Introduction

Increasing intake of energy-dense foods may be partly responsible for the growing prevalence of adult obesity (Hill & Peters, 1998). It is important to examine the relations between eating styles and daily energy intake, since different eating styles may lead to different patterns of energy intake. Three different styles of eating behaviour can be distinguished: restrained, emotional and external eating (Van Strien, Frijters, Van Staveren, & De Fares, 1986). Restrained eating (i.e., dieting) refers to the deliberate restriction of energy intake with the intent to decrease or maintain weight. Emotional eating implies eating in response to emotional arousal, whereas loss of appetite would be the ‘natural’ response. External eating can be defined as eating in response to external food-related cues, such as the sight and smell of food, regardless of physical need.

The aim of the present study was to examine the relations between the three different eating styles and energy intake, whereas previous studies mainly focused on restrained eating. Furthermore, previous studies have never taken into account the mutual relations between the different eating styles, which is important since restrained eating is often related to emotional eating, and emotional and external eating are often related to each other as well (e.g., Van Strien, Schippers, & Cox, 1995).

As mentioned above, eating styles and energy intake have been studied primarily in relation to restrained eating. Wardle and Beales (1987) found that restrained eating was related to lower energy intake in daily life when restrained eaters were not forced to eat (as they are in a laboratory taste test). Further support for this relation was provided by studies using self-reports to measure energy intake outside the laboratory, showing that high levels of restrained eating were associated with lower energy intake, particularly with lower levels of fat and carbohydrate intake (De Castro, 1995; Laessle, Tuschl, Kotthaus, & Pirke, 1989; Van Strien et al., 1986; Wardle et al., 1992). Additionally, highly restrained eaters were found to avoid fat and therefore used more calorie-reduced products than unrestrained eaters (Tuschl, Laessle, Platte, & Pirke, 1990). In general, the findings of survey research showed that restrained eaters restrict their energy intake.

Only a few studies examined the relations between emotional and/or external eating and energy intake. Wardle et al. (1992) found that external eaters had a lower body weight but higher energy intake than restrained eaters. Emotional eating was not found to be related to energy intake. In addition, results from the Stanislas Family Study (using 3-day food consumption diaries) showed that higher external eating was associated with higher energy intake, whereas no relation was found between emotional eating and energy intake (Lluch, Herbeth, Mejean, & Siest, 2000).

In the present study, it was expected that restrained eating would have a negative relation with total energy intake, fat intake and carbohydrate intake. In contrast, high external eating was expected to be related to higher energy intake in general as well as higher fat and carbohydrate intake. Emotional eating was not expected to be related to energy intake.
Method

Participants and procedure

The sample consisted of 475 female students recruited at the Radboud University Nijmegen. Their mean age was 20.8 (SD = 3.2) and their mean body mass index (BMI = weight/length², calculated from self-reported heights and weights) was 21.7 (SD = 2.6). There were no further specific exclusion or inclusion criteria. In addition, the questionnaires were self-administered, with a research assistant present to answer possible queries.

Measures

Eating styles. The Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien et al., 1986) was used to assess different eating styles. This 33-item questionnaire contains three scales measuring restrained eating (10 items; e.g., Do you deliberately eat less in order not to become heavier?), emotional eating (13 items; e.g., Do you have the desire to eat when you are irritated?), and external eating (10 items; If food smells and looks good, do you eat more than usual?). Response categories ranged from 1 ‘never’ to 5 ‘very often’. The DEBQ has good internal reliability and good concurrent, construct, and predictive validity (Allison, 1995; Van Strien, 2005). Cronbach’s alphas of the DEBQ scales in this sample were .92, .89, and .76 for restrained, emotional and external eating, respectively.

Physical activity. Since energy intake may also be affected by physical activity (e.g., Stubbs, Johnstone, O’Reilly, & Poppitt, 1998), we controlled for individual differences in heavy physical activity by asking participants how many times a week they performed heavy, tiring physical activities (e.g., jogging) for at least 15 min.

Energy intake. To assess energy intake we used a Food Frequency Questionnaire (FFQ), in which the frequencies of consumption of 145 food items during 4 weeks were scored retrospectively. The instruction of the FFQ explicitly stated that the participants had to recall their intake of all items listed over the past 4 weeks, corresponding with 28 days. The FFQ is a method often used (see Bingham et al., 1994; Willett, 1998) for nutritional assessment in large epidemiological studies (e.g., Orton, Szabo, Clare-Salzler, & Norris, 2008; Sun, Ma, Campos, Hankinson, & Hu, 2007). Total energy intake (kcal) and total fat and carbohydrate intake were calculated using software designed especially for the questionnaire (Komeet 4.0, BaS Nutrition Software, The Netherlands). In validation studies the FFQ showed results similar to those of dietary history assessed by dieticians (Feunekes, Van Staveren, De Vries, Burema, & Hautvast, 1993), and it also showed good reproducibility (Feunekes, Van Staveren, Graveland, De Vos, & Burema, 1995; Willett et al., 1985).

Strategy for analyses

The relations between the eating styles and energy intake were examined with structural equation modelling (SEM) using Amos 5. SEM was used since it has several advantages over other statistical methods. That is, the use of unobserved (latent) variables with multiple indicators can reduce measurement error. In addition, it enables estimation of hypothesized pathway models with multiple dependent variables.

Restrained, emotional and external eating were treated as latent variables. Two parcels were used as indicators for each of the latent variables, because using the individual items as indicators would result in too many parameters to estimate regarding the sample size of the present study (Bandolos & Finney, 2001). Parcels are combinations of subsets of items underlying latent variables. The items were divided in two equal parts by splitting up items with equivalent factor loadings, resulting in parcels that represented the original factor structure of the latent variable. Scores on parcels were computed by summing the items of each part.

Two models were tested: (1) one model with total kilocaloric intake as dependent variable, and (2) one model with total fat and total carbohydrate intake as two separate dependent variables. In both models, self-reported BMI and physical activity were controlled for.

To evaluate the fit of the three models we used two recommended fit measures: the Comparative Fit Index (CFI) and the Root Mean Square Error of Approximation (RMSEA). For CFI, values between .90 and .95 indicate a good fit and values greater than .95 suggest very good fit. RMSEA assesses approximate fit, with values below .08 indicating an acceptable fit and values below .05 indicating a good fit (Kaplan, 2000). Chi-square values and their p-values are reported but are less suitable as indicators of model fit since they are extremely sensitive to sample size.

Results

Descriptive statistics

Means and standard deviations of all variables included in the models are shown in Table 1. Total daily kilocaloric, fat and carbohydrate consumption scores were computed by dividing the average score over one month by 28 days, since participants were explicitly asked in the instruction of the FFQ to recall their food intake over the past 4 weeks (corresponding with 28 days). In addition, Table 2 depicts the correlation matrix used as input for SEM analyses. In our sample, 6.0% (N = 28) of the female students were underweight (BMI < 18.5); 83.2% (N = 386) had a normal weight (18.5 < BMI < 25), and 9.5% (N = 44) were classified as being overweight (25 < BMI > 30), whereas 1.3% (N = 6) was classified as being obese. To determine these BMI categories, we used the international classification system as provided by the World Health Organization (WHO, 2000).

Structural equation modelling

To facilitate presentation, the standardised factor loadings of the latent variables ‘restrained eating’, ‘emotional eating’, and ‘external eating’ are not presented in the graphic representations of the models. The links between the parcels and the latent variables all

<table>
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<tr>
<th>Table 1</th>
<th>Means and standard deviations (SD) of the model variables.</th>
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<tr>
<td></td>
<td>Mean</td>
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<tr>
<td>BMI</td>
<td>21.74</td>
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<tr>
<td>Physical activity</td>
<td>1.94</td>
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<tr>
<td>Restrained eating</td>
<td>2.70</td>
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<tr>
<td>Emotional eating</td>
<td>2.66</td>
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<tr>
<td>External eating</td>
<td>3.07</td>
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<tr>
<td>Total kcal/day</td>
<td>2329.87</td>
</tr>
<tr>
<td>Total fat/day (grams)</td>
<td>97.72</td>
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<tr>
<td>Total carbohydrate/day (grams)</td>
<td>253.57</td>
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<tr>
<th>Table 2</th>
<th>Pearson correlations between all model variables.</th>
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<td>1</td>
<td>2</td>
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<tr>
<td>1. BMI</td>
<td>–</td>
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<tr>
<td>2. Physical activity</td>
<td>.02</td>
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<tr>
<td>3. Restrained eating</td>
<td>–</td>
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<tr>
<td>4. Emotional eating</td>
<td>.35</td>
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<tr>
<td>5. External eating</td>
<td>.05</td>
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<tr>
<td>6. Total kcal/day</td>
<td>.01</td>
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<tr>
<td>7. Total fat/day</td>
<td>.06</td>
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* p < .01.
Eating styles and total energy intake. Fig. 1 shows the paths with their standardised regression weights and the correlation between BMI and physical activity. The fit indices showed that the model fitted the data well; CFI was .98 and RMSEA was .06. The model explained 16% of the variance in total energy intake.

Eating styles and total fat and carbohydrate intake. Fig. 2 shows the paths with their standardised regression weights, and the correlations between BMI and physical activity and between total fat and total carbohydrate intake. The second model also fitted the data well; CFI was .98 and RMSEA was .06. The model explained 16% of the variance of total fat intake and 10% of the variance in total carbohydrate intake. The interrelations between the three eating styles are the same for Model 2, so they are not depicted in Fig. 2.

Discussion

One of the main findings was that restrained eating consistently had a negative relation with total energy intake, fat intake, and carbohydrate intake. The importance of our study is that these relations were found after controlling for emotional and external eating. As restrained eaters might also engage in emotional eating and binge eating behaviours (see Van Strien, Herman, Engels, Larsen, & Van Leeuwe, 2007), it is essential to test the unique effect of restrained eating on energy intake. In addition, there was a positive relation between physical activity and restrained eating indicating that restrained eaters are more physically active than unrestrained eaters.

When fat and carbohydrate intake were used as separate dependent variables, it was found that external eating was even more strongly related to fat intake than to carbohydrate intake. Additionally, external eating was found to be negatively related to physical activity. Although one would therefore expect external eating to be associated with a higher BMI, this was not the case in the present study (see also Snoek, Van Strien, Janssens, & Engels, 2007). Wardle et al. (1992) also found that external eaters had a lower body weight but a higher energy intake than restrained eaters. It is possible that there are metabolic differences between external and non-external eaters. Another possibility is that external eaters tend to overreport their energy intake due to the salience of the visual imagery of the food items in the questionnaires to them. Since it has been suggested that external eating is positively related to BMI in overweight and (latent) obese adults (Schachter & Rodin, 1974; Van Strien, Frijters, Roosen, Knuiman-Hijl, & Defares, 1985), it would be interesting to test our model separately for the

Footnotes:
1 In the present study no significant relations were found between BMI or physical activity and total energy intake. Because we only controlled for these variables, we removed the direct paths from BMI and physical activity to total energy intake from all three models.
different BMI categories (underweight, normal weight, overweight, and obesity).

In the present study emotional eating was not related to total energy intake, fat intake or carbohydrate intake. Emotional eaters may only eat more if they are emotionally aroused, which might only be observed shortly after the arousal, whereas we measured energy intake over a 1-month period without assessing emotional states or life events (see O’Connor, Jones, Conner, McMillan, & Ferguson, 2008; Oliver & Wardle, 1999). An interesting suggestion for future research would be to examine the relations between emotional eating, energy intake, and BMI over time, including measures of emotional states and life events (see Viana, Sinde, & Saxton, 2008).

A limitation of our study might be the use of a self-report Food Frequency Questionnaire, due to possible recall biases. However, other techniques have other drawbacks. For example, a drawback of using self-monitoring or record keeping is its reactivity. Therefore, these methods are often used in dietary interventions. Moreover, assessing food intake at a given moment in time is not a valid way of dietary assessment, since a minimum time window of 24 h is required for dietary assessment (Stubbs et al., 1998; Van Strien, Engels, Van Staveren, & Herman, 2006). There is an ongoing debate about the validity of self-reported intake in restrained eaters, as some scholars stress that restrained eaters tend to underreport their energy intake (for recent details we refer to Stice, Fisher, & Lowe, 2004; Van Strien et al., 2006). Although it is possible that the restrained eaters in our study underreported their energy intake, they had an average energy intake of 2248 kcal. This is more than the recommended amount of 2000 kcal a day for Dutch women (Stichting Voedingscentrum Nederland), which might indicate that many of them did not severely underreport their intake. Another limitation of the present study is the measurement of physical activity, since we only investigated vigorous activity. In future studies measurement of physical activity should include moderate activity, since moderate activity was often found to be related to BMI as well (e.g., McTiernan et al., 2007). A third limitation might be that BMI scores used in the present study were based on self-reported heights and weights instead of objectively measured heights and weights.

The main strength of the current study is that it carefully examined the relations between restrained, emotional and external eating and energy intake using sophisticated multivariate analyses. More insight is needed into the different eating styles and their corresponding eating patterns, to better understand the development of eating pathologies. In the long term, research on eating behaviour might contribute to the development of adequate interventions to decrease the obesity epidemic and other eating pathologies that are currently on the increase.

References


