weight gain, unhealthy dietary patterns and weight-related diseases. It is also possible that interventions that decrease depressive symptoms can lead to a decrease in unhealthy eating styles.

1. Introduction

Depression is one of the most prevalent and disabling disorders in Europe, with lifetime prevalence's between 9.9% and 21.0% [1]. The World Health Organization (WHO) global burden of disease study (2013) indicated that depressive disorders carry the heaviest burden of all mental disorders [2]. Obesity is another major global challenge, with over 50% of the European citizens is classified as being overweight, and over 15% as having obesity in 2014 [3]. These two challenges are not independent, depression and obesity have been consistently associated

[4]. Extensive research suggest a bidirectional link between psychological health and a high body mass index, with depression associated with an 58% increased odds of being obese over ≥ 10 years [4]. The relationship between depression and unhealthy lifestyle factors contributing to obesity, such as poor diet, physical inactivity, smoking, and insufficient sleep, has received considerable attention [5,6]. Recent findings in mainly European samples indicate that depression might also be related to unhealthy eating styles as another unhealthy lifestyle factor [7–15].

Three major unhealthy eating styles (emotional eating, external/

uncontrolled eating, and restrained eating), with three corresponding theories, have been proposed in the literature. Emotional eating is based on the psychosomatic theory, which assumes that some people are unable to distinguish hunger from other bodily arousal (e.g. emotions) [16]. External/uncontrolled eating is based on the externality theory, which suggests that exposure to attractive food and food-related external stimuli triggers uncontrolled or external eating [17]. Restrained eating is based on the restraint theory, which assumes some individuals to be chronic dieters, who constantly try to cognitively regulate their eating. However, at some point this control might break down due to "emotional turmoil", and they start to overeat again [18]. This process is called restrained eating.

Previous studies have shown associations between high depressive symptoms and more unhealthy eating styles [7–15]. The majority of previous studies have examined the association between depression and eating styles by assessing depressive symptomatology using self-report depression scales, although establishing major depressive disorder with formal psychiatric diagnostic criteria in a clinical interview is the "gold standard" [19,20]. Another important yet little studied aspect in this research area is the role of specific characteristics of depression, such as symptom clusters and profiles, in eating styles. Previous studies treated depression as a homogeneous entity, while depression is now known to be phenotypically and biologically heterogeneous [21–24]. Specifically, the symptom profile of depression with atypical, neuro-vegetative features is characterized by increased appetite [25,26], a heightened risk of obesity [23] and subsequent weight gain [27]. Hence, it could be expected that these specific somatic, neuro-vegetative symptoms of depression (e.g. increased appetite, weight gain, leaden paralysis) would have differential and stronger associations with unfavorable eating styles than other symptoms of depression. This has however so far not properly been investigated.

The existing body of research on associations between depressive symptoms and eating styles has focused on these relationships within single regions or nations, while culture is one of the main factors influencing food and meals [28–30]. While these studies indicate the depression - eating styles associations to be present in multiple countries, differences in inclusion criteria for participants, questionnaires used and covariates added make direct comparisons of these countries difficult. Only one study used two European countries to evaluate depression-eating styles associations [31], finding similar associations between higher depressive symptoms and more emotional eating in Danish and Spanish participants. However, participants in this study showed almost no depressive symptoms, and there were differences between the Danish and Spanish samples ("… evidence of fundamental differences in response tendencies…" p. 501), making comparisons difficult. No other studies investigated depression-eating styles association in multiple European countries simultaneously.

In a previous large scale study in Dutch patients with depressive disorder and healthy controls, we were the first to thoroughly examine associations between depression in its full clinical heterogeneity and unhealthy eating styles [32]. Associations were found between higher depression severity and higher levels of unhealthy eating styles. In addition, we found specific somatic depressive symptoms, associated with depression with atypical features, to be more strongly related to unhealthy eating styles as compared to mood symptoms associated with depression with melancholic features. Given potential differences in depression rates across Europe, for the current study our first research question was whether in a large four-country, European sample with subclinical depressive symptoms, history of major depressive disorder (MDD) and depression severity were associated with unhealthy eating styles. Our second research question was whether in four different European countries: The Netherlands, United Kingdom, Germany and Spain, associations between depression and eating styles were generalizable, or whether any cultural differences existed. Our third research question was whether specific symptom patterns associated to the different depressive subtypes were associated with unhealthy eating

styles. For this, associations of depression symptom clusters and individual symptoms with eating styles were examined.

2. Method

2.1. Study sample

Baseline data of the MooDFOOD (Multi-country cOllaborative project on the role of Diet, Food-related behavior, and Obesity in the prevention of Depression) prevention study were used. The MooDFOOD prevention study is a randomized controlled trial (RCT), and its primary objective is to examine the feasibility and effectiveness of two different nutritional strategies to prevent a new episode of MDD in high-risk overweight persons with subsyndromal symptoms of depression. A detailed description of the MooDFOOD study design can be found elsewhere [33]. This prevention trial recruited a total of 1025 subjects in four different European countries (Germany, Spain, The Netherlands and United Kingdom). Participants were recruited via diverse strategies, including websites; local advertisements in social media and newspapers; mailings to registered subjects in the general practice setting or in other registers (e.g. city registers); and MooDFOOD brochures and posters in public areas. Participants were recruited in both urban and rural municipalities. Inclusion criteria were being aged 18 to 75 years old, being overweight or obese (body mass index (BMI) between 25 and 40 kg/m^2) and reporting subsyndromal symptoms of depression as operationalized by the Patient Health Questionnaire (PHQ-9) score of at least 5 [34]. Exclusion criteria were an episode of major depressive disorder in the past 6 months (according to psychiatric DSM-IV criteria), as determined in the structured MINI International Neuropsychiatric Interview 5.0 (MINI 5.0 [35]); use of antidepressant drugs or psychological interventions in the past 6 months; current eating disorder; history of psychosis, bipolar disorder, substance dependence or other severe, psychiatric disorder that requires specialized clinical attention; history of or planned bariatric surgery; currently pregnant or breastfeeding; current severe, life-threatening physical disease; severe cognitive impairment sufficient to limit the conduct of the study as assessed through research staff evaluation of participant's ability to complete the screening instruments in an adequate manner; current adherence to supervised behavioral interventions or using specific dietary supplements that are competing with the MooDFOOD prevention trial multi-nutrient intervention. The research protocol was approved by the Ethical Committees of the contributing countries and all participants provided written informed consent. Between September 2015 and October 2016, all participants underwent a baseline assessment containing an extended face-to-face interview conducted by a trained research assistant, which included a standardized diagnostic psychiatric interview (MINI 5.0 [35]), blood sampling and self-report questionnaires. After excluding those with missing data on the eating styles questionnaire (n = 35) the final sample consisted of 990 subjects.

2.2. Depression measurements

At baseline, presence of a lifetime history of major depressive disorder was established using the MINI 5.0 [35]. All participants were classified as either not having or having a lifetime diagnosis of major depressive disorder, thereby composing the variable "depression history yes/no".

Severity of depressive symptoms in the past week was assessed with the 30-item Inventory of Depressive Symptomatology - Self Report (IDS-SR, range 0–84; [36]). Items were scored from 0 ("no problems") to 3 ("severe problems"), and a sum score was computed. In order to further improve clinical interpretability, individual symptoms were categorized into symptom clusters, as done in earlier studies [37–39]. Three symptom clusters were made: mood symptoms (10 items, range 0–30), somatic symptoms (16 items, range 0–48) and cognitive symptoms (4 items, range 0–12; see Supplementary Table 1 for an overview). For

each cluster, a sum score was created. Furthermore, presence of individual depressive symptoms was assessed. In line with previous studies, symptoms were recoded into dichotomous variables, with a score of 0 or 1 indicating the symptom was not present, and a score of 2 or 3 indicating presence of the symptom [39,40]. The separate items weight loss and weight gain were recoded into a single three-category variable: no change (score of 0 or 1 on both variables), decreased weight (score of 2 or 3 on weight loss), or increased weight (score of 2 or 3 on weight gain). Increased appetite and decreased appetite were recoded accordingly. The item asking about diurnal variation was recoded to distinguish those with worse mood in the morning from those with no diurnal variation or no worse mood in the morning.

2.3. Eating styles measurement

The three unhealthy eating style scales of the shortened and revised 18-item Three Factor Eating Questionnaire (TFEQ-R18) [41] were used to assess emotional, uncontrolled and restrained eating. The TFEQ-R18 was developed on the basis of factor analyses of the original 51-item TFEQ [42] in a large sample of obese subjects [41], and has also been found to be applicable to the general population [43]. The emotional eating scale consists of three items, e.g., "When I feel blue I often overeat", the uncontrolled eating scale includes nine items, e.g. "I am always hungry enough to eat at any time", and the cognitive restrained eating scale consists of six items, e.g., "I consciously hold back at meals in order not to gain weight". Thirteen of the items are rated on a four-point scale from 1, does not describe me at all, to 4, describes me exactly, four have other 4-point scale answers and one question is measured on an 8-point scale (from 1, no restraint in eating, to 8, total restraint). As was done earlier [43], raw scale scores are transformed to a 0–100 scale (((raw score − lowest possible raw score) / possible raw score range)) ∗ 100). The Cronbach's alphas for the current study were 0.82, 0.89 and 0.73 for emotional eating, uncontrolled eating, and cognitive restrained eating, respectively.

2.4. Sociodemographic and health variables

Age, sex and level of education were assessed during the baseline interview. Educational level was recoded into a three-item variable indicating lower education (from 'no studies but able to read and write' to "lower secondary education"), middle education (from "upper secondary education" to "short-cycle tertiary education") and higher education (from "bachelor's or equivalent level" to "doctoral of equivalent level"). Body weight and body height were measured by a trained research assistant. BMI was calculated as weight kilograms divided by height squared in meters (kg/m^2).

2.5. Statistical analyses

First, sample characteristics per European country were described as means and standard deviations, or percentages. Before starting the main analyses, it was examined whether there was an interaction effect of country for the association between depression and unhealthy eating. This was done by adding interaction terms of country*depression severity into the analyses between depression severity and eating styles in models adjusted for sociodemographic variables. In case interactions were observed, analyses were subsequently stratified by country. The same was done for interaction with gender. It was also checked whether there was collinearity between depression history and depression severity by calculating the Variance Inflation Factor (VIF) value and the Pearson correlation coefficient. All subsequent analyses were adjusted for age, gender and educational level. Linear regression analyses were performed with history of major depressive disorder (depression history) or depression severity as determinants, and the three eating styles as outcome variables. This analysis was thereafter repeated with depression history and severity together included as determinants, to

study which depression characteristic was strongest associated with the eating styles. To check whether associations between depression and eating styles were independent of BMI, in an extra model, an extra adjustment for BMI was made. Hereafter, linear regression analyses were also used with specific depressive symptom clusters entered separately as determinants and eating styles as outcome, with the depression symptom clusters being standardized before entered into the analyses. To investigate to what extent specific depressive symptoms were associated with eating styles, linear regression analyses were performed for all depressive symptoms separately. We corrected for multiple testing with use of the modified False Discovery Rate Benjamini and Yekutieli (FDR B−Y) method [44]. These analyses were corrected for overall depression severity, to study the pure associations of the single depressive symptoms on top of the association of depression severity, rather than studying individual symptoms without correction that would reflect a combination of that particular symptom and overall depression severity.

Analyses were conducted using SPSS version 22.0 (IBM Corp., Armonk, NY, USA). A *p*-value of 0.05 was considered statistically significant.

3. Results

3.1. Descriptives

Participant's mean age was 46.6 years (SD = 13.0) and participants in Germany and Spain were on average younger than those in The Netherlands and the United Kingdom (UK) (Table 1). The participant sample from Spain contained the fewest females, and had the most participants with low educational levels. BMI levels of the four countries were similar, with the average BMI of the total sample 31.4 kg/m2 (SD = 4.0). The highest smoking levels, and lowest alcohol use levels were found in Germany and Spain. The highest levels of lifetime depression diagnosis were found in the UK, and the average depression severity of the total sample indicated mild depressive symptoms (IDS-SR mean = 21.7 (SD = 10.1)). Scores on emotional eating were highest in Spain and the UK (mean = 3.0), highest scores on uncontrolled eating were found in Spain (mean = 2.70) and for restrained eating in The Netherlands (mean = 2.5).

3.2. History of depression, severity of depression and eating styles

We found no significant effects of country on the relationship between depression severity and eating styles (*p*-values ranged from 0.37 to 0.94), indicating similar associations between depression and unhealthy eating styles across the European countries. Therefore all subsequent analyses were not stratified by country. For depression history, no interactions with gender were found for emotional, uncontrolled and cognitive restrained eating (*p*-values. 39, 0.86 and 0.44 respectively). For depression severity, no interactions with gender were found for emotional and uncontrolled eating (p-values 0.88 and 0.31 respectively). A significant interaction was only found for cognitive restrained eating (β = −0.05, *p* = .01), suggesting that this association is different for males and females. When we stratified this analysis for gender, associations of depressive symptoms with cognitive restrained eating were only significant in the female group (β = −0.17, *p* < .001), but not within the male group (β = −0.08, *p* = .94). No evidence of collinearity between depression history and severity was found, indicated by Pearson correlation of 0.14 and VIF value of 1.021. Participants with a history of major depressive disorder showed higher levels of emotional and uncontrolled eating, and lower levels of cognitive restrained eating as compared to those without a lifetime diagnosis (Table 2). Participants with higher depressive symptoms showed higher levels of emotional and uncontrolled eating. Those with higher depressive symptoms also had lower levels of cognitive restrained eating (Table 2). Additional adjustment for BMI did not modify this

Table 1
Baseline characteristics of participants of the MooDFOOD prevention trial (N = 990).

	Germany (n = 276)	Spain (n = 241)	The Netherlands (n = 234)	United Kingdom (n = 239)	Total group (N = 990)
Demographics					
Age (mean, sd)	43.5 (13.8)	42.7 (12.3)	50.1 (11.3)	50.3 (12.4)	46.6 (13.0)
Gender (%, female)	75.7	68.6	76.6	79.3	75.2
Level of education					
Lower education (%)	3.2	22.2	12.0	3.5	10.0
Middle education (%)	67.5	42.5	35.1	46.9	48.6
Higher education (%)	29.2	35.3	52.9	49.6	41.0
Lifestyle					
BMI (mean, sd)	31.1 (3.9)	32.4 (4.1)	31.4 (4.1)	30.7 (3.8)	31.4 (4.0)
Smoking (%, yes)	22.8	21.4	15.9	11.2	18.0
Alcohol use (drinks/week) (median, IQR)	2.6 (4.2)	2.2 (3.5)	4.7 (6.1)	4.6 (6.2)	3.5 (5.2)
Psychiatric characteristics					
History of depression (%, yes)	22.5	27.8	31.4	53.9	33.5
Severity of depressive symptoms (mean, sd)	20.3 (9.9)	26.2 (11.1)	18.7 (8.8)	22.1 (8.9)	21.7 (10.1)
Mood symptom cluster (mean, sd)	6.7 (4.6)	9.7 (5.2)	6.2 (4.4)	7.5 (4.4)	7.5 (4.9)
Somatic symptom cluster (mean, sd)	10.8 (5.0)	13.1 (5.2)	10.2 (4.3)	11.9 (4.4)	11.5 (4.9)
Cognitive symptom cluster (mean, sd)	2.7 (1.9)	3.3 (2.3)	2.3 (1.9)	2.7 (1.9)	2.8 (2.0)
Psychological eating styles					
Emotional eating (mean, sd)	40.8 (29.4)	67.3 (28.5)	55.1 (28.5)	65.7 (27.1)	56.6 (30.4)
Uncontrolled eating (mean, sd)	42.7 (22.1)	57.3 (24.7)	49.7 (22.7)	51.3 (22.0)	49.9 (23.4)
Cognitive restraint (mean, sd)	36.8 (20.2)	42.3 (20.5)	50.9 (17.3)	20.2 (17.7)	42.3 (19.7)
IQR = inter quartile range					

Table 2
Multiple linear regression analyses on the associations between depression characteristics separately in univariable models and together in a multivariate model and eating styles (N = 990).

	Emotional eating		Uncontrolled eating		Cognitive restraint	
	β	*p*-value	β	*p*-value	β	*p*-value
Depression history[a]	0.13	< .001	0.08	< .01	−0.08	.01
Depression severity[b]	0.38	< .001	0.31	< .001	−0.13[c]	< .001
Depression history[a]	0.08	< .01	0.03	.25	−0.06	.05
Depression severity[b]	0.36	< .001	0.30	< .001	−0.12	< .001

All analyses adjusted for age, gender and education.

[a] Having a history of major depressive disorder (yes/no).

[b] Severity of depressive symptoms as measured with the IDS questionnaire total score.

[c] Due to a significant interaction between gender * depressive symptoms for this outcome, we stratified this analysis for gender. Associations of depressive symptoms with cognitive restrained were only significant in the female group (β = −0.17, *p* < .001), but not within the male group (β = −0.08, *p* = .94).

pattern of results, history of depression was still associated to emotional (β = 0.14, *p* < .001), uncontrolled (β = 0.08, *p* < .01), and cognitive restrained eating (β = −0.08, *p* < .001), as was depression severity (emotional eating: β = 0.35, *p* < .001, uncontrolled eating: β = 0.30, *p* < .001, cognitive restrained eating: β = −0.12, *p* < .001). When studying associations between depressive symptoms and cognitive restrained eating separately for males and females, associations were only

significant in the female group (β = −0.17, *p* < .001), but not within the male group (β = −0.08, *p* = .94). When combining both history and severity of depression in a single model, the associations of depression severity with all three unhealthy eating styles remained significant. However, the associations of history of depression with both uncontrolled eating and cognitive restrained eating were no longer significant, suggesting that depression severity may be relatively more important as compared to depression history in the association with these eating styles. Extra adjustment for BMI did not change the associations between history and severity of depression and emotional (*p*-values < .01 and < .001 respectively), uncontrolled (*p*-values .17 and < .001 respectively) and cognitive restrained eating (*p*-values .05 and < .001 respectively). Mood, somatic and cognitive symptom clusters entered separately to the analyses showed positive associations with emotional and uncontrolled eating, and negative associations with cognitive restrained eating (Fig. 1).

3.3. Individual depressive symptoms and eating styles

After correction for multiple testing, in addition to the effect of depression severity, five individual depressive symptoms were relatively less strongly associated to emotional eating, while one was more strongly related (Fig. 2; Supplementary Table 2). On top of the association of depression severity, the somaticsymptoms "increase in appetite" and "increase in weight" were more strongly associated to emotional eating, while somatic symptom "other bodily symptoms" was associated less strongly. The somatic symptoms "increase in appetite" and "increase in weight" also showed to be more strongly related to uncontrolled eating, while somatic symptom "decrease in appetite" and mood symptom "diminished quality of mood" were related to
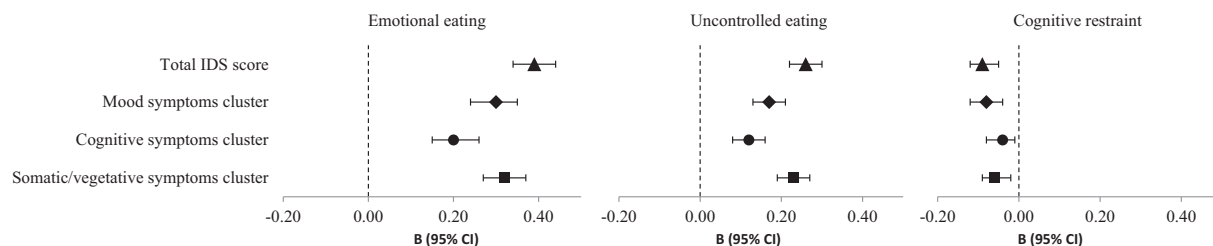

Fig. 1. Multiple linear regression analyses with standardized depression severity and symptom clusters as determinants and eating styles as outcome variables (N = 990).
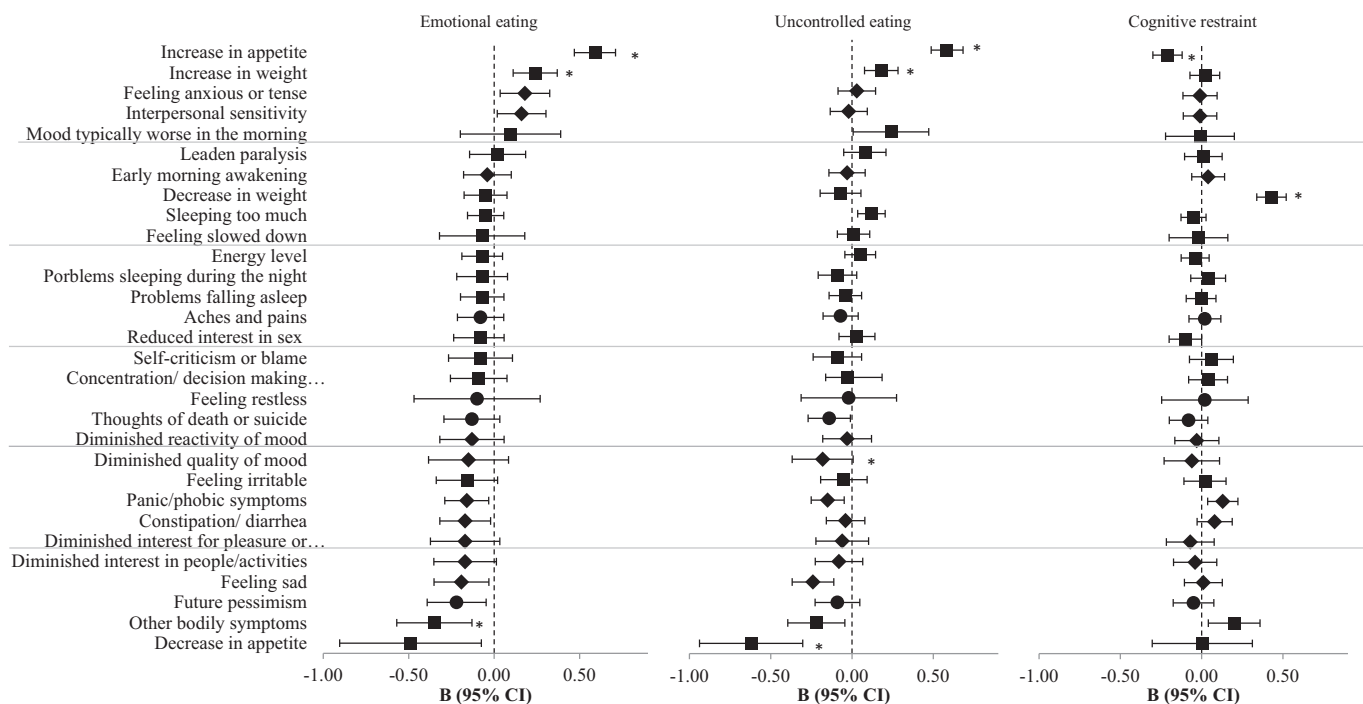
Fig. 2. Multiple linear regression with depressive symptoms as determinant and eating style as outcome variable, with correction for depression severity (IDS score) (N = 955).

uncontrolled eating relatively less (Fig. 2; Supplementary Table 2). Finally, for cognitive restrained eating, "increase in appetite" was relatively less strongly associated, while somatic symptom "decrease in weight" was more strongly related (Fig. 2; Supplementary Table 2).

4. Discussion

This study showed that in a sample of participants with subsyndromal depressive syptoms, persons with a history of major depressive disorder (MDD) have higher levels of emotional and uncontrolled eating, and lower levels of cognitive restrained eating as compared to those without a former depression diagnosis. Increasing severity of depressive symptoms was associated with more emotional and uncontrolled eating, while those with higher depressive symptoms showed less cognitive restrained eating. Associations in the same directions were found between mood, somatic and cognitive depressive symptom clusters and eating styles. The associations were comparable and not significantly different across the four European countries, although the countries differed in history and severity of depression and in level of eating styles. When depression severity and history of depression were considered together, depression severity, but not history of depression was independently related to uncontrolled eating and cognitive restrained eating, suggesting that the current presence of depressive symptoms is more important for these styles.

Our findings that both history and severity of depression were associated with higher levels of emotional and uncontrolled eating are in line with previous research [7–14,32]. Results also show that, even in participants with subsyndromal depressive symptoms, eating styles are more unhealthy as compared to the general population [43,45]. It can however not completely be ruled out that participants who are willing to take part in an RCT on food intake and food related behavior already experience more disordered eating. Earlier literature has suggested several mechanisms that could explain why depression and emotional and uncontrolled eating are associated. A study in adolescents suggested a possible role for decreased serotonin, as adolescents with depressive symptoms showed more increase in emotional eating if they carried the 5-HTTLPR genotype that results in lower serotonin activity [46]. However, the authors could not replicate this finding in a more

recent study in adults [13]. Psychological factors like difficulties identifying feelings (alexithymia), impulsivity, and alleviation of, or distraction from, negative emotional states, have also been proposed as mechanisms that underlie the associations between depression and eating styles [9,47,48].

Interestingly, as opposed to earlier studies that found positive [12–14] or non-significant [7,15,32] associations between depression and cognitive restrained eating, we found depression to be associated with lower levels of cognitive restrained eating (irrespective of BMI), only in females. In the literature on cognitive restrained eating, there has been much debate about the implications of having high versus low levels of restrained eating. Recent reviews conclude that cognitive restrained eating cannot be classified as entirely healthy or unhealthy [49,50]. In persons suffering from obesity, high cognitive restrained eating may promote health, as it can be an indication of an attempt to control overeating. Because our sample consists of persons with overweight/obesity, the current finding that those who suffer from high depressive symptoms or have a history of depression experience less cognitive restrained eating, could indicate a negative health effect of depression in those who already suffer from overweight or obesity. Four of the previous studies that found positive or no associations between depression and cognitive restrained eating used non-obese samples [7,13,14,32], making comparisons difficult as the current study uses an overweight/obese sample. Two studies were more comparable to our sample because the sample's mean BMI was above 30 [12,15]. However, in contrast to our finding, a positive [12] and no association [15] with restrained eating were observed in these studies. As in both earlier studies participants displayed only minimal depressive symptoms, which is different from our study, this could potentially explain the different findings with restrained eating.

As expected, the current study confirms our earlier findings that depression should not only be used as one homogeneous variable when investigating eating behavior [32]. No other studies have investigated associations between single depressive symptoms and eating styles, and therefore the current results can only be compared with our earlier research. We previously found symptoms associated with depression with atypical features to be more strongly related to unhealthy eating styles as compared to symptoms belonging to depression with

melancholic features. The current findings partly support this result in samples from four countries, although we find overall less significant associations between single depressive symptoms and eating styles as compared to our earlier findings [32]. We confirm that the somatic depressive symptoms "increase in appetite" and "increase in weight", associated with depression with atypical features, were more strongly related to emotional and uncontrolled eating, while "decrease in appetite" (for uncontrolled eating) was associated relatively less strong. The somatic symptom "decrease in weight" showed to be more strongly associated with cognitive restrained eating, while "increase in appetite" was of relative less importance. As opposed to our previous study, almost no significant associations were found between specific mood symptoms, associated to depression with melancholic features, and eating styles. The differences between the current and earlier study might be due to differences in samples, as the participants in the previous study had a broader BMI range, from underweight to obesity, with a mean BMI of 26.5. Also, we previously included a less uniform group with respect to mental health status, with both healthy controls without current symptoms or history of depression and people suffering from a current severe depression.

Our results suggest that eating styles could be a target in the prevention of depression, specifically in persons with symptoms associated to depression with atypical features. By teaching persons at risk for depression better emotion regulation skills, unhealthy eating styles can possibly be diminished. This could subsequently not only help to prevent depression, but also reduce adverse health consequences like further weight gain, unhealthy dietary patterns and weight-related diseases. However, as only cross-sectional evidence is available for associations between depression and eating styles, it is also possible that interventions that decrease depressive symptoms can lead to a decrease in unhealthy eating styles. While previous studies already showed that different kind of treatments (e.g. mindfulness based treatment, acceptance and commitment therapy, behavioral therapy) can be successful in changing eating styles, no consistent pattern has emerged. A total of 7 intervention studies reported a significant decrease in emotional eating [51–57] while 5 did not find significant effects [58–62]. For, uncontrolled eating, significant decreases were found in 3 studies [54,55,60], but not in 5 others [51,52,58,59,61]. Finally, 3 studies found significant increases in cognitive restrained eating [52,54,58], while one did not find a significant effect [55]. Overall, as findings of different studies are contradictory, and as sample sizes are small (only two studies with sample sizes above 100 [56,58] and one above 200 [54]), uncertainty remains. Continued efforts need to focus on developing treatment strategies that have a sizable impact on unhealthy eating styles.

There are known differences between European countries in, among others, the prevalence of eating disorders like anorexia and bulimia nervosa [63,64], and healthy and unhealthy eating habits like eating fruits and vegetables and snacking in front of the television [65,66]. Also, different European countries perceive and treat depressive disorders differently [67]. Despite these suggested differences in eating behavior and depression, our results suggest that the associations between depression and eating styles are consistent across the four included countries in this study. This consistency is in accordance with results from another study including Danish and Spanish samples [31], although in this study the similarities in the association between the two countries were not statistically tested. To our knowledge, there are no other studies directly comparing the relationship between depression and eating styles in two or more countries.

The current study has important strengths. It presents novel findings showing that in four European countries, depression is consistently associated with unhealthy eating styles. Also, body weight and body height were measured in each participant, which provides more accurate information than self-reported methods. However, this study has several limitations, most notably the reliance on cross-sectional data. Although it is likely that more severe depressive symptoms lead to more

unhealthy eating, it is also possible that especially emotional eating leads to negative emotions, as discussed in emotion-regulation theories [68], or that both are related to a third common factor such as experience of elevated stress. Additionally, the current study was carried out with baseline data of a specific population of European citizens with a high BMI and subsyndromal depressive symptoms that took part in a RCT that studied prevention of depression. Therefore, it is difficult to extrapolate the results to other population groups. However, we previously showed in a Dutch observational cohort study that associations between depression and eating styles were also present in normal weight individuals [32], suggesting that the current results are not specific for persons with a high BMI. Moreover, since the different countries in this study used diverse types of recruitment strategies, this could have caused the countries' samples to differ from each other. However as we adjusted for some potential confounding factors, we made an effort to minimize the potential confounding effects of different samples included across the four countries, and associations appear to be similar across countries. It should also be noted that depressive symptoms "increase in appetite" and "decrease in appetite" and eating styles are related constructs and because of criteria contamination therefore stronger relationships could be expected. However associations between depression severity and eating styles are still significant when excluding the appetite symptoms from the sum score ($\beta = 0.35$, $p < .001$ for associations between severity and emotional eating, adjusted for sociodemographic variables, $\beta = 0.29$, $p < .001$ for uncontrolled eating and $\beta = -0.13$, $p < .001$ for cognitive restrained eating), indicating that associations between depression and eating styles are significant independently of the appetite symptoms. Moreover, it cannot be completely ruled out that change in appetite (and also in weight) are due to an underlying eating disorder instead of occurring in the context of depression. As depression and eating disorders like binge eating disorder are related [69–71], more research taking both into account simultaneously is needed to draw firm conclusions. Furthermore, no information on experience of social stigma was available, while studies suggest strong associations between stigma and both depression [72] and obesity [73]. Finally, the use of a self-report questionnaire to measure eating styles heightens the risk of underreporting due to social desirability or unawareness of one behavior.

To conclude, this study showed that in a large, European sample, both history of depression diagnosis as well as depression severity are associated with higher levels of emotional and uncontrolled eating, and lower levels of cognitive restrained eating. These associations were similar across the four European countries, Germany, Spain, The Netherlands and United Kingdom. It was confirmed that somatic symptoms, associated with depression with atypical features, were more strongly associated to unhealthy eating styles. Our results suggest that unhealthy eating styles may be a possible target for interventions for the prevention of depression, in particular in persons with more atypical depressive symptoms. Given the high and increasing rates of depression in Europe, there is an urgent need to replicate the current findings and to unravel causal pathways between depression and its negative health consequences.

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Competing interest

The authors declare that they have no competing interests.

Declarations of interest

None.

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