Subtyping Children and Adolescents Who Are Overweight Based on Eating Pathology and Psychopathology

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Abstract

Children and adolescents who are overweight can differ on dimensions measuring dietary restraint and psychopathology. Classifying clinical obese children and adolescents based on these psychological characteristics is shown to be useful in making differential diagnoses. The present study aimed to research the validity of subtyping children and adolescents with overweight (N=138) in a non-clinical sample. Using cluster analysis, results revealed three subtypes: a dietary restraint/internalizing group (DR+IN; n=41), a pure internalizing group (IN; n=20) and a non-symptomatic group (NS; n=77). The DR+IN group outscored both other groups on measures of eating pathology, whereas the IN group outscored both other groups on measures of negative affect. Interestingly, the three groups did not differ on degree of overweight. The results seem to suggest that different psychological mechanisms can be observed in subgroups of young overweight adolescents. Further research should explore how individual psychological characteristics can be helpful when stipulating weight loss treatment programmes. Copyright © 2011 John Wiley & Sons, Ltd and Eating Disorders Association.

Keywords

subtyping; overweight; eating pathology; children; adolescents

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Introduction

There is a clear consensus about the etiology of obesity, and the processes lying behind the development of obesity are assumed to be identical in children and in adults. In children, overweight (>BMI 85th percentile, which includes obesity) seems to be explained both by reduced physical activities and current eating habits (Rosenbaum, Leibel, & Hirsch, 1997). However, despite this generally acknowledged mechanism, children and adolescents who are overweight are considered to be a heterogeneous group and differ on dimensions like eating pathology and internalizing psychopathology (Goldschmidt, Tanofsky-Kraff, Goossens, et al., 2008; Goossens, Braet, & Decaluwé, 2007). High levels of eating pathology and internalizing psychopathology were acknowledged as predictors for poor prognosis and have been associated with increasing weight gain (Lowe, Annunziato, Tutman Markowitz, et al., 2006; Stice, Cameron, Killen, Hayward, & Barr Taylor, 1999; Stice, Presnell, & Spangler, 2002; Stice, Presnell, Shaw, & Rohde, 2005; Tanofsky-Kraff, Cohen, Yanovski, et al., 2006). Moreover, risk factor models do suggest that specifically these markers also trigger overeating in adults (Macht, 2008) and in children (Goossens et al., 2007; Stice et al., 2005).

At least two theoretical models stimulated a growing body of research on maladaptive psychological mechanisms in people with eating and weight problems. Although both models have different assumptions, research in adults indicates that they were to some extent complementary. The dietary restraint theory (DRT; Polivy & Herman, 1985) assumes that stringent dieting practices increase the risk that an individual will overeat to counteract the effects of caloric deprivation. Eventually, one may lose control over eating during these episodes and develop binge eating. Conforming the hypothesis of Van Strien, Frijters, Bergers, and Defares (1986), it is worthwhile to consider that also in overweight people specifically the dietary restraint attitudes must be seen as a weight-related coping strategy but to some extent also as dysfunctional. Next, the affect regulation theory (ART; Grilo & Shiffman, 1994) introduced the concept ‘emotional eating’ and looks upon binge eating as a coping mechanism to regulate and reduce negative emotions. In line with the findings in overweight people by Mustillo et al. (2003), it could be assumed that in a Western society promoting the thin ideal, suffering from overweight in early life forms a scar, leading to low self-esteem and negative affect. ART suggests that as long as these children do not learn to cope with their emotions, they will be further faced with periods of emotional eating. Unfortunately, these psychological characteristics were often neglected in weight loss programmes. Also, until now, little research attention is dedicated to specify how many overweight children and adolescents suffer from one of these psychological characteristics or both. Therefore, subtyping overweight people based on both restraint eating and psychopathology might be of clinical utility, given that treatment needs might be different for different subtypes (Jansens, Havermans, Nederkoorn, & Roefs, 2008).

Subtyping cannot only be helpful in stipulating specific treatment guidelines but also in making differential diagnoses. A recent study based on cluster analysis in two samples of children...
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and adolescents being treated for their overweight revealed that three different subtypes could be identified (Braet & Beyers, 2009). Comparable to studies in adults (Grilo, Masheb, & Wilson, 2001; Stice, Agras, Telch, Halmi, Mitchell, & Wilson, 2001) and children (Goldschmidt et al., 2008), a first subtype emerged, which was characterized by high restraint and internalizing problems (DR+IN). A second subtype, a non-symptomatic group (NS), could also be identified. In both samples, a comparable number of cases were assigned to the DR+IN subtype (22%) and the NS subtype (respectively 31% and 33%). Also a third cluster showed up characterized by high internalizing psychopathology but low dietary restraint (IN). A pure dietary restraint (DR) type could not be identified in overweight children and adolescents seeking treatment. This is also found in a study in a community sample of adolescents (Chen, McClosky, & Keenan, 2009). However, this is in contrast with studies in populations with eating disorder symptoms where a pure DR group encompasses a substantial part of the study samples (Goldschmidt et al., 2008; Grilo et al., 2001; Grilo, 2004; Stice et al., 2001).

In adults, the DR+IN subtype signals a more severe variant marked by higher scores on psychopathology measures and poorer treatment response. Further analyses of the Braet and Beyers (2009) study on different psychological validating measures revealed that also in children and adolescents the DR+IN subtype was the most impaired one, and a more problematic subtype compared with the NS subtype. This study also suggested that compared with NS, children and adolescents belonging to the subtypes characterized by enhanced internalizing psychopathology (DR+IN and IN subtypes) have a less positive weight prognosis (Braet & Beyers, 2009). It was concluded that treatment might be specifically complicated for children who are overweight and also suffer from psychological problems. However, the samples of both studies were not selected randomly, and further evidence for the robustness of the DR+IN and IN subtypes in overweight children and adolescents seems indicated. More specifically, it remains to be seen whether the clusters can be identified also in non-clinical overweight groups.

So far, only one community study in adults with overweight, recruited via advertising, demonstrated that people with low and high in negative affect (referring to internalizing psychopathology) belonged to two different subtypes (Jansen et al., 2008). Unfortunately, no other dimensions were entered in their cluster analysis, and no studies in younger overweight non-clinical populations exist. Therefore, the objective of the present study was to test whether also overweight children and adolescents from community samples could be subtyped. Given that psychological correlates are indeed prevalent in some but not all children in the general population which may contribute to the development or maintenance of the obesity problem in a dynamic way (Puder & Munsch, 2010), detecting psychological factors for subtyping adolescents within the community can be helpful in stipulating differential intervention guidelines. As theoretically motivated, we will base our subtyping analyses on two important and relevant psychological constructs: restraint eating and internalizing psychopathology. We selected well-established measures assessing these constructs, taken into account the age constraints of the sample. Based on Jansen et al. (2008), we predict to find at least an IN subtype. Further, based on the Braet and Beyers (2009) study, we also expect that a DR+IN subtype can be identified, besides an NS subtype.

Method

Participants

Participants comprised 63 boys (46%), and 75 girls (54%) with overweight, with age ranging between 8 and 18 years (N=138; mean age is 12.8 years; SD=2.3), recruited via three consecutive calls between 2006 and 2007. The mean weight of the participants was 67.6 kg (SD=16.9) and the mean length was 160.0 cm (SD=11.1), corresponding to a mean body mass index (BMI) of 26.0 (SD=4.1), a mean BMI of 30 at age 18 (International Obesity Task Force) or a mean adjusted BMI of 143.3% (SD=17.0). Compared with American Centers for Disease Control (CDC) norms, BMI z-scores ranged from 0.97 (83rd CDC percentile) to 2.58 (99th CDC percentile) (Ogden, Kuczmarski, Flegal, et al., 2002). According to the Hollingshead index (Hollingshead, 1975), 21% of the sample was classified as upper or upper-middle class, 61% of the sample belonged to middle class and 18% of the sample was classified as low or lower-middle class.

Procedure

The study was described as research on the psychosocial well-being of children and adolescents ‘with a bigger size’. Children and adolescents were eligible when at the moment of the study they did not receive any treatment in order to lose weight with at least the help of a dietician and if they were willing to come to the university. Children and adolescents with a BMI below the 85th percentile and intellectually disabled children who were not following the regular school track were excluded, with no other selection criteria besides having an age between 8 and 18 years. Recruitment was comparable with the advertising campaign in the adult subtype study (Jansen et al., 2008).

Because non-clinical obese youngsters are often hard to identify by any single approach and also because a single-source sampling frame may lead to bias, we used a variety of sources for recruitment combining different sampling methods (advertisements in health care magazines, large-scale school mailings, individual target sampling). As such, we decrease the sampling error, and we add to the external validity of the findings in this study (Kamal, Kumar, & Sarcar, 2011). The study was firstly announced via advertisements in health care magazines, yielding a sample of 36 overweight children and adolescents. Secondly, participants were recruited via large-scale school mailings, resulting in an additional sample of 41 overweight children and adolescents. In a third call, psychology students were instructed to recruit one child or adolescent with an average weight and one with ‘above average weight’, leading to a third group of 216 children and adolescents whereby 68 were classified as overweight. Students were both from rural and urban region, enhancing the representativeness of the sample. Seven participants were excluded during the study because they did not meet the overweight criterion (n=3) or because they started treatment for their overweight (n=4), resulting in a final sample of N=138. We conducted a multivariate analysis of covariance (MANCOVA) to check whether there were any differences in study variables due to different recruitment methods. After controlling for gender and age, as was done in the primary
analyses of our study, no differences in psychopathology nor in eating problems were found between the three sampling groups [multivariate test based on Wilks’ lambda: F(36,232) = 0.84, ns].

All participants in this non-clinical group were aware that they would not receive any kind of treatment as part of the study. Informed consent was obtained from participants and their parents. The study was approved by the ethics committee of the university.

**Measures**

**Weight index**

Weight was measured without shoes, in street clothes, on a standardized balance. Height was measured to the nearest cm using a wall-mounted ruler. The BMI was calculated as kg/m². Participants were defined as overweight if their BMI ≥ 85th percentile, corresponding to a z-score of 0.97, according to the CDC (83th CDC percentile) (Ogden et al., 2002). To compare the BMI of children at different ages, the adjusted BMI was used in this study, calculated as actual BMI/percentile 50 of BMI for age and gender 100. Percentiles of BMI are based on normative Dutch data (Fredriks, van Buuren, Wit, & Verloove-Vanhorick, 2002). Here, 75 participants met the criteria for obesity (adjusted BMI >140 and CDC z-score >1.64 = 95th CDC percentile).

**Psychopathology**

The Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1983) and the Youth Self Report (YSR; Achenbach, 1991) are parallel questionnaires assessing several emotional and behavioural problem areas as reported respectively by the parent and the child. Both the parent version (CBCL) and the self-report version (YSR) are generally accepted as objective tools for screening symptoms of psychopathology. For both informants, global internalizing and externalizing problem scores can be obtained. Dutch versions of both the CBCL and the YSR are reliable and valid instruments (Verhulst, van den Ende & Koot, 1997). Based on data from a large community sample, T-scores were computed and used in the present study. T-scores ≥ 60 are defined as clinically deviating (Achenbach & Edelbrock, 1983; Achenbach, 1991). Test–retest reliability is between .82 and .95. Cronbach’s alphas for the subscales vary between .90 and .93 in this study, indicating excellent reliability.

For the clustering analysis, we selected the internalizing scale based on the CBCL and the YSR, whereas for the external validation analyses, we used the externalizing and total problems scales. Having two informants of psychopathology (self-report and parental report), we calculated aggregated latent factor scores of internalizing, externalizing and total problems. Variance explained by the aggregated latent factors was 68% for all three scores and showed that both informants share a lot in their view. In this study, we consistently used these latent factor scores of psychopathology because latent factors typically contain little to no measurement error, compared to scores derived from only one single informant (Bollen, 1989). Therefore, the latent factor comprises true variance that is shared by both informants in their view on the problems, and is a much better reflection of the true problems of the adolescent, compared to a single informant’s view (Simons, Whitbeck, Conger, & Wu, 1991). Moreover, van Dulmen and Egeland (2011) showed that latent factors summarizing true variance in psychopathology based on multi-informant reports were the best predictors of adolescent psychopathology as measured with a semi-structured diagnostic interview, compared to other aggregation methods (e.g. averaging across informants) and single informant scores.

The Children’s Depression Inventory (CDI; Kovacs, 1992) is a self-report inventory to measure depression in children and adolescents. The CDI has relatively high levels of internal consistency, test–retest reliability and predictive, convergent and construct validity (Kovacs, 1992). The reliability of the translated version is sufficient (Cronbach’s alpha >.79) (Timbremont & Braet, 2002). For at risk groups, the cut-off is defined here as a total score of > 13. In the present study, the coefficient alpha for the CDI total score was .84.

**Eating pathology**

The Dutch Eating Behavior Questionnaire (DEBQ; Van Strien et al., 1986) includes three subscales: emotional eating, external eating and restrained eating. We developed a child version of the DEBQ with the same items, whereby only minor adaptations were made, in order to make it comprehensible for children. This adapted DEBQ proved to have good internal consistency, satisfactory factorial validity and dimensional stability in samples aged 7–17 years (Braet, Claus, Goossens, Moens, Soetens, & Van Vlierberghe, 2008; Edlund, Halvarsson, & Sjoden, 1996; Halvarsson & Sjoden, 1998). In the current study, the coefficient alpha for the subscales varies between .77 and .87. Based on study of Braet et al. (2008), we have now age-specific and gender-specific clinical cut-off points of scores > 1SD for all scales.

The Eating Disorder Examination (EDE; Fairburn & Cooper, 1993) is a standard investigator-based interview measuring the severity of the core psychopathology of eating disorders and generating eating disorder diagnoses. The child version of the EDE (ChEDE) is based on the adult EDE and is modified by experts in the field of eating disorders in children in collaboration with the authors of the original EDE (Bryant-Waugh, Cooper, Taylor, & Lask, 1996). A translation of the ChEDE was designed for use in populations of Dutch children (Decaluwé & Braet, 1999a). The ChEDE contains four subscales designed to provide a profile of individuals in terms of four major areas of eating disorder psychopathology: restraint, eating concern, shape concern and weight concern. The interrater reliability of the ChEDE is very good (r = .91–.99). The test–retest reliability is also good (r = .61–.83) (Decaluwé & Braet, 2004). No cut-off points for defining at risk groups were available yet, but clinically, absence of symptoms were scored as 0, so mean scores ≥ 1 will be defined here as indicating borderline symptomatology and mean scores of ≥ 2 as clinical.

A self-report questionnaire version of the EDE was also administered. The items of the adult version (EDE-Q) are constructed by Fairburn and Beglin (1994) and derived from the EDE interview. Luce, Crowther, and Pole (2008) indicated that the subscales of the EDE-Q have excellent internal consistency (Cronbach’s alpha ranged from .78 to .93) and test–retest reliability (Pearson’s r ranged from .81 to .94). This version was designed for use in younger populations (ChEDE-Q; Decaluwé & Braet, 1999b). Like the EDE-Q, the ChEDE-Q has a 28-day time frame for each of the subscales. Based on community study by Goossens and Braet...
(2010), we have cut-off points for the ChEDE-Q with scores >1SD deviating from the mean, that is, >1.11 for eating concern, >2.17 for shape concern, >2.04 for weight concern, >1.33 for restraint.

Coefficient alphas for the subscales of both versions were respectively for restraint .60 and .70, eating concern .56 and .71, weight concern .64 and .90 and shape concern .81 and .90 indicating that the ChEDE-Q has more reliable subscales, compared with the ChEDE. Although agreement between the ChEDE and the ChEDE-Q is good and is comparable with previously reported data in adult samples, it must be acknowledged that sometimes children and adolescents have difficulties in identifying binge-eating episodes when they receive no detailed instruction (Decaluwé & Braet, 2004). So, clinical interviews will always be necessary to identify eating disorders in children with overweight and a self-report questionnaire can only be used as a first screening measure. Despite this modest internal consistency of these subscales of the ChEDE interview, excellent interrater and test–retest reliabilities were found in the Decaluwé and Braet (2004) study. Therefore, we decided to keep this interview scales in the study. Nevertheless, the more reliable ChEDE-Q restraint scale was selected for the clustering analysis, which also enables us to compare our findings with previous findings. All other eating pathology measures were included for the external validity analyses.

Missing data

In this study, 7.2% of the DEBQ data, 8% of the CDI data, 6.5% of the CBCL data, 11.6% of the YSR data and 7.2% of the data ChEDE were missing due to age constraints or errors. Comparison of means and covariances of all questionnaire variables using Little’s missing completely at random (Little, 1988) test revealed that data were missing completely at random ($\chi^2$ (538)=24.22, ns). Therefore, it was decided to estimate missing values based on all available data for this sample using maximum likelihood estimation and the expectation maximization algorithm available in SPSS.

Analyses

After examination of possible univariate (i.e. $|z|$-scores >3) and multivariate outliers (i.e. high values for Mahalanobis distance), two outliers were found and removed from the data prior to this study, cluster analysis was conducted using a two-step procedure (Gore, 2000; Tan, Steinbach, & Kumar, 2006) using the Ginkgo software (De Caceres, Olivia, Font, & Vives, 2007). In the first step, hierarchical cluster analysis was carried out using Ward’s method on squared Euclidian distances among standardized variables. Based on the very efficient stepsize criterion and the Calinski–Harabasz index (Calinski & Harabasz, 1974), which showed to be the most efficient criteria to select the number of clusters in a dataset (Milligan & Cooper, 1985), the appropriate number of clusters was selected. In the second step, k-means clustering was used to form the final groups. This procedure used the centroids from hierarchical clustering as nonrandom starting partitions in an iterative procedure. The latter procedure remedies one of the major shortcomings of the hierarchical method, namely that once an object is clustered using this method, it cannot be reassigned to another cluster. Iterative clustering, however, allows reassignments to better fitting clusters and thus optimizes cluster membership of the different objects (Gore, 2000). Internal validity of the clusters was examined, comparing mean levels of the two clustering variables (ChEDE-Q restraint and CBCL+YSR internalizing symptoms) to check whether the clustering procedure indeed resulted in qualitatively different clusters of obese youngsters.

In the next step, the external validity of the subtypes was examined, by comparing the clusters on mean levels of a set of variables that are related to but different from the clustering variables. To investigate hypothesized cluster differences on 15 validating variables, three MANCOVAs were used, with participants’ age and gender as covariates, and as dependent variables: (i) adolescents’ BMI and adjusted BMI; (ii) the eating pathology measures (the ChEDE scales (restraint, eating, shape and weight concern), the remaining ChEDE-Q scales (eating, shape and weight concern), the DEBQ scales (emotional, external and restraint eating); and (iii) the psychopathology measures [a specific measure of negative affect (CDI) and the global measures externalizing and total psychopathology (CBCL+YSR)]. Post-hoc tests of group differences were used to determine which group means differed significantly on the criterion variables. Each time, a MANCOVA was inspected prior to the ANOVAs, as such avoiding Type I error. Additionally, in each MANCOVA, we adjusted the alpha using Sidak’s correction for multiple tests ($\alpha =$ .021, .010 and .012, respectively) (Tabachnick & Fidell, 1996). Cohen’s $d$ effect sizes measuring standardized mean differences between subtypes were calculated. Values of $d>$0.5 indicate medium effects $>$0.8 large effects (Cohen, 1992).

Results

Cluster analysis

Based on our hypothesis, solutions with two to four clusters were evaluated. The decision on the number of clusters was dependent on multiple criteria (Milligan & Cooper, 1985), that is, the stepsize criterion, explained variance, the Calinski–Harabasz index and interpretability. The stepsize criterion revealed that the three-cluster solution was superior to two-cluster or four-cluster solution: The explained variance in clustering variables increased from 67% and 17% for restraint and internalizing, respectively (two clusters), to 68% and 55% (three clusters). No such increase was found from three to four clusters. Moreover, the Calinski–Harabasz index was lowest for the solution with three clusters (114.76) compared to solutions with two and four clusters (125.05 and 116.47, respectively), providing strong support for our choice of the solution with three clusters. Taking these criteria together clearly pointed to a solution with three clusters.

The three clusters comprised a non-symptomatic type (NS; $n =$ 77; 56%), a mixed dietary restraint/inneralizing subtype (DR+IN; $n =$41; 30%) and a purely internalizing type (IN; $n =$20; 14%). Correlation between the two clustering variables was .32 ($p<$.001).

The NS cluster had low levels of internalizing symptoms and restraint (Table 1). The DR+IN group showed relatively high levels of internalizing symptoms combined with the highest levels of restraint. Compared with normal weight norm groups, the scores were respectively one and two standard deviations above the norm (Achenbach & Edelbrock, 1983; Achenbach, 1991;
Goossens & Braet, 2010). Compared to the two other groups, the IN cluster had the highest scores on internalizing but scored low on dietary restraint. No gender differences were found in the clustering and validating variables in non-clinical obese adolescents (N=138).

### Table 1 Estimated marginal means of clustering and validating variables in non-clinical obese adolescents (N=138)

<table>
<thead>
<tr>
<th></th>
<th>No symptoms</th>
<th>Restraint + internalizing</th>
<th>Purely internalizing</th>
<th>F(2,133)</th>
<th>p</th>
<th>eta²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internalizing symptoms&lt;sup&gt;a&lt;/sup&gt;</td>
<td>51.25&lt;sub&gt;c&lt;/sub&gt;</td>
<td>59.91&lt;sub&gt;b&lt;/sub&gt;</td>
<td>67.84&lt;sub&gt;a&lt;/sub&gt;</td>
<td>61.61</td>
<td>.000</td>
<td>.48</td>
</tr>
<tr>
<td>Restraint&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.70&lt;sub&gt;b&lt;/sub&gt;</td>
<td>2.46&lt;sub&gt;a&lt;/sub&gt;</td>
<td>0.75&lt;sub&gt;c&lt;/sub&gt;</td>
<td>131.46</td>
<td>.000</td>
<td>.66</td>
</tr>
<tr>
<td>BMI</td>
<td>25.63</td>
<td>26.46</td>
<td>26.61</td>
<td>1.35</td>
<td>.263</td>
<td>.02</td>
</tr>
<tr>
<td>Adjusted BMI</td>
<td>141.39</td>
<td>145.45</td>
<td>146.42</td>
<td>1.19</td>
<td>.308</td>
<td>.02</td>
</tr>
<tr>
<td>Eating concern</td>
<td>0.71&lt;sub&gt;b&lt;/sub&gt;</td>
<td>1.75&lt;sub&gt;a&lt;/sub&gt;</td>
<td>1.04&lt;sub&gt;c&lt;/sub&gt;</td>
<td>21.79</td>
<td>.000</td>
<td>.25</td>
</tr>
<tr>
<td>Shape concern</td>
<td>1.81&lt;sub&gt;b&lt;/sub&gt;</td>
<td>3.46&lt;sub&gt;a&lt;/sub&gt;</td>
<td>2.17&lt;sub&gt;c&lt;/sub&gt;</td>
<td>20.98</td>
<td>.000</td>
<td>.24</td>
</tr>
<tr>
<td>Weight concern</td>
<td>1.92&lt;sub&gt;b&lt;/sub&gt;</td>
<td>3.32&lt;sub&gt;a&lt;/sub&gt;</td>
<td>2.04&lt;sub&gt;c&lt;/sub&gt;</td>
<td>27.23</td>
<td>.000</td>
<td>.29</td>
</tr>
<tr>
<td>Restraint</td>
<td>3.61&lt;sub&gt;c&lt;/sub&gt;</td>
<td>1.90&lt;sub&gt;a&lt;/sub&gt;</td>
<td>0.75&lt;sub&gt;b&lt;/sub&gt;</td>
<td>18.89</td>
<td>.000</td>
<td>.22</td>
</tr>
<tr>
<td>Eating concern&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.27</td>
<td>0.47</td>
<td>0.36</td>
<td>1.89</td>
<td>.154</td>
<td>.03</td>
</tr>
<tr>
<td>Shape concern&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.36</td>
<td>2.15</td>
<td>1.60&lt;sub&gt;a&lt;/sub&gt;</td>
<td>7.05</td>
<td>.001</td>
<td>.10</td>
</tr>
<tr>
<td>Weight concern&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.58</td>
<td>2.36</td>
<td>1.50&lt;sub&gt;b&lt;/sub&gt;</td>
<td>7.76</td>
<td>.001</td>
<td>.11</td>
</tr>
<tr>
<td>Emotional eating</td>
<td>1.97</td>
<td>2.22</td>
<td>2.22</td>
<td>2.08</td>
<td>.129</td>
<td>.03</td>
</tr>
<tr>
<td>External eating</td>
<td>2.67</td>
<td>2.91</td>
<td>2.80</td>
<td>2.86</td>
<td>.061</td>
<td>.04</td>
</tr>
<tr>
<td>Restraint eating</td>
<td>2.44&lt;sub&gt;b&lt;/sub&gt;</td>
<td>3.19&lt;sub&gt;a&lt;/sub&gt;</td>
<td>2.62&lt;sub&gt;c&lt;/sub&gt;</td>
<td>17.09</td>
<td>.000</td>
<td>.20</td>
</tr>
<tr>
<td>Negative affect</td>
<td>8.02&lt;sub&gt;b&lt;/sub&gt;</td>
<td>11.56</td>
<td>14.32</td>
<td>13.02</td>
<td>.000</td>
<td>.16</td>
</tr>
<tr>
<td>Externalizing symptoms</td>
<td>51.21&lt;sub&gt;c&lt;/sub&gt;</td>
<td>55.93&lt;sub&gt;b&lt;/sub&gt;</td>
<td>62.77&lt;sub&gt;a&lt;/sub&gt;</td>
<td>18.73</td>
<td>.000</td>
<td>.22</td>
</tr>
<tr>
<td>Total psychopathology</td>
<td>53.17&lt;sub&gt;c&lt;/sub&gt;</td>
<td>60.72&lt;sub&gt;b&lt;/sub&gt;</td>
<td>69.43&lt;sub&gt;a&lt;/sub&gt;</td>
<td>50.10</td>
<td>.000</td>
<td>.43</td>
</tr>
</tbody>
</table>

Note: Controlled for adolescents' age and gender. Means not sharing subscripts differ significantly, as indicated by Bonferroni adjusted contrasts.

<sup>a</sup>Clustering variables.

<sup>b</sup>Measured with the ChEDE.

External validation of the subtypes

Results of the MANCOVAs on the validating measures spread over three multivariate tests based on Wilks' lambda were respectively (i) BMI and adjusted BMI: F(4,264)=4.77, p<.001, eta²=.28; and (ii) psychopathology measures: F(6,262)=16.28, p<.001, eta²=.27. Univariate analysis revealed that clusters did not differ significantly on BMI or adjusted BMI, eating concern (ChEDE-Q), and emotional and external eating (DEBQ), so differences were found for 10 validating variables. Table 1 shows univariate F-values, variance explained and estimated means of all validating variables.

The DR+IN group scored most impaired compared with the NS group on all these validating variables (Table 1): restraint (DEBQ, d=1.24; ChEDE, d=1.02), eating concern (ChEDE-Q, d=1.30), shape concern (ChEDE, d=0.92; ChEDE-Q, d=1.62), weight concern (ChEDE, d=0.86; ChEDE-Q, d=1.37), negative affect (CDI, d=0.70) and externalizing (CBCL+YSR, d=0.76).

Also, the IN group scored worse compared with the NS group for negative affect (CDI, d=1.10), externalizing (CBCL+YSR, d=1.46) and total psychopathology (CBCL+YSR, d=2.47). These two groups did not differ from each other on the eating pathology measures (measured with the DEBQ, the ChEDE and the ChEDE-Q).

Finally, the DR+IN scored worse than the IN group on the restraint variables (DEBQ, d=1.01; ChEDE, d=1.36). Moreover, both subgroups also differed on eating concern (ChEDE-Q, d=0.85), shape concern (ChEDE, d=0.92), weight concern (ChEDE, d=1.48; ChEDE-Q, d=1.46), externalizing and total psychopathology (CBCL+YSR, d=0.76 and 1.24, respectively). The IN outscored the DR+IN group on psychopathology whereas the scores for the IN group on the five eating pathology measures were significantly lower compared with the DR+IN group.

Discussion

The present study aimed to evaluate the relevance of identifying subtypes in overweight samples based on scores for dietary restraint and internalizing psychopathology. Although some studies already found subtypes in eating disorder patients and adults with obesity, only one study reports on subtyping in clinical samples of children and adolescents with overweight (Braet & Beyers, 2009). Moreover, until now, not one study researched the relevance of subtyping in non-clinical adolescent overweight samples. The results confirm our hypothesis that in the present sample three different clusters emerged as well. Not surprisingly, considering the non-clinical nature of the sample, the NS group was larger compared with the Braet and Beyers (2009) findings (56% versus 33%). However, given that not all subjects can be assigned to an NS cluster fuels our assumption that overweight children and adolescents, both in clinical and non-clinical settings, are very heterogeneous and that identifying subgroups based on specific psychological markers in overweight populations is relevant.

Remarkable, in this non-treatment seeking group, about 44% suffer from negative affect and psychopathology. Also, Van...
Vlierberge, Braet, Goossens, and Mels (2009) concluded that although referral status and age are associated with the presence of psychopathology, differences between referred and non-referred children and adolescents with overweight are not as pronounced as expected on the basis of earlier research in the field. Furthermore, it is assumed that the presence of psychological symptoms affects quality of life, hampers initial weight loss and, even after programme completion, a substantial number of children and adolescents still suffer from severe psychopathology (Braet & Beyers, 2009; Van Vlierberge, Braet, Goossens, Rosseel, & Mels, 2009). Paying attention to these distal variables might help us deepen our understanding of these overweight children. Interestingly, in this community study, the clusters did not differ on degree of overweight. This means that the severity of the overweight problem is not a good indicator for estimating the global psychological functioning of the child. So, consequently, there is a strong need for early detection of psychological factors in overweight children and adolescents also in community samples. It seems worthwhile to consider that when non-clinical children with overweight are identified by school nurses or when they enter primary care settings, screening for symptoms of psychopathology is indicated when estimating their quality of life or when stipulating treatment goals.

In accordance with our hypotheses, a subtype emerged, which was characterized by high restraint and internalizing problems and prevalent in 30% of the children and adolescents in this community sample (DR+IN). This is comparable to studies in adults (Grilo et al., 2001; Stice et al., 2001) and children and adolescents (Chen et al., 2009; Braet & Beyers, 2009; Goldschmidt et al., 2008). The subtype is not only different from the NS group on all variables measured in his study, but the DR+IN outscored also the IN group on several of the eating pathology scales: eating, weight and shape concern and restraint. The subtype revealed scores $>$1SD deviating from the norm group on all ChEDE-Q subscales. Similarly, their score for restrained eating on the DEBQ clearly is more than 1SD above the norm. T-scores for total and internalizing psychopathology were above 60 which is defined as clinically deviating, whereas scores for externalizing symptoms and for the CDI were borderline. These results lead to the conclusion that the children and adolescents belonging to the DR+IN subtype represent a more problematic subgroup of youngsters with overweight. We further assume that specifically this profile, because of the presence of the eating pathology markers, could predict the development of eating disorders (Chen et al., 2009). Conforming the hypothesis of Van Strien et al. (1986) and according to the DRT (Polivy & Herman, 1985), it is worthwhile to consider that specifically the restraint scores in this overweight group must be seen to some extent also as dysfunctional and therefore related with eating pathology via vicious circles of eating, weight and shape concerns. How and why this is related to the relatively high feelings of negative affect is still unknown.

Although the third group, the IN group, is a rather small group ($n=20$, 14% of the sample) and, compared with the DR+IN subtype, displays a less severe variant regarding eating pathology, the IN outscored both other groups on the psychopathology measures. So, this seems to suggest that the findings of Braet and Beyers (2009) in children and adolescents and Jansen et al. (2008) in adults regarding the existence of a ‘pure’ psychopathology group within overweight samples are replicated. So, dietary restraint did not appear to be a core feature in all overweight children, and negative affect may act also independently in some overweight groups. Although this cross-sectional study is not helpful in detecting causal pathways, we can only speculate on the precise nature of the association between overweight and psychopathology in the IN group. Because of the absence of any restraint attitudes, the DRT here cannot be helpful to understand the dysfunctional processes affecting this group. An interesting prospective study in overweight adolescents suggests shared biological and social determinants linking depressed mood and obesity (Goodman & Whitaker, 2002). But whereas some studies suggest that it is depression that causes obesity later in life (Liem, Sauer, Oldehinkel, & Stolk, 2008), others refer to longitudinal studies evidencing that also the reverse relation is possible, that is obesity as predictor of later onset depression (Markowitz, Friedman, & Arent, 2008). In line with findings by Mustillo et al. (2003), it could be assumed that in a Western society promoting the thin ideal, overweight in early life leads to repeated actual and perceived discrimination on a daily basis and is associated with low self-esteem and negative affect. Within a diathesis-stress perspective on psychopathology (Rutter, 2006), we know that specifically peer rejection leads to heightened levels of stress and psychopathology. Furthermore, the ART suggests that as long as these children do not learn to cope with their emotions, they will be further faced with enduring psychopathology and will escape in emotional eating.

Until now, both the DRT and the ART were studied in populations with eating disorders and obesity (Jansen et al., 2008; Grilo & Shiffman, 1994), and some already suggest that they were not necessary competing models but rather complementary models. However, they have different clinical implications and applying both can unnecessarily burden the treatment of overweight people. For example, the DRT put forward that we must help our patients to stop with unhealthy dieting and implement a healthy lifestyle with more leisure-time physical activity and more healthy eating attitudes challenged via cognitive techniques. Next, the ART teaches specifically emotion-focused techniques for adequate affect regulation and stress management like planning difficult situations and choosing problem solving or relaxation as alternatives to emotional eating. Based on our findings, we should suggest the clinical implications of the DRT will be most helpful only for those suffering from DR and those of the ART will be most suitable in only those suffering from IN.

The prudent predictions regarding both the differential mechanisms leading to DR+IN and IN in overweight groups and the associated clinical implications, according to different models, need further testing, preferable in a longitudinal design. In future research, we also recommend the replication and further validation of the subtypes in even larger and more representative samples. Due to the recruitment method, the non-clinical group does parallel a population of overweight children and adolescents who are currently not in treatment for overweight but is not necessarily representative for the general population of overweight children and adolescents. Future research should also explore if some measures were better able to characterize different subtypes in overweight populations than others. For example, in accordance with Braet and Beyers (2009), external eating did not
differeniate between the three types, suggesting that all children and adolescents who are overweight are too much focused on external food cues. Finally, it is generally assumed that human eating behaviour is not only stimulus driven or determined by powerful physiological drives but mainly guided by cognitive and affective processes, both implicit and explicit. Besides the variables under study here, it is not totally impossible that also other psychological factors (e.g. impulsivity) can explain at least some of the individual differences within obese children.

One of the strengths of the present study is that a multi-method multi-informant procedure was used with well-validated instruments. Cronbach’s alphas of most measures were at least adequate (.70, good (.80) or even very good (.90). The validating variables contain information from three different informants (the child, the parent and the psychologist), and although correlations between different informants can be low (Achenbach, Mcconaghy, & Howell, 1987), we could still detect patterns of consistent response trends, which adds further evidence on the existence of three subtypes in both clinical and non-clinical overweight samples of young adolescents. In the case the existence of three subtypes can be further confirmed in new and stronger research designs, it seems worthwhile to study which models can be helpful to understand why a substantial part of the people with overweight suffers also from a range of psychological problems.

REFERENCES


