



## PhD thesis

Anja Munkholm, MD

# Problematic eating behaviours in preadolescence



**PhD Thesis**

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# Preface

This PhD project was carried out at the Child and Adolescent Mental Health Center, Mental Health Services, Department Glostrup, Capital Region of Denmark. The study is part of the longitudinal birth cohort study, the Copenhagen Child Cohort Study (CCC2000) that consists of all children born in year 2000 in the former county of Copenhagen. The thesis is based on the 11-12 year follow up of the CCC2000 that was conducted from May 2011 till October 2012. Baseline data and data from the 5-7 year follow-up of the cohort is included in order to investigate prospective associations of problematic eating behaviors in preadolescence.

The overall aim of the thesis is to improve our understanding of the epidemiology of eating behaviours in preadolescence in the general population. A better understanding of eating behaviour and problems in preadolescence is needed in order to distinguish normal variations from clinically relevant eating problems. This identification of potential predictors of later eating disorders and obesity is essential for preventive strategies, early detection and targeted interventions.

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## List of papers

The thesis is based on the following papers:

1. Munkholm A, Bjorner JB, Petersen J, Micali N, Olsen EM, Skovgaard AM. Validation of the Eating Pattern Inventory for Children (EPI-C) in a general population sample of 11-12-year-old children. *Assessment*. January 29, 2016
2. Munkholm A, Olsen EM, Rask CU, Clemmensen L, Rinvall MK, Jeppesen P, Micali N, Skovgaard AM. Eating behaviours in preadolescence are associated with body dissatisfaction and mental disorders - results of the CCC2000 study. *Appetite* 101 (2016) 46-54
3. Munkholm A, Olsen EM, Rask CU, Clemmensen L, Rinvall MK, Jeppesen P, Micali N, Skovgaard AM. Early predictors of eating problems in preadolescence - a prospective birth cohort study. *Journal of Adolescent Health*. In press.

## List of abbreviations

|         |                                                                                |
|---------|--------------------------------------------------------------------------------|
| CCC2000 | The Copenhagen Child Cohort                                                    |
| CC5-7   | The 5-7 year follow-up of the CCC2000                                          |
| CC11-12 | The 11-12 year follow-up of the CCC2000                                        |
| EPI-C   | The Eating Pattern Inventory for Children                                      |
| DAWBA   | The Development and Well-Being Assessment                                      |
| OR      | Odds Ratio                                                                     |
| CI      | Confidence Interval                                                            |
| DSM-IV  | Diagnostic and Statistical Manual of Mental Disorders, 4 <sup>th</sup> Edition |
| CPR     | Civil Registration Number                                                      |
| CHN     | Community Health Nurses                                                        |
| MHP     | Mental Health Problems                                                         |
| EB      | Eating Behaviour                                                               |
| IOTF    | International Obesity Task Force                                               |
| BMI     | Body Mass index                                                                |



# Background

## Introduction

Eating problems are common in early childhood with estimated rates of 20-50% in general populations (Cardona Cano et al., 2015; Carruth, Ziegler, Gordon, & Barr, 2004; Chartoor & Ganiban, 2004; McDermott et al., 2008; Nicholls & Bryant-Waugh, 2009; Wright, Parkinson, Shipton, & Drewett, 2007). Most of these problems are transient and improve with age, albeit some may persist beyond the preschool age (Cardona Cano et al., 2015). In late childhood and preadolescence, weight concerns and body dissatisfaction commonly emerge (L. Ricciardelli, McCabe, Holt, & Finemore, 2003; Schur, Sanders, & Steiner, 2000), and prior research suggests that problematic eating behaviours in this age-group may be associated with the more severe eating problems seen in adolescence (Combs, Pearson, Zapolski, & Smith, 2013; Tanofsky-Kraff et al., 2011).

Eating disorders and obesity are major public health concerns (C. L. Ogden, Carroll, Kit, & Flegal, 2012; Swanson, Crow, Le Grange, Swendsen, & Merikangas, 2011), and a better understanding of the epidemiology of childhood eating behaviour and problems is needed to help early prevention and targeted interventions. Some research indicates that the developmental pathways for childhood eating problems may differ for general population samples and samples exhibiting clinically significant eating problems (Hafstad, von Soest, & Torgersen, 2013). Thus there is a need of well-designed epidemiological studies investigating problematic eating behaviours (Nicholls & Bryant-Waugh, 2009) to increase our understanding of childhood eating behaviours and to distinguish normal variations from clinically relevant eating problems.

Adolescence is a high-risk period regarding the onset of eating disorders (Keski-Rahkonen et al., 2007; Pedersen et al., 2014). Preadolescence is the developmental period preceding adolescence, usually defined as ranging from age 8-12 years and characterised by the onset of the pubertal development. On average the onset of pubertal changes is around 10-11 years for girls and 11-12 years for boys. The children begin to

experience physical and socio-emotional changes as part of the pubertal process (Susman & Dorn, 2009) that may entail a particularly vulnerability in relation to problematic eating behaviours, weight concerns and body dissatisfaction (Davison, Markey, & Birch, 2003; L. Ricciardelli et al., 2003; Schur et al., 2000). Thus, the preadolescent years are of particular research interest in understanding the development of problematic eating and eating disorders.

## Terminology and definitions

Reviewing the literature in the field of eating problems reveals an inconsistent use of terminology and definitions (R. Bryant-Waugh, 2013). The definitions vary from being broad and non-specific to clinical manifestations of eating disorders.

Several measures have been used to describe eating behaviours and problems. Some are based on single item question, whereas others are large multi-item questionnaires. Some measures have been developed for the use in both clinical and non-clinical samples, and some have primarily been designed for diagnostic purposes. Differences in cut-offs defining an eating problem may imply difficulties in distinguishing the severity of an eating problem. This is further complicated by changes in diagnostic criteria that may entail difficulties in comparisons due to differences in typology and classification over time. This, however, is primarily a problem when investigating eating disorder symptomatology.

Exploring the terminology used to describe eating problems reveals a considerable variability. Several terms have been used; of which *disinhibited, disordered, disturbed, dysregulated, problematic, abnormal, pathological, and maladaptive eating* seems to be the most common. The terms are used interchangeably with little precision, and with an inconsistent use of what type of behaviours and problems included in these 'umbrella' terms. Moreover the use of for example 'disordered' eating in one study does not necessarily equals the definition of an eating problem in another study using the same terminology, whereby comparisons may be difficult. Additionally, 'problems' and 'disorders'

seem to be used interchangeably, albeit 'disorders' often indicate more severe eating behaviours. Also, the literature shows considerable variations in terminology regarding under- and overeating behaviours in childhood and preadolescence (Berger, Schilke, & Strauss, 2005; A. E. Field et al., 2008; Jones, Bennett, Olmsted, Lawson, & Rodin, 2001; Littleton & Ollendick, 2003; Micali, Hagberg, Petersen, & Treasure, 2013; Moy, Petrie, Dockendorff, Greenleaf, & Martin, 2013; D. Neumark-Sztainer, Wall, Story, & Standish, 2012; Nicholls & Bryant-Waugh, 2009; Tanofsky-Kraff et al., 2004). Consequently, comparisons across studies may be difficult as e.g. picky eating; selective eating; fussy eating and choosy eating are all used to describe an extreme faddy eating behaviour. Additionally, some researchers use picky eating and food neophobia interchangeably as well, whereas others make a clear distinction (Nicholls & Bryant-Waugh, 2009).

The lack of consensus regarding terminology and definitions poses challenges to epidemiological investigations of eating behaviours and problems and might explain some of the contradictory findings regarding development and course of eating problems in childhood and adolescence.

## **Eating behaviour in a developmental perspective**

Eating is a fundamental process/behaviour, essential for survival and part of everyday life. It is a highly complex behaviour, influenced by several factors (Larson & Story, 2009).

### **Early developmental factors**

Infants appear to be born with a predisposition to like sweet and salty flavours and dislike bitter and sour tastes (Birch & Fisher, 1998). However, early flavour experiences based on maternal food choices pre- and postnatal are also believed to modify and influence later food preferences and acceptance (Mennella & Castor, 2012; Mennella, Griffin, & Beauchamp, 2004). A predisposition to reject new food also appears to be present (Scaglioni, Salvioni, & Galimberti, 2008), albeit infants and children are believed to

be able to learn to accept new flavours and food through repeated exposure (Wardle et al., 2003a; Wardle, Herrera, Cooke, & Gibson, 2003b). The willingness to try new food, however, is highly influenced by the food and feeding environments provided by the parents. Thus, the parents represent a significant influence in children's early eating experiences by controlling the availability and accessibility of food and shaping the social context of eating.

### **Appetite and regulation**

Infants are born with an ability to self-regulate energy intake in response to nutritional needs (Bronson, 2000). This ability, however, is highly influenced by the caregiver and depends on appropriate interpretation and responds from caregiver, when the child signals hunger and satiety cues (Black & Aboud, 2011). The feeding needs and skills change as the child matures, and eating behaviours evolves rapidly during the first years of life along with major changes in diet that occur. During infancy, children's eating is highly internally regulated, and food intake in early childhood seems to be influenced by the predisposition related to appetite self-regulatory mechanisms (Fisher & Birch, 2002; Rolls, Engell, & Birch, 2000). When moving into toddler and preschool age, the children's eating behaviour becomes less internally regulated and increasingly influenced by parental food cues, eating attitudes and behaviours (Savage, Fisher, & Birch, 2007) as well as environmental factors (Golan & Crow, 2004). Based on these cultural and familial norms, the children learn when, what and how much to eat. When moving into the preadolescent age, children's eating behaviour is gradually becoming more influenced by peers and friends (Hendy & Raudenbush, 2000; Salvy, Coelho, Kieffer, & Epstein, 2007a; Salvy, de la Haye, Bowker, & Hermans, 2012; Salvy, Romero, Paluch, & Epstein, 2007b; Scaglioni et al., 2008). Despite of increasing independence as the children get older (Boutelle, Lytle, Murray, Birnbaum, & Story, 2001) and desire to take control over their life, parents seem to continue to influence food choices, portion sizes and mealtime environments throughout childhood and adolescence (Fulkerson, Neumark-Sztainer, & Story, 2006; Savage et al.,

2007).

From a *physiological* perspective, eating is the result of interplay between several processes signalling initiating of food intake when hungry, and termination of food intake when feeling satiated (Benelam, 2009). Eating, however, can be extended beyond satiation or triggered in absence of internal state of hunger (Lowe & Butryn, 2007) influenced by social factors (C.P. Herman & Polivy, 2004) or environmental factors (Cohen & Babey, 2012; Stroebele & De Castro, 2004). That is, eating may be influenced by the presence of others resulting in initiation of food intake as well as prolonged or limited food intake regardless of internal state of hunger (C.P. Herman & Polivy, 2004) or food choices, and food intake may also be influenced by several external cues such as packaging, sizes etc. (Cohen & Babey, 2012; Stroebele & De Castro, 2004). Thus in order to sustain a healthy eating behaviour, a successful self-regulation is essential.

## **Social influence**

There is an increased focus on factors in the social environment that may impact children's eating behaviours. Especially peers, friends and parents are considered to be key groups of influence (Houldcroft, Haycraft, & Farrow, 2014a; Salvy et al., 2012; Scaglioni et al., 2008) regarding the development of eating attitudes and behaviour.

According to *The social learning theory* 'most human behaviours are learned through observation of other's behaviour, and then imitation and modelling this behaviours' (Bandura, 1977). Thus, from a developmental perspective, observational learning and experience are important determinants of children's eating behaviour and food preferences. Parents are considered to have a significant influence on the children's eating behaviour throughout childhood (Houldcroft et al., 2014a; Salvy et al., 2012; Walsh & Nelson, 2010); and parental eating behaviours and attitudes are important aspects of social learning. In a study of 5-year old girls (N=197) and their mothers, Birch et Fischer (2000) found that girls eating and weight was predicted by maternal feeding practices that in turn was predicted by mothers own level of restrained eating and perceptions of their

child's risk of overweight (Birch & Fisher, 2000). Peers and friends, however, seem to play an increasingly important role, as the child gets older. In preadolescence, significant associations have been found between peer- and friend group levels of eating behaviour and children's own eating behaviour (Farrow, Haycraft, & Meyer, 2011). This may reflect an observational learning or modelling of peers and friend's behaviours influencing children's own eating behaviour.

According to *the normative model of eating* proposed by Herman (2003), eating is directed by social norms, and influenced by the wish to gain social approval/seek social acceptance (C. P. Herman, Roth, & Polivy, 2003). The child observes the eating behaviours of others, and a comparison of food intake and selection determines what and how much the child eats. Thus, the presence of others may facilitate or limit food intake, which may explain why some children are likely to eat more, when their co-eaters eat more and similarly eat less when their co-eaters eat less (Salvy, Kieffer, & Epstein, 2008; Salvy et al., 2007b). The influence of peer and friend group on children's eating behaviours, however, seems to depend on weight status; and prior research indicates that overweight children and preadolescents eat more when alone than with peers, whereas non-overweight children do not eat differently (Salvy et al., 2007a; Salvy et al., 2008). Additionally, Salvy et al (2009) found that overweight children ate more when paired with overweight than with non-overweight peers and friends (Salvy, Howard, Read, & Mele, 2009)

## **Predictors of problematic eating behaviours**

The aetiology of childhood eating problems is believed to be multifactorial in nature, reflecting an interaction of developmental, environmental and social factors (D. Field, Garland, & Williams, 2003). Studies of predictors and risk factors of problematic eating behaviours in early childhood and preschool age have suggested the following being implicated in the aetiological mechanism: perinatal factors such as preterm birth, low birth weight and early gestational age (D. Field et al., 2003; Oliveira et al., 2015), early

regulatory problems (Hafstad et al., 2013; McDermott et al., 2010; Micali, Rask, Olsen, & Skovgaard, 2016; Micali, Rask, Olsen, & Skovgaard, submitted; Ostberg & Hagelin, 2011), disturbed mother-infant relationship (Farrow & Blissett, 2006; Winsper & Wolke, 2014) and maternal mental health problems (McDermott et al., 2010; Micali, Simonoff, Stahl, & Treasure, 2011). In a large population based study, McDermott (2010) found persistence of irregular eating between 6 months and 14 years being associated with infancy problems of feeding and sleeping, high maternal age and anxiety. Similarly, Halfstad (2013) found sleeping problems in early childhood predictive of eating problems in an adolescent sample of 16 year-olds (Hafstad et al., 2013). Also, LeGrange et al (2014) found that early gestational age, persistent temperamental difficulties and high body weight were associated with increased risk of eating behaviour problems in another adolescent sample of 15-16 year-olds (Le Grange et al., 2014).

Previous research suggests that childhood adversities may also contribute to the development of eating problems in adolescence and later in life. Social factors, such as maternal age, parental education and household income are believed to influence eating behaviours (Cameron et al., 2012); and low parental education in particular have been found associated with eating problems in adolescence (J. G. Johnson, Cohen, Kasen, & Brook, 2002). In spite of a growing literature in the field of risk factors and predictors of childhood eating problems, the prospective studies investigating predictors of eating behaviours and problems in preadolescence remain limited.

## **Stability of eating behaviours**

Some prospective studies indicate a continuity of eating behaviour and appetite traits across childhood (Ashcroft, Semmler, Carnell, van Jaarsveld, & Wardle, 2008; McDermott et al., 2010). Thus, Ashcroft (2008) found that eating behaviours such as satiety, responsiveness, slowness in eating, food fussiness, enjoyment of food, emotional under- and overeating identified at age 4 showed high continuity throughout childhood (Ashcroft et al., 2008). McDermott (2010) found that irregular eating behaviours showed

high continuity from age 5 to 14 years (McDermott et al., 2010); and Northstone and Emmett (2008) found eating patterns consistent across childhood (Northstone & Emmett, 2008). Previous research also suggest that early problematic eating patterns are stable over time and may be associated with eating disorders (Kotler, Cohen, Davies, Pine, & Walsh, 2001; Marchi & Cohen, 1990) and obesity later in life (Han, Lawlor, & Kimm, 2010; Mitchell, Catenacci, Wyatt, & Hill, 2011). Thus, Kotler et al (2001) found that early eating problems (e.g. struggles with food, negative affect at mealtimes, and eating conflicts) are associated with eating disorders in adolescence (Kotler et al., 2001); and Marchi & Cohen (1990) found childhood picky eating patterns associated with anorexia nervosa in adolescence (Marchi & Cohen, 1990). Another study by Sonnevile et al (2015) showed continuity of overeating throughout childhood into mid-adolescence (Sonneville et al., 2015).

## **Problematic eating behaviours in preadolescence**

Among the range of problematic eating behaviours described in non-clinical populations of children, restrained, emotional and external eating seem to be the most commonly researched behaviours (C. P. Herman & Mack, 1975; Macht & Simons, 2011; Marcus & Kalarchian, 2003; Schachter, 1974). These eating behaviours do not necessarily reflect eating disorders *per se*, but associated with under- and overeating tendencies that may represent preclinical manifestations.

### **Restrained eating**

Dietary restraint reflects restriction in eating in order to loose or maintain weight. However, restrained eating seems to involve both under- and overeating tendencies (J. Ogden, 1993). According to the theory of restrained eating (C. P. Herman & Mack, 1975), restriction in eating is at times successfully achieved, which may lead to episodes of overeating (C. P. Herman, & Polivy, J., 1980; C.P. Herman & Polivy, 2004; Polivy & Herman, 1985); This is supported by other studies suggesting that restrained eating may



cause weight gain and overweight due to periods of overeating and failed weight loss attempts (A. E. Field et al., 2003; Haines, Neumark-Sztainer, Wall, & Story, 2007; D. Neumark-Sztainer et al., 2012). Thus, this behaviour may result in weight fluctuation and not an actual weight loss, due to compensatory overeating that limit attempts of weight loss (Heatherton, Polivy, & Herman, 1991). However, there are conflicting reports of the direction of effects, and other studies suggest that overeating may lead to restrained eating due to weight concerns and body dissatisfaction (A. E. Field et al., 2003; Haines et al., 2007; D. Neumark-Sztainer et al., 2012).

Some individuals seem to manage to restrict their eating and maintain their weight-loss attempts without episodes of overeating, and a direct association between restriction and overeating tendencies has been questioned. The majority of children with restrained eating, however, seem to fluctuate between restriction and overeating episodes, and most research supports the theory of restrained eating (J. Ogden, 2010). Also, there is consistent evidence of a positive association between restrained eating and overweight status in preadolescence and early adolescence (A. E. Field et al., 2003; D. R. Neumark-Sztainer et al., 2007; Snoek, van Strien, Janssens, & Engels, 2007; van Strien & Oosterveld, 2008) indicating a certain level of overeating.

Some research suggests that restrained eating is more common among girls compared to boys in preadolescence (Forrester-Knauss, Perren, & Alsaker, 2012) as well as adolescence (Snoek et al., 2007). Schacht et al (2006), however, found boys being more vulnerable to restrained eating in a sample of preadolescents (Schacht, Richter-Appelt, Schulte-Markwort, Hebebrand, & Schimmelmann, 2006).

## **Emotional eating**

Emotional eating is described as an eating behaviour used in response to emotional arousal rather than internal state of hunger and satiety cues. Thus, emotional eating may be used as a coping mechanism to reduce negative emotions (Macht & Simons, 2011) or emotional distress (i.e. anxiety or feelings of loneliness or anger). Emotional eating may

result in both under- and overeating, albeit most commonly overeating tendencies have been described. According to the Psychosomatic Theory, proposed by Bruch (1975), emotional eating may promote weight gain when eating is used in attempts to reduce anxiety and other negative emotions (Bruch, 1975).

Previous research suggests an age-related difference in emotional eating, and suggests that emotional under-eating tends to decrease with age, while emotional over-eating tends to increase (Ashcroft et al., 2008; Svensson et al., 2011; Wardle, Guthrie, Sanderson, & Rapoport, 2001). Prior research also indicates that emotional eating is highly associated with weight status in young children, albeit both positive (Braet et al., 2008; Jahnke & Warschburger, 2008; Ledoux, Watson, Baranowski, Tepper, & Baranowski, 2011; Parkinson, Drewett, Le Couteur, Adamson, & Gateshead Millennium Study Core, 2010; Viana, Sinde, & Saxton, 2008) and negative associations have been found (Braet et al., 2008; Jahnke & Warschburger, 2008; Ledoux et al., 2011; Parkinson et al., 2010; Viana et al., 2008). In older children, most studies suggest that emotional eating is unrelated to weight status (Snoek, Engels, van Strien, & Otten, 2013).

Gender differences have been shown in emotional eating, albeit with similar contradictory results as described in restrained eating. Thus Forrester-Knauss (2012) showed that emotional eating was more common among preadolescent girls compared to boys, (Forrester-Knauss et al., 2012), whereas Schacht et al (2006) found emotional eating more common in boys (Schacht et al., 2006).

### **External eating**

External eating refers to eating in response to external stimuli (e.g. taste, visibility and accessibility of food) regardless of internal state of feelings of hunger or satiety (Schachter, 1974). Previous research suggests that external eating is related to a higher vulnerability to overeating tendencies (Brignell, Griffiths, Bradley, & Mogg, 2009), while others suggest external eating might be seen as a result of impulsivity (Hou et al., 2011). The association between external eating and BMI is less consistent. Some studies have

found external eating being associated with overweight, however most studies have found external eating negatively associated with BMI or no association at all. (Hill et al., 2008; Jahnke & Warschburger, 2008; Moens & Braet, 2007; Shomaker et al., 2010; Silva, 2013; Tanofsky-Kraff et al., 2008). Previous research indicates that the tendency of external eating to increase with age (Birch, Fisher, & Davison, 2003; Fisher & Birch, 2002).

Most studies of preadolescent samples (8-11y) suggest higher levels of external eating in boys compared to girls (Farrow et al., 2011; Houldcroft, Farrow, & Haycraft, 2014b; Schacht et al., 2006). However, Hirsch et al (2014) found no gender-differences in external eating among 8-year old children (Hirsch et al., 2014).

## **Correlates of eating behaviours in preadolescence**

### **Body dissatisfaction**

The physical changes experienced during puberty include weight gain that may affect body image and satisfaction (Jacobi, Hayward, de Zwaan, Kraemer, & Agras, 2004). Additionally, the influence of peer group and social awareness increases during preadolescence (Hayward, 2003), and the child becomes more vulnerable to other's opinion (particularly, parents, peers and friends) about weight and shape, which also may affect body image and satisfaction (Eisenberg, Neumark-Sztainer, Story, & Perry, 2005; Farrow et al., 2011; Meyer & Gast, 2008). Moreover, the ideal body figures being portrayed in the media are believed to be an important factor (L. A. Ricciardelli & McCabe, 2004; Smolak & Stein, 2006) in relation to the development of body dissatisfaction.

Conceptualization and assessment of body dissatisfaction varies across the literature (J. Ogden, 2010). Some research suggests that body dissatisfaction can be conceptualized as the discrepancy between perceived and actual body size (Slade & Russell, 1973). This disturbance in the way one's body shape is experienced is one of the core symptoms of anorexia nervosa and bulimia nervosa, and may reflect a body image distortion rather than body dissatisfaction (Stice & Shaw, 2002c). However, body dissatisfaction has also been conceptualized as the discrepancy between perceived and

ideal size (Stunkard, Sorenson, & Schulsinger, 1983; Tiggemann & Wilson-Barrett, 1998); while other researchers have suggested that body dissatisfaction should be conceptualized as the feelings of discontent with one's body size and shape (T. A. Brown, Cash, & Mikulka, 1990) such as discontent with one's stomach, chest, hips etc. (Stice & Shaw, 2002c). Among measurement tools to assess body dissatisfaction, most research has used whole-body silhouette drawings of varying sizes, ranging from very underweight to very overweight, whereby the child is asked to select the drawing that he/she considers mostly resembling his/her own body (perceived body size), and the drawing that he/she mostly wish to resemble (ideal body size). Regardless of conceptualization or measurement used, previous research indicates that body dissatisfaction is a common phenomenon in general population samples of preadolescents (Davison et al., 2003; Schur et al., 2000; Shunk & Birch, 2004) with estimated rates of 25-48% of children reporting discrepancy between 'perceived' and 'ideal' body size and shape (D. R. Neumark-Sztainer et al., 2007)

Weight concern and body dissatisfaction has been found associated with overweight and female gender in studies of children and adolescents (Gardner, Friedman, Stark, & Jackson, 1999; Makinen, Puukko-Viertomies, Lindberg, Siimes, & Aalberg, 2012; Schur et al., 2000; Smolak & Levine, 2001). The awareness of a thin body ideal has been found present in girls down to the age of five years (F. L. Brown & Slaughter, 2011), and even at this young age, girls have been found trying to restrain their eating (Carper, Orlet Fisher, & Birch, 2000). There seems to be a gender specific pattern of body dissatisfaction, with girls in general wishing for a thinner body size and shape, whereas boys more often want to be bigger. A sociocultural ideal of a thin body has been suggested implicated in this pursuit for thinness in girls, and a pursuit for muscularity in boys (Cohane & Pope, 2001; L. A. Ricciardelli & McCabe, 2004; Smolak & Stein, 2006). Boys not only have a wish for more muscle tone, they also seem to express concerns about thinness (Stanford & McCabe, 2005) that may reflect the wish for a lean toned body (Flament et al., 2012). Thus, as concluded in a review by Stice and Shaw (2002), several factors seem to

be involved in the development of body dissatisfaction, including a perceived pressure to be thin, internalization of a thin ideal as well as being overweight (Stice & Shaw, 2002c).

Body dissatisfaction is a well acknowledged feature of eating disorders in adolescence (Stice & Shaw, 2002c), and several studies indicate that body dissatisfaction is also associated with problematic eating behaviour in preadolescence, particularly with restrained and emotional eating (Allen, Byrne, McLean, & Davis, 2008; Forrester-Knauss et al., 2012; F. Johnson & Wardle, 2005). Body dissatisfaction and weight concerns tend to increase with age (Calzo et al., 2012; A. E. Field et al., 2003) and both are considered to be risk factors for developing eating disorder and obesity (D. R. Neumark-Sztainer et al., 2007; Stice & Shaw, 2002c).

### **Mental health disorders**

The developmental changes experienced during the preadolescent years may confer a particular psychological vulnerability (Graber, Brooks-Gunn, Paikoff, & Warren, 1994; Rutter, Caspi, & Moffitt, 2003), and preadolescence is a period accompanied by an increased risk of mental health problems and disorders (Ford, Goodman, & Meltzer, 2003; Jansen et al., 2013; Jeppesen et al., In preparation; Micali et al., 2013).

Symptoms of anxiety are very common in childhood and preadolescence (Cartwright-Hatton, McNicol, & Doubleday, 2006). Based on a meta-analysis of general population studies, Costello et al (2011) reported an estimated rate of anxiety disorders in preadolescent children of approximately 12% (Costello, Egger, Copeland, Erkanli & Angold, 2011), whereas depression is less prevalent in this age group, with an estimated rate of 2.8% (Costello, Egger, Copeland, Erkanli & Angold, 2011). In the Copenhagen Child Cohort (CCC2000), the prevalence of anxiety disorders and depression among 11-12 years old children was 6.8 % and 2.6 % respectively (Jeppesen et al., In preparation). In a longitudinal study of preadolescents, Gardner et al (2000) found depression symptomology to be a strong predictor of eating disorders (Gardner, Stark, Friedman, & Jackson, 2000), and symptoms of anxiety and depression have been found co-existing

with eating behaviour problems in studies of children and pre-adolescents (Herpertz-Dahlmann et al., 2008; Houldcroft et al., 2014b; Stice, Burton, & Shaw, 2004; Touchette et al., 2011). Problematic eating behaviours in preadolescence have also been found associated with symptoms of other mental disorders such as ADHD and/or Autism Spectrum Disorders (Rastam et al., 2013). Also, in adolescence significant associations between eating disorder symptoms and emotional- and behavioural problems have been shown (Micali, Ploubidis, De Stavola, Simonoff, & Treasure, 2014).

The co-occurrence of problematic eating behaviours and mental health problems and disorders are well established in clinical samples (Cortese et al., 2007; Pallister & Waller, 2008; Santos, Richards, & Bleckley, 2007), and similar associations seem to be present in general population-based samples (Swanson et al., 2011).

## **Assessment of eating behaviours**

Among the published measures that have been used to investigate eating behaviours and problems, the majority focuses on eating disorder symptomatology (e.g. the Eating Disorder Inventory for children (EDI-c) (Garner, 1991), the Children's Eating Attitudes Test (Maloney, McGuire, Daniels, & Specker, 1989) and the Children's Eating Disorder Examination Questionnaire (chEDE-Q) (R. J. Bryant-Waugh, Cooper, Taylor, & Lask, 1996)), or they are primarily parent-report measures (e.g. the Children's Eating Behaviour Questionnaire (CEBQ) (Wardle et al., 2001) and the Children's Eating Behaviour Inventory (CEBI) (Archer, Rosenbaum, & Streiner, 1991)). Among self-report measures suitable for preadolescents, however, the Questionnaire on Eating and Weight Patterns- Adolescent form (QEWPA) (W. G. Johnson, Kirk, & Reed, 2001) is designed for the assessment of binge eating behaviour only, whereas the Dutch Eating Behaviour Questionnaire for Children (DEBQ-C) (van Strien & Oosterveld, 2008) and the Eating Pattern Inventory for Children (EPI-C) have been developed specifically for assessing a broader spectrum of eating behaviours in children and preadolescents. The DEBQ-c is a modified adult measure, assessing restrained, emotional and external eating, and the

factorial validity and internal consistency seem to be satisfactory for use in 7-12 year-olds (van Strien & Oosterveld, 2008). The EPI-C is another self-report instrument suitable for children aged 8-11 assessing general psychological dimensions of eating behaviours including parental pressure to eat, restrained, emotional and external eating. The EPI-C has been used in both studies of general populations and clinical samples, and initial exploratory factor analysis has shown satisfactory psychometric properties of the instrument (Schacht, 2006).

## **Aims of the thesis**

The preadolescent years are described as a particularly vulnerable period in which problematic eating behaviours, weight concerns, body dissatisfaction and mental health problems seem to increase. Epidemiological research is needed, which take into account the psychometric challenges of defining problematic eating behaviour in general populations of preadolescent children, while exploring anthropometric as well as psychological correlates. Previous research has suggested continuity of childhood eating behaviour, however, longitudinal data are still limited regarding associations of risk factors and predictors of eating behaviour problems in preadolescence. A better understanding of eating behaviour and associated problems in preadolescence, and identification of potential predictors is essential for clinical as well as public health interventions.

Thus, the overall aim of this thesis is to improve our understanding of the epidemiology of eating behaviours in preadolescent children from the general population. Initially we sought to examine the psychometric properties of a measure developed to assess eating behaviours. Secondly, we sought to investigate cross-sectional associations of problematic eating behaviours; and finally we aimed to study putative predictors of problematic eating behaviours in preadolescence.

## **Specific aims and hypotheses**

### **Study I**

The aims of study I were to:

- examine the psychometric properties of The Eating Pattern Inventory for Children (EPI-C) in a Danish population-based sample of 11-12-year-olds
- investigate gender and weight-group differences in eating behaviours in preadolescence identified by the EPI-C

We hypothesized that the four-factor structure proposed by Schacht et al (2006) in a study of 8-11 year old German children (Schacht et al., 2006) could be replicated in our sample



of Danish 11-12 year old children. Furthermore, in line with previous findings (Schacht et al., 2006; Schuetzmann, Richter-Appelt, Schulte-Markwort, & Schimmelmann, 2008; Snoek et al., 2007), we hypothesized that eating behaviours would be associated with weight status; in particular, we expected an association between restrained eating and overweight.

## **Study II**

The aims of study II were to:

- investigate restrained, emotional and external eating identified by the EPI-C in a general population-based sample of 11-12 year olds
- explore how these eating behaviours are cross sectional associated with body dissatisfaction, weight status and mental disorders

We hypothesized that eating behaviour problems would be associated with weight status and body dissatisfaction, and would be more prevalent in girls. Additionally, we expected to find eating behaviour problems differentially associated with mental disorders.

## **Study III**

The aims of study III were to:

- explore longitudinal associations of perinatal-, infancy- and family related factors with problematic eating behaviours at age 11-12
- investigate whether parents reports of eating behaviour patterns at age 5-7 years were associated with children's self-reports of eating behaviour at age 11-12

We hypothesized that perinatal factors, early regulatory problems, disturbed mother-infant relationship, maternal psychopathology and socio-economic disadvantages in early childhood would be differentially associated with eating behaviour problems in preadolescence. Also, we hypothesized, that eating behaviour patterns (i.e. overeating and picky eating) at age 5-7 would precede eating behaviour problems at age 11-12.

# **Material and Methods**

## **Design**

The thesis is based on cross-sectional and longitudinal data from the Copenhagen Child Cohort (CCC2000). Study I and II are cross sectional studies based on data from the 11-12 year follow-up of the CCC2000, whereas study III is a longitudinal study including data from birth to age 12 months and data from the 5-7 years and the 11-12 years follow-up.

## **Population**

The study population was children from the Copenhagen Child Cohort (CCC2000). The CCC2000 study is an on-going longitudinal birth cohort study that was designed to investigate determinants of risk factors and early signs of psychopathology (Skovgaard et al., 2005). Eligible children for the CCC2000 study were all children born in year 2000 in 16 municipalities in the former Copenhagen County in Denmark (N=6090). The cohort has been followed prospectively since birth and has been shown to be largely representative of all children born in Denmark that year regarding key perinatal characteristics (Olsen et al., 2005).

## **Procedure**

The present study was part of the 11-12-year follow-up of the CCC2000 study that was conducted from May 2011 till October 2012. The children were traced through the Danish Central Civil Registration System (Pedersen, 2011; Pedersen, Gotzsche, Moller, & Mortensen, 2006) - a system in Denmark that contains information about gender, date and place of birth, identity of parents and siblings, nationality, vital status and place of living. All residents in Denmark are assigned a unique personal 10-digit identification number (CPR-number) for the use in relation to registration and personal identification. A total of 4847 children (79.6% of the initial cohort) were eligible for follow-up at age 11-12.

Of those children lost to follow-up (N=1243), a total of 14 were not traceable, 19 had deceased, 217 had emigrated and 993 had claimed 'research protection' (a Danish option used at that time when citizens wished to avoid inquiries from research and consumers surveys).

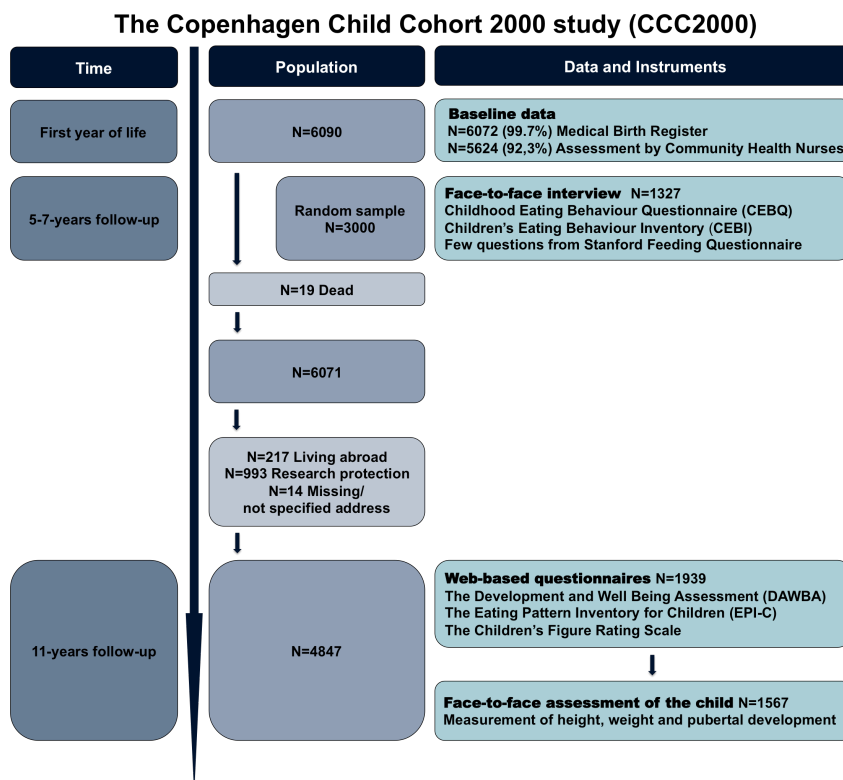
Letters announcing the 11-12-year follow-up were sent to all eligible children and their parents, and they were asked to fill in web-based questionnaires using personalized logins for each of the informants in order to encourage independent answers. Non-responders were contacted up to four times by letter and/or telephone and invited to participate. Upon consent, the child's teacher was also asked to fill in a web-based questionnaire. The children were also invited to a face-to-face clinical assessment scheduled at the Glostrup University Hospital in Copenhagen. Families living far away were offered home visits. Children and parents who had not completed the questionnaires prior to the assessment were helped to do so at the hospital.

### **Website and gifts**

To increase motivation and interest among the children in the cohort and their parents, a website ([www.CCC2000.dk](http://www.CCC2000.dk)) was set up with information about previous findings, news and more information about the 11-12 year follow-up. To encourage participation, gifts were offered in reward for participation.

### **Data collection**

Data for the present studies included data from the following three waves of data collection: 1) First year of life 2) 5-7 years follow up and 3) 11-12 years follow-up. An overview of the data collection is given in Figure 1.



**Figure 1**  
Flowchart of study population, data and instruments at the three waves of data collection

## First year of life

The baseline data collection was embedded in an existing child health surveillance programme in Denmark. According to this programme, the community health nurses (CHN) are informed about all child deliveries, and offer routine home visits free of charge to all families with new-born children during first year of life. According to national guidelines, the main function of the CHN is to screen children regarding physical and developmental problems and make interventions when needed.

For the CCC2000 study, the CHN's used a standardized record and manual for the assessment of the child health and development at four routine home visits (Skovgaard et al., 2005). In total data were obtained on 92.3% of the children in the cohort (N=5624) from the first year of life. Data on the children's health and development, the parent-child relationship and the overall family functioning were systematically recorded at the home visits conducted between child age 0-10 months: 1<sup>st</sup> visit (1-5 weeks), 2<sup>nd</sup> visit (2-3 months), 3<sup>rd</sup> visit (4-6 months) and 4<sup>th</sup> visit (8-10 months) (Skovgaard et al., 2007).

### **Follow-up at age 5-7 years**

Data on eating behaviour at age 5-7 years were obtained on 1327 children from a randomly selected sample of 3000 children in the cohort that was included in the 5-7 year follow-up of CCC2000. (Micali, Simonoff, Elberling, et al., 2011). Assessments measures were The Childhood Eating Assessment Questionnaire (CEAQ) (Micali, Simonoff, Elberling, et al., 2011) - a 41-item parent-report questionnaire/measure derived from the Child Eating Behaviour Questionnaire (CEBQ)(Wardle et al., 2001), the Childhood Eating Behaviour Inventory (CEBI)(Archer et al., 1991) and a few questions from The Stanford Feeding Questionnaire (Jacobi, Agras, Bryson, & Hammer, 2003).

### **Follow-up at age 11-12 years**

Of the 4847 eligible children at the time of the 11-12-year follow-up, data on eating behaviours were obtained on 1939 children (40%) using web-based questionnaires (47.6% boys, 52.4% girls; mean age 11.5 years; SD  $\pm 0.4$ ). Of the 1939 participating children, a total of 1567 children attended the subsequent face-to-face assessment and data on height, weight and pubertal status were available on 1567 (80%) of those children (52.3% girls, 47.7% boys; mean age 11.6 years; range 10.8-12.7 years). Only children completing both the questionnaires and the face-to-face assessment were included in study I and II, as weight data were a crucial parameter in these studies. All 1939 children were included in the longitudinal analyses in study III.

Of the 1939 participating children at the 11-12 year follow-up, a total of 825 (42.5%) children also participated in the 5-7 year follow-up. Thus complete data on eating behaviours from 5-7 years to 11-12 years were available for this subsample.

### **Data from Danish National registers**

Danish national registers contain individual-level information on several social- and health-related issues (Thygesen, Daasnes, Thaulow, & Bronnum-Hansen, 2011), and data from these registers was used to describe background characteristics of the children in our study. The CCC2000 database was linked with Danish national registers using the

unique personal identification numbers (CPR-number) of the children in the Cohort and access to register-based information at an individual-level was available. Registers that were linked with the CCC2000 database are listed below.

### **The Danish Medical Birth Register**

Information on perinatal child factors such as pregnancy and delivery, earlier pregnancies, delivery complications, birth length and weight, gestational age, Apgar score, maternal age, ethnicity and whether the parents were living together at time of birth were obtained from the Danish Medical Birth Register (Knudsen & Olsen, 1998).

### **The Danish Psychiatric Central Research Register**

The Danish Psychiatric Central Research Register contains information on all in- and outpatients visits to psychiatric hospitals in Denmark (Mors, Perto, & Mortensen, 2011). Information was obtained on family history of the mental disorders (all ICD-10 diagnoses given within the child's first year of life).

### **The National Patient Registry**

The National Patient Registry contains information on all individual level information on all admissions and out-patients visits to public hospitals in Denmark (Lyng, Sandegaard, & Rebolj, 2011). Information was obtained on birth complications and congenital malformations.

### **The Integrated Database for Labour Market Research**

Information on socio-economic status (parental education, employment status, annual household income and marital status) was obtained using the Integrated Database for Labour Market Research (DS, 1991).

## **Measures**

The instruments used in our studies were administered as part of the large web-based questionnaire used in the 11-12 year follow-up, and included The Eating Pattern

Inventory for Children, The Children's Figure Rating Scale and The Development and Well-Being Assessment. Measurements of height and weight, as well as self-reports of pubertal status were obtained at a face-to-face assessment. The instruments listed below are only those related to the eating behaviour sub-study of the 11-12 year follow-up.

### **The Eating Pattern Inventory for Children**

The Eating Pattern Inventory for Children is a 20-items self-report questionnaire assessing general psychological dimensions of eating behaviours in preadolescent children (Schacht, 2006). The instrument is derived from the German Eating Behaviour and Weight Problems Inventory for children (EWI-C) (Diehl, 1999), however shortened and modified in order to match the children's reading and comprehension level and to ensure age-appropriate item content. The EPI-C comprises four subscales that measures restrained eating (restriction in eating), emotional eating (eating as coping with emotional distress), external eating in response to external stimuli regardless of internal state of hunger and parental pressure to eat children's perceptions of parental behaviour in relation to child eating. Subscale scores were calculated by dividing the total scale score by the number of items in the respective subscales. Higher scores on each subscale indicated higher levels of parental pressure to eat, restrained, emotional or external eating). A Danish version of the EPI-C was used in the current study. Translation of the instrument followed standardized procedures. Response choices were listed in a 5-point Likert Scale format – 'not at all' (1) 'a little' (2), 'sometimes' (3), 'mostly' (4) and 'always' (5). The EPI-C is presented in appendix A.

### **The Children's Figure Rating Scale**

The Children's Figure Rating Scale is a measure assessing body dissatisfaction in children (Tiggemann, 2005; Tiggemann & Wilson-Barrett, 1998). It includes nine same-sex silhouette drawings ranging from very underweight (1) to very overweight (9). The child is asked to point out a) the drawing that he/she think resemble him/her the most (perceived body size), b) the drawing that he/she most wish to resemble (ideal body size) and c) the

drawing that he/she think the opposite sex find most attractive (attractive body size). Body dissatisfaction is calculated as the discrepancy between perceived and ideal body size. Higher scores indicated higher body dissatisfaction. The Children's Figure Rating Scale is presented in appendix B.

### **The Development and Well-Being Assessment**

The Development and Well-Being Assessment (DAWBA) is a validated diagnostic semi-structured interview measuring mental disorders in children and adolescents (Goodman, Ford, Richards, Gatward, & Meltzer, 2000). It is a web-based questionnaire covering child development, psychiatric symptoms, distress and social impairment. Structured questions cover the operationalized criteria of mental disorders. Included in the present study were DSM-IV diagnoses of Pervasive Developmental Disorders (PDD) including Autism-Spectrum Disorders (ASD), Attention Deficit Hyperactivity Disorders (ADHD), Conduct disorders (CD), Tics, Psychosis, Anxiety Disorder (AD), Depressive Disorders (DD) and Obsessive Compulsive Disorders (OCD). Additionally, open-ended questions allow the respondent's to freely describe the child's problems. A computerized algorithm generates preliminary diagnoses and experienced child- and adolescent psychiatrists subsequently reviewed all available information, including the children's, parents and teacher's description of the problem to determine the final DSM-IV diagnoses. The DAWBA is a widely used measure and has shown good reliability and validity ([www.dawba.net](http://www.dawba.net)). The inter-rater reliability in our study was high for any DSM-IV diagnosis (kappa 0.81) (Jeppesen et al., 2015).

### **Anthropometrics**

#### *Height and weight*

At the face-to-face assessment, trained research staff from the CCC2000 study group obtained measurement of height and weight. Height was measured without shoes using a Sohnle Professional Height Measuring Rod to the nearest 0.1 cm, and weight was measured without shoes on a digital Scale (OBH Nordica exact/personal scale Type 6295)



to the nearest 0.1 kg. Body Mass Index (BMI) was calculated using the formula:  $BMI = \text{weight (kg)} / \text{height (m)}^2$ . The children were classified into BMI categories of underweight, normal weight, or overweight/obese using the age and gender-specific BMI cut-offs for Thinness, Overweight and Obesity in Children provided by The International Obesity Task Force (IOTF) (Cole, Bellizzi, Flegal, & Dietz, 2000; Cole, Flegal, Nicholls, & Jackson, 2007). These cut-off points are given for gender and exact ages by months from 2-18 years and defined as centile curves passing through BMI scores of 18.5, 25 and 30 kg/m<sup>2</sup> at age 18 years, respectively.

### *Pubertal development*

Information on pubertal status was obtained at the face-to-face assessment. The children were presented to gender-specific drawings of the development stages using the Tanner Stages of Development (stage 1-4), and were asked to point out the drawing most resembling themselves (Rapkin, Tsao, Turk, Anderson, & Zeltzer, 2006; Slora et al., 2009). Onset of pubertal development was defined as Tanner stages above stage 1.

## **Ethical considerations**

The study was approved by The Danish Data Protection Agency (J.nr.2010-41-4438), The Capital Region of Denmark (J.nr.: 2007-58-0015) and The Scientific Ethics Committee of Copenhagen County (KA-05103). Additionally, The National Committee on Health Research Ethics was consulted in accordance with national guidelines (J.nr.H-C-FSP-2010-09). Participation was voluntary and all data was kept confidential.

## **Statistical analyses**

### **Study I**

Factor analytic models for ordinal categorical data were used applying probit regressions estimated by a robust weighted least squares estimator with mean and variance adjustment (WLSMV) (Beauducel & Herzberg, 2006; Muthen & Muthen, 2010).

The fit of the factor model was assessed by overall goodness-of-fit statistics including the comparative fit index (CFI), the non-normed fit index (NNFI), and the root mean square error of approximation (RMSEA), where CFI >0.95, NNFI >0.95 and RMSEA<0.08 were regarded as appropriate fit (Bentler, 1990; Browne & Cudeck, 1993; Hu & Bentler, 1999; Reeve, 2007; Steiger, 1990). Additionally, robustness of the factor model were tested in three ways: 1) to evaluate whether an exploratory factor analysis (EFA) would point to a different factor solution in our sample, the data was spilt into two random subsamples. Subsequent exploratory factor analysis was performed in one subsample, and the resulting factor solution was tested in the other subsample 2) to examine the robustness of our factor solution across gender, a multi-group confirmatory factor analysis (Muthén & Christofferson, 1981) was performed, fixing factor loadings and item category thresholds across gender and weight groups. 3) to further test the measurement invariance, logistic regression methods (Zumbo, 1999) were used to evaluate differential item functioning (DIF). Average inter-item correlations were calculated and the reliability was evaluated using Cronbach's alpha with values of >.70 being considered desirable. Theta reliability coefficients was presented as an alternative indicator of the internal consistency (Ferketich, 1990). In order to investigate gender and weight group differences in eating behaviours, the CFA model was expanded to a structural equations model by including the covariates (gender and weight groups) as independent variables in the model. Again, fit was evaluated using the CFI, RMSEA, and NNFI. All analyses were carried out using Mplus version 5.

## **Study II**

Descriptive statistics were used to analyse sample characteristics, and between groups comparisons were performed using  $\chi^2$  for categorical outcomes and Mann Whitney U-test for continuous outcomes. All univariate analyses were conducted stratified by gender enabling to investigate potential gender-specific associations. Multiple logistic regression analyses were performed in order to investigate the effect of body

dissatisfaction on eating behaviours. To avoid over-fitting, only three additional explanatory variables (gender, puberty and weight status) were included in the models. The significance level was set to a p-value of  $<0.05$  (two-sided) in all association analyses and  $<0.01$  in the attrition analyses. All analyses were carried out using the Statistical Package for the Social Sciences software version 21 (SPSS, 2012).

### **Study III**

Differences between groups were tested using Chi-square tests. Due to multiple comparisons, a p-value of  $<0.01$  (2-sided) was considered statistically significant in the univariate analyses. In the analyses of associations, restrained, emotional and external eating was used as separate outcomes. Complete case analyses were used, and sample size thus varies depending on the completeness of data collection during first year of life and at age 5-7. Variables associated with the outcomes at a  $<0.01$  p-level in the univariate analyses were subsequently included in a multivariable logistic regression analysis. Recently, we found both gender and contemporaneous overweight associated with eating behaviour problems at age 11-12 in this sample (Munkholm et al., In press) and thus gender and overweight were included in the multivariable model as a priori confounders.

Annual household income at child age 9-10 was used as a proxy measure of socioeconomic status in the multivariate analyses. The number of available data varied slightly owing to missing data on some of the variables. Thus multiple imputations with 30 imputation sets were imputed in STATA version 13, assuming all data missing at random. The imputation model included all variables used in the multivariable model (gender, BMI at age 11-12 and annual house income at age 9-10). No differences in results were found when using complete cases versus when using the imputed dataset. The results obtained using the imputed data are reported and presented as Odds Ratios (OR), 95% Confidence Interval (CI). A p-value of 0.05 (2-sided) was considered statistically significant in the multivariate analysis. Analyses were carried out using SPSS (version 21) and STATA (version 13).

# Summary of results

## Attrition analyses

Compared with all the non-participants from the cohort alive at age 11 years (N=4132), the group of participants (N=1939) included more girls, more often had two Danish parents, had fewer family composition changes between 0-10 years, had more well-educated parents (highest education 2010 (15+ years) and families with higher annual household income. No significant differences were seen regarding Apgar score and birth weight at a 0.01 p-level. Detailed attrition analyses are shown in the appendix. Attrition analyses comparing the subsample of 1567 children with the rest of the cohort showed similar differences. See appendix C.

## Study I

### Psychometric properties of the EPI-C

#### *Factorial structure*

- Our results supported the conceptualization of the EPI-C as comprising four factors: dietary restraint, emotional eating, external eating and parental pressure to eat.
- A confirmative factor analysis revealed a four-factor model with good psychometric properties, similar to the original proposed by Schacht et al (2006)
- The four factors explained 64.8 % of the total variance.
- The factor loading were within acceptable range ( $>.40$ ) and ranged between 0.46-0.95
- Model fit statistics indicated very good model fit ( $X^2$  759; df 164; RMSEA 0.055; CFI 0.977; NNFI .982)

#### *Correlation between scales*

- Inter-correlations between restrained and external eating as well as between parental pressure to eat and the other eating behaviour scales were small ( $< .30$ ).

The correlation between restrained and emotional eating was 0.43, while the correlation between emotional and external eating was 0.52.

### *Reliability*

- The reliability estimates showed good internal consistencies for three of the scales (Cronbach's alpha 0.73 – 0.92). The parental pressure to eat had fairly low alpha coefficient (0.59).

## **Gender and weight group differences**

### *Gender differences*

- Gender differences were identified, with girls reporting higher scores of restrained and emotional eating compared to boys. Significantly higher scores of parental pressure to eat were seen among the boys, whereas no gender difference was seen with respect to external eating. Mean subscale scores are shown in table 1.

**Table 1** EPI-C subscale scores by gender

|                          | Girls (N=1017) |           |      | Boys (N=922) |           |      | Total (N=1939) |           |      | Statistics |
|--------------------------|----------------|-----------|------|--------------|-----------|------|----------------|-----------|------|------------|
|                          | Mean           | CI (95%)  | SD   | Mean         | CI (95%)  | SD   | Mean           | CI (95%)  | SD   | p-value    |
| Mean subscale score      |                |           |      |              |           |      |                |           |      |            |
| Dietary restraint        | 1.56           | 1.51-1.61 | 0.80 | 1.38         | 1.34-1.42 | 0.64 | 1.48           | 1.44-1.51 | 0.73 | <0.001     |
| Emotional eating         | 1.20           | 1.16-1.23 | 0.53 | 1.11         | 1.09-1.12 | 0.35 | 1.15           | 1.13-1.17 | 0.46 | 0.002      |
| External eating          | 1.81           | 1.77-1.85 | 0.63 | 1.81         | 1.77-1.85 | 0.62 | 1.81           | 1.79-1.84 | 0.63 | NS         |
| Parental pressure to eat | 2.52           | 2.46-2.58 | 1.00 | 2.69         | 2.63-2.76 | 1.01 | 2.60           | 2.56-2.65 | 1.01 | <0.001     |

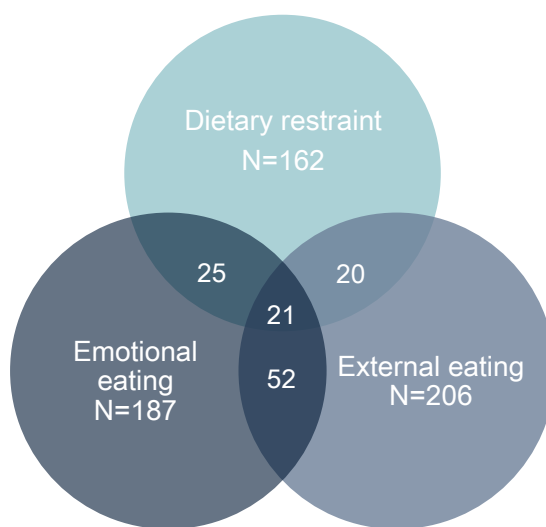
### *Weight group differences*

- Significant differences in eating behaviour across weight groups were demonstrated. Comparisons of eating behaviours of underweight, normal and overweight children revealed that the overweight children indicated significantly higher scores on restrained, emotional and external eating compared to normal weight children, while significant higher levels of parental pressure to eat was seen among underweight children.

## Study II

### Eating behaviour problems in preadolescence

- Of the 416 children who reported problematic eating behaviours (defined as EPI-C scores  $\geq$  90th percentile within each scale), 118 children (28.4%) reported multiple problematic eating behaviours (N=97 reported two problematic behaviours and N=21 reported three problematic behaviours). Occurrence and co-occurrence of the three eating behaviours are shown in Figure 2.



**Figure 2**  
Occurrence and co-occurrence  
of problematic eating behaviours  
N=1939

### Correlates of eating behaviour problems at age 11-12 years

- Our findings indicated that reports of restrained, emotional or external eating with scores  $\geq$  90th percentile (the top 10%) did in fact seem to be indicative of problematic behaviours. Overweight, body dissatisfaction and mental disorders in both boys and girls were shown to be important correlates.
- Based on the IOTF age and gender specific BMI references, 9.6% of the children were underweight, 74.3% were normal weight and 16.1% were overweight. In particular, overweight were significantly associated with problematic eating behaviours.

- Body dissatisfaction defined as a discrepancy between perceived and ideal body size was common, and 14.5% of the children reporting body dissatisfaction indicated an ideal body size two or more sizes thinner than perceived. The majority of these children were overweight, however 41 % were normal weight. Approximately one third of these normal weight children expressing body dissatisfaction also reported restrained eating.
- In total, 13.1% (N=206) of the children met the criteria for a specific DSM-IV mental disorder; emotional disorders (N=110) and neurodevelopment disorders (N=75). Nearly one fifth of the children with problematic eating behaviours met the criteria for a contemporaneous DSM-IV mental disorder, and our study demonstrated significant associations between mental disorders and all three types of problematic eating behaviours investigated at age 11-12 years.

#### *Associations of restrained eating*

The children with restrained eating (top 10%) were statistically more likely to:

- be overweight
- report body dissatisfaction
- have a concurrent emotional disorder

#### *Associations of emotional eating*

The children with emotional eating (top 10%) were statistically more likely to:

- be overweight
- have a concurrent neurodevelopmental or emotional disorder (uniquely among girls)

#### *Associations of external eating*

The children with external eating (top 10%) were statistically more likely to:

- be overweight (uniquely in girls)
- report body dissatisfaction (uniquely among boys)
- have a concurrent neurodevelopmental disorder

### *Associations of multiple eating behaviours*

- A dose-response effect seemed to be present when investigating associations between our key variables and problematic eating behaviours categorized into 'none', 'one' and 'more'. See Table 2.

**Table 2** Associations of multiple problematic eating behaviours

|                                        | None<br>problematic<br>EB<br>N=1151 | One<br>problematic<br>EB<br>N=297 | Two or more<br>problematic<br>EB<br>N=118 | Statistics   |         |
|----------------------------------------|-------------------------------------|-----------------------------------|-------------------------------------------|--------------|---------|
|                                        |                                     |                                   |                                           | OR/ $\chi^2$ | p-value |
| Gender (girl)                          | 572 (49.7%)                         | 172 (57.7%)                       | 75 (63.6%)                                | 12.63 (2)    | 0.002   |
| Body dissatisfaction (yes)             | 104 (9%)                            | 76 (25.6%)                        | 47 (39.8%)                                | 118.28 (2)   | <0.0001 |
| Weight status                          |                                     |                                   |                                           |              | <0.0001 |
| Underweight                            | 117 (10.2%)                         | 27 (9.1%)                         | 6 (5.1%)                                  | 62.31 (4)    |         |
| Normal weight                          | 893 (77.6%)                         | 203 (68.1%)                       | 68 (57.6%)                                |              |         |
| Overweight                             | 141 (12.3%)                         | 68 (22.8%)                        | 44 (37.3%)                                |              |         |
| Any neuro-developmental disorder (yes) | 62 (5.4%)                           | 19 (6.4%)                         | 15 (12.7%)                                | 10.03 (2)    | 0.007   |
| Any emotional disorder (yes)           | 77 (6.7%)                           | 28 (9.4%)                         | 26 (22.0%)                                | 33.41 (2)    | <0.0001 |
| Any mental disorder (yes)              | 126 (10.9%)                         | 43 (14.4%)                        | 37 (31.4%)                                | 39.03 (2)    | <0.0001 |

## **Study III**

### **Predictors of eating behaviour problems at age 11-12 years**

#### *Child and early relational factors*

- Birth weight, gestational age and birth complications were not found to be associated with eating behaviour problems in preadolescence.
- Infancy developmental problems, early regulatory problems, weight faltering, abnormal mother-child relationship were not found to be associated with eating behaviour problems in preadolescence

#### *Maternal factors*

- Neither maternal reported psychological problems in the pre- or perinatal period, nor overall maternal mental disorders diagnosed before the age of 11 were found to be significantly associated with eating behaviour problems at 11-12 years.



### *Feeding and eating problems in infancy and at age 5-7*

- No associations were seen between feeding problems in infancy and eating behaviour problems in preadolescence.
- Overeating patterns at age 5-7 years reported by parents, predicted self-reported restrained eating at age 11-12 years, with overweight at age 11-12 years and low annual household income at child age 9-10 as strong explanatory factors
- None of the other parentally reported eating patterns at age 5-7 showed significant associations with eating behaviour problems at age 11-12.

### *Social factors*

- Significant associations were found between socio-economic adversities at the time of birth and later eating behaviour problems, with social disadvantages being more pronounced in restrained eating. Two parents born outside Denmark, low maternal educational level, and low annual household income at time of birth were all more common in children with restrained eating at age 11-12.
- This social adversity seemed to remain a factor of significance throughout childhood and our study showed restrained eating at age 11-12 being associated with low maternal educational level and low annual household income not only at time of birth, but also at child age 9-10.

# **General discussion**

## **Findings compared with other studies**

The overall aim of this thesis is to improve our understanding of eating behaviours and common co-morbidities in preadolescent children. We investigated the epidemiological aspects of assessment, correlates and putative predictors of restrained, emotional and external eating in a general population birth cohort sample of 11-12 year old children.

In study I, we examined the psychometric properties of the EPI-C and tested gender and weight-group differences. Previously, only explorative factor analytic investigation of the EPI-C has been performed (Hirsch et al., 2014; Schacht et al., 2006) and to our knowledge our study is the first to validate the EPI-C using confirmative factor analysis. As hypothesised the four-factor structure provided by Schacht et al (2006) was replicated in our sample of Danish children. Factor loadings roughly corresponded to the original model (Schacht et al., 2006), and good reliability for the three out of four scales was shown. Weak to moderate factor correlations and lack of item cross loading were found supporting a distinction between the four behaviours. Our study supported the use of the EPI-C as a valid measure assessing eating behaviours in preadolescent general population samples.

The mean scores of restrained, emotional and external eating in our study were slightly lower than found in the other studies that have used the EPI-C (Farrow et al., 2011; Houldcroft et al., 2014b; Schacht et al., 2006). This, however, might be explained by predominantly participants with fewer socio-economic adversities in our study.

Significant gender differences in eating behaviours have been shown in studies of preadolescents, albeit mixed results seem to be present. Our findings suggested that restrained and emotional eating is more prevalent among girls compared to boys, while no gender differences in external eating were identified. Our results are in line with some studies and contradictory to others, but corroborate to the understanding of gender

differences being present in preadolescent eating behaviours (Farrow et al., 2011; Forrester-Knauss et al., 2012; Houldcroft et al., 2014b; Schacht et al., 2006).

Also in line with previous research, our study indicated weight group differences in eating behaviours in preadolescence. Consistent with previous research of comparable age (Braet et al., 2008; A. E. Field et al., 2003; Forrester-Knauss et al., 2012; Haines et al., 2007; D. R. Neumark-Sztainer et al., 2007), our study highlighted overweight children reporting higher scores on restrained, emotional and external eating compared to normal weight children.

In study II, we investigated restrained, emotional and external eating identified by the EPI-C and explored correlates of these behaviours in preadolescence. As hypothesised, restrained, emotional and external eating was in different ways associated with overweight, body dissatisfaction and mental disorders in preadolescence. Notably, our results showed significant co-existence of body dissatisfaction and restrained eating in normal weight children. Acknowledging that the direction of causality cannot be assessed using a cross sectional design, our findings may indicate, that restrained eating could constitute a potential predictor of later eating disorder risk, worth monitoring.

In study III we explored putative predictors of eating behaviour problems in preadolescence. Consistent with previous findings (Cameron et al., 2012; J. G. Johnson et al., 2002), our results showed childhood disadvantage being associated with problematic eating behaviours in preadolescence. Additionally, our findings showed that overeating patterns at age 5-7 predicted restrained eating in preadolescence. This might be explained by weight concern and body dissatisfaction (A. E. Field et al., 2003; Haines et al., 2007; D. Neumark-Sztainer et al., 2012). Other research suggests that overeating patterns show high continuity across childhood, and is associated with the development of overweight and obesity (Ashcroft et al., 2008; van Jaarsveld, Boniface, Llewellyn, & Wardle, 2014). Our findings may reflect fluctuation between overeating and restriction in eating as suggested by the Restraint Theory (C. P. Herman & Mack, 1975), albeit this has to be further explored..

Contrary to our hypotheses, perinatal factors, early regulatory factors, or mother-child relational problems were not predictive of eating behaviour problems in preadolescence. The lack of associations could be explained by power issues or maybe explained by effective interventions by the CHN's. Despite maternal mental health problems being quite prevalent in our sample (11%), this did not seem to be associated with child problematic eating behaviours as found in other studies. Factors such as the possibility of early psychological problems being temporary with only short-term impact on child eating, and differences in severity and type of disorders measured compared with other studies might explain the difference in findings.

## **Methodological considerations**

### **Sample representativeness**

The children in the CCC2000 represent 9% of all children born in Denmark in year 2000. The cohort has been shown to be largely representative of all children born in Denmark that year regarding key perinatal characteristics (gender, birth weight, gestational age and Apgar score) (Olsen et al., 2005),

The participants were more often of Danish origin and with fewer socio-economic adversities compared to non-participants at the 11-12 year follow-up, which could have influenced our results (Dex, 2005). Nevertheless, despite this socio-economically positive skewness of the data, social adversity was still significantly associated with eating behaviour problems in preadolescence, and we would expect this to have been even more so within the full cohort. Selective loss of more disadvantaged families is well known in longitudinal studies (Boyd, 2013), and the possibility of such selection-bias affecting the generalizability of our study cannot be excluded.

### **Study design**

The thesis is based on both cross-sectional and longitudinal data. In cross-sectional studies, the association between a disease and other variables of interest are examined in

a defined population at a specific time point. Thus the exposure and outcome are measured at the same time. The strength of an association can be measured, however direction of causality cannot be assessed using a cross-sectional design. Longitudinal studies, pose the opportunity to examine associations between exposures at one time point and outcome at another time point, allowing to explore whether a particular exposure at baseline predicts a particular outcome at follow-up. Thus longitudinal studies enable to examine causal relationships and are very useful for studying aetiological mechanisms (Vandenbroucke, 2008). The use of prospectively collected data diminishes the risk of recall bias, albeit longitudinal studies are sensitive to attrition due to the long follow-up time.

### **Attrition issues**

A notable strength of our study was the large sample size (N=1939) corresponding to 40% of the eligible children (N=4847). However, despite this large sample size, the attrition was 68,2% (N=4151/6090). Attrition is of major concerns in longitudinal studies and 30-70% attrition has been reported (Fischer, Dornelas, & Goethe, 2001; Tambs et al., 2009). Several risk factors have been shown to influence non-participation and loss to follow-up in epidemiological studies. Notably, factors such as educational level, employment status, marital status and socio-economic position (SEP) are important factors related to non-response and attrition (de Graaf, Bijl, Smit, Ravelli, & Vollebergh, 2000; Gustavson, von Soest, Karevold, & Roysamb, 2012; Nilsen et al., 2009; Tambs et al., 2009; Twisk & de Vente, 2002).

Similar to the attrition rates reported in other longitudinal studies (Fischer et al., 2001; Tambs et al., 2009), only 32% (N=1939) of the entire cohort alive at the time of follow-up (N=6071) participated in our study. In total, 1243 children (20.5%) were lost to follow-up, albeit mainly due to families (N=993) that had claimed 'research protection'. Whatever the reason, attrition may course loss of power and lead to biased estimates of associations between variables (Marcellus, 2004)

## **Data quality**

Data collection at the 11-12 year follow-up was obtained using web-based questionnaires. This procedure is a timesaving and financially feasible method in large population studies. However, even though each parent and child received personalized logins for each of the informants in order to encourage independent answers, we expect that some parents helped their children answering the questionnaires. In cases where the children may have difficulties in comprehending what is being asked, help from the parents may be useful. However, in such cases some children may not answer all questions honestly and may tend to reduce the extent of any problem behaviour or their answers may be influenced by the parents opinion. The participants may also have interpreted the questions differently, and their answers may have been influenced by their attitudes toward participating in the study whereby the reliability of their answers also may have been affected. This type of misclassification may be diminished by the use of personalized logins.

The baseline data collection during first year of life also needs to be discussed. The child health surveillance programme in Denmark offers all parents of new-borns regular visits by community health nurses (CNH) during the first year of life. These visits are free of charge and are offered irrespectively of family income, social class or risk status and are well established and accepted in the Danish society with participation rates of more than 90% (Skovgaard et al., 2005). Our data collection during infancy was embedded in this existing programme, where CHN collected the baseline data using standardized records including observational measures and maternal responses to semi-structured questions during four routine home visits. A manual describing how to obtain and record data was designed prior to baseline data collection, in order to reduce the variability in content. Using such procedure diminishes the risk of method variance and reporter bias, although the possibility of problems of inter-rater reliability cannot be discounted. The reliability and validity of the standardized records used in the baseline data collection has not yet been established, albeit CNH concerns has been found to be associated with objectively

measured failure to thrive and with different mental health problems at 1½ years (Olsen, Skovgaard, Weile, & Jorgensen, 2007; Skovgaard et al., 2008).

Finally, possible power issues have to be discussed. Some of the baseline variables were infrequently occurring (e.g. preterm birth and low birth weight), which might imply insufficient power to detect possible significant associations. On the other hand, some of the other baseline variables may have been over-inclusive (e.g. feeding and sleeping problems in infancy), that also may reduce the possibility to detect significant associations.

### **Specific points concerning self-report of pubertal status**

Estimates of pubertal development were obtained by self-report using the Tanner Stages of Development. There appears to be more inaccuracies of self-reported staging related to the latter stages of maturation and thus arguments for collapsing stage 4 and 5 have advanced (Coleman & Coleman, 2002). Accordingly, the children in our study were only presented to gender-specific Tanner stages 1-4. Despite conflicting reports on the validity of self-reported Tanner stages as an adequate estimate of pubertal development in general, Coleman & Coleman (2002) stated in a review that this procedure is considered a reasonably reliable proxy marker of pubertal development used in population-based studies (Coleman & Coleman, 2002). Risk of over- or underestimation of course cannot be excluded, however we have no reason to believe there would be such a problem of misreporting in our study.

### **Specific points concerning objective measurement of height and weight**

The objective measurement of height and weight by trained research staff is strength of the study. In general population samples, the use of self-reported height and weight are common, probably due to time and financial issues. However, parents tend to underestimate their child's weight (Rietmeijer-Mentink, Paulis, van Middelkoop, Bindels, & van der Wouden, 2013) and studies of adolescents and adults using self-reports reveal a tendency to overestimate height and underestimate weight (Gorber, Tremblay, Moher, & Gorber, 2007; Sherry, Jefferds, & Grummer-Strawn, 2007). In particular, girls tend to

underestimate weight compared to boys, and self-reported data generally tend to underestimate overweight (Sherry, 2007). Objectively measured anthropometric data are considered more accurate and recommended.

### **Specific points concerning the Eating Pattern Inventory (EPI-C)**

Our study showed good factorial validity of the EPI-C. The reliability estimates were in general satisfactory showing good internal consistencies for three of the four scales, except for the 'parental pressure to eat' scale showing a fairly low alpha coefficient (0.59). This scale, however, is based on only three items, and the item 'At home, I am allowed to leave food I don't like on my plate' had a fairly low loading compared to the other items of the EPI-C. The wording in this item is in the opposite direction compared to the other items in the instrument in the sense that a high score (Always) is indicative of a 'non-problematic' behaviour. This is different from the all other items, where a high score indicates a 'problematic' behaviour. The most likely cause of the low factor loading of this item is that some respondents did not read the question carefully and just chose the response category in line with their previous response. Eliminating this item with the low factor loading would prevent us from defining a factor in a factor analysis, as at least 3 items are considered a minimum in order to label something a factor (Yong & Pearce, 2013). Reliability, however, can be measured using only the two items, but eliminating the item did not improve the reliability estimate in our study.

Response choices of the EPI-C items were listed in a 5-point Likert Scale format ranging from 'not at all' to 'always'. Likert scales are the most frequently used format in questionnaires and are very useful in investigating behaviours and attitudes in allowing for respondents to indicate level of agreement of a given statement, and not just positive/negative answers. Respondents however, may tend to avoid extreme response categories, whereby the results can be biased by central tendency. Also, the validity of using a Likert scale measurement can be compromised due to social desirability bias as some respondents may answer the questions in a way they believe will be viewed more



favourably by others such as over-reporting 'good behaviours' and underreporting 'bad or undesirable behaviours'.

### **Specific points concerning the definition of problematic eating behaviours**

The EPI-C does not have specified cut-offs to differentiate 'normal' versus 'problematic' eating behaviours. Scheutmann et al (2008) classified the upper 15% of the subscale scores as problematic. However, they used a much smaller sample size (N=373), compared to our study (N=1939) and a broader definition might have been necessary to ensure enough 'cases'. We chose to use an EPI-C subscale score  $\geq$  90th percentile (the top 10%) within each subscale as indicative of a problematic eating behaviour in our study. We are aware that our case definition does not necessarily reflect the occurrence of an actual eating problem, but represent levels of eating behaviours that may be potentially problematic and of clinical significance. Our findings of significant associations with body dissatisfaction, overweight and mental health indicate that levels of eating behaviours within the top 10% may in fact be problematic and of clinical significance.

In total, 118 children (28.4%) reported multiple problematic eating behaviours according to our 'case-definition' of eating behaviours being considered problematic within the top 10%. One might expect that this group with multiple problematic eating behaviours would maybe represent a group of children with more disorganized and maybe more severe eating behaviours, albeit a frequently occurring single eating behaviour such as restrained eating also could be severe. Our findings suggest that the group of children with multiple problematic eating behaviours included more children reporting contemporaneous body dissatisfaction, being overweight and full filling the criteria for a mental disorder. Well aware of our pragmatic 'case-definition' of an eating behaviour problem, our findings might indicate a dose-response effect. This, however, is not the scope of the present study and needs to be further investigated in future studies.

## Conclusions

The EPI-C is a psychometrically sound instrument for measuring eating behaviours in general population samples of preadolescents. Using the top 10% highest subscale scores of the EPI-C as indicative of a 'problematic' eating behaviour, patterns of behaviours that may not just be variants of 'normal' behaviours, seem to be identified. These behaviours seem to be problematic and of putative clinical significance as they were significantly associated with overweight, body dissatisfaction and serious mental disorders. Notably, body dissatisfaction seems to be an important concurrent factor of restrained eating in normal weight children. The identified problematic eating behaviours in preadolescence, with restrained eating in particular, might constitute potential predictors of later eating disorder risk, that need to be further explored.

Overeating patterns were found prospectively associated with restrained eating in preadolescence. This might reflect a developmental course of restrained eating fluctuating between restriction- and overeating episodes. Overeating in preschool/early school age, however, might be worth monitoring in order to not only to reduce the risk over overweight, but also to the reduce the risk of the development of restrained eating in preadolescence.

# **Clinical and research perspectives**

## **Clinical perspectives**

The co-existence of problematic eating behaviours, body dissatisfaction, weight problems and mental disorders underscore the importance of health professionals considering these contemporary problems when assessing preadolescents with problematic eating behaviours; regardless of putative direction of causality.

## **Research perspectives**

There is still a need of further epidemiological research in childhood eating behaviours and problems. Longitudinal studies are needed to further investigate putative developmental trajectories of eating and weight problems across childhood, that may be imperative to prevention of the more severe eating pathology seen in adolescence. In particular, future studies should focus on a further exploration of the implications of problematic eating behaviours in preadolescence, that co-exists with body dissatisfaction and mental health problems.

Factorial validity of the EPI-C has been demonstrated. A further exploration of the external and predictive validity of the EPI-C, however, may improve the conditions for research of developmental pathways of eating behaviours and problematic eating in preadolescence.

## **Public health perspectives**

Preschool/early school age and preadolescence might constitute particular windows of opportunity regarding public health interventions. Examinations by community health nurses at school entry and regularly measurements of height and weight are part of an existing public health programme in Denmark. Preadolescence seems to be a key developmental period of interest in relation to eating behaviour problems, weight concerns and body dissatisfaction, and a period accompanied with increased risk of mental health problems. Thus early identification of eating- or weight problems in preadolescence might be crucial for preventive strategies of later eating pathology.

# Summaries

## English Summary

Eating problems are common in childhood and previous longitudinal studies suggests continuity of eating behaviours across childhood with early problematic eating behaviours being associated with the development of more severe eating and weight problems. The aetiology of eating problems in childhood and adolescence is believed to be multifactorial in nature, reflecting an interaction of developmental, environmental and social factors. In spite of a growing interest, however, knowledge on predictors and risk mechanisms of problematic eating behaviours in preadolescence are scarce. Pre-adolescence is characterised by the experience of physical and socio-emotional changes. Weight concerns and body dissatisfaction typically emerge during pre-adolescence, and the risk of mental health problems and development of problematic eating behaviours is increased.

A better understanding of problematic eating behaviours in pre-adolescence is needed in order to distinguish normal variations from clinically relevant eating problems. Knowledge on risk factors and predictors, as well as correlates of problematic eating behaviours in preadolescence is essential for preventive strategies, early detection and targeted interventions of eating and weight problems in adolescence.

The overall aim of this thesis is to improve our understanding of the epidemiology of eating behaviours in preadolescents in the general population. Initially we aimed to explore the psychometric properties of the Eating Pattern Inventory for Children. Also, we aimed to explore gender and weight-group differences in preadolescent eating behaviours and to study risk factors and predictors of problematic eating behaviours in preadolescence.

The study population was 1939 children from 11-12 year follow-up of the general population birth cohort study, CCC2000. All participants filled in a comprehensive web-based questionnaire including the Eating Pattern Inventory for children, the Children's Figure Rating Scale and the Development and The Development and Well-Being

Assessment (DAWBA). Height and weight was objectively measured, and pubertal development was estimated at a face-to-face assessment.

In study I, the psychometric properties of the EPI-C was evaluated using a confirmative factor analysis. Previous research suggests that the EPI-C is best conceptualized as comprising four factors: dietary restraint, emotional eating, external eating and parental pressure to eat. We found good reliability for the three out of four scales. Significant gender differences in preadolescent eating behaviours were identified, and eating behaviours were shown to differ among underweight, normal and overweight preadolescents.

In study II, we investigated correlates of problematic eating behaviours in preadolescence, using the top 10% highest sub scores of the EPI-C as indicative of 'problematic' eating behaviours. We found restrained, emotional and external eating being cross-sectional associated with overweight, body dissatisfaction and mental disorders. Notably, body dissatisfaction was found associated with restrained eating even in normal weight children. We found emotional disorders associated with restrained eating and neurodevelopmental disorders associated with external eating. Among the children with emotional eating were more likely to have a concurrent neurodevelopmental or emotional disorder, however uniquely among girls.

In study III, putative predictors of problematic eating behaviours were investigated and our study revealed significant associations between socio-economic adversities and later problematic eating behaviours, with social disadvantages being more pronounced in restrained eating. Low maternal educational level and low annual household income at the time of birth and at child age 9-10 were associated with restrained eating at age 11-12.

Finally we found overeating patterns at age 5-7 years reported by parents, predicted self-reported restrained eating at age 11-12 years.

Thus our findings indicate that problematic eating behaviours in preadolescence are associated with overweight, body dissatisfaction and mental disorders, worth monitoring. Our findings also suggest putative developmental pathways of problematic eating that needs to be further explored.

## Danish Summary

Spiseproblemer er hyppige hos børn, og longitudinelle studier tyder på, at problematisk spiseadfærd er relativt stabilt over tid og associeret med spise- og vægtforstyrrelser senere i livet. Overordnet anses årsagen til spiseproblemer i barndom og ungdomsår for at være multifaktoriel, og flere faktorer menes at spille en rolle, herunder udviklingsmæssige, psykologiske og socioøkonomiske faktorer. Til trods for en stigende interesse på området, er viden om det udviklingsmæssige forløb af problematisk spiseadfærd i tiden omkring puberteten imidlertid begrænset. Præpuberteten er karakteriseret ved store fysiske og socio-emotionelle forandringer. I denne periode opstår typisk bekymringer om vægt og negativ kropsopfattelse, og risikoen for psykiske helbredsproblemer og problematisk spiseadfærd er øget.

Der mangler imidlertid viden om de epidemiologiske forhold ved problematisk spiseadfærd i tiden omkring puberteten - en viden der er nødvendig for at kunne skelne mellem normale variationer og klinisk relevante spiseproblemer. Viden om risikofaktorer, prædiktorer, samt psykologiske og helbredsmæssige korrelater til problematisk spiseadfærd i tiden omkring puberteten er således afgørende for tidlig forebyggelse og målrettet indsats overfor spise- og vægtforstyrrelser i barnealder og ungdomsår.

Afhandlingens overordnede formål er at bidrage med viden om problematisk spiseadfærd i tiden omkring puberteten hos børn i normalbefolkningen. Målet var at undersøge de psykometriske egenskaber ved The Eating Pattern Inventory for Children. Derudover var målet at undersøge køns- og vægtmæssige forskelle i relation til spiseadfærd, samt at undersøge associationer i at udforske mulige risikofaktorer og prædiktorer for udvikling af problematisk spiseadfærd.

Deltagerne var 1939 børn 11-12 års opfølgningen af den generelle fødselskohorte, The Copenhagen Child Cohort, CCC2000. Alle deltagerne udfyldte omfattende web-baserede spørgeskemaer, bestående af bla. the Eating Pattern Inventory for Children, the Children's Figure Rating Scale and the Development og the Development and Well-Being

Assessment (DAWBA). Børnene deltog endvidere i en helbredsundersøgelse med måling af højde og vægt, samt vurdering af pubertets stadie.

I studie I, anvendte vi en konfirmatorisk factor analyse til at undersøge de psykometriske egenskaber af EPI-C. Tidligere studier foreslår at EPI-C omfatter 4 faktorer: *dietary restraint*, *emotional eating*, *external eating* og *parental pressure to eat*. Vi fandt god realibilitet for 3 ud af de 4 faktorer. Vi fandt desuden betydelige kønsforskelle i spiseadfærd, samt forskelle i spiseadfærd afhængig af vægtstatus i præpuberteten.

I studie II, undersøgte vi mulige faktorer associeret med problematisk spiseadfærd. Vi definerede 'problematiske' som værende de 10% højeste score indenfor hver undergruppe af spiseadfærd baseret på EPI-C. Vi fandt *restrained*, *emotional* og *external eating* forbundet med overvægt, negativ kropsoptagelse og psykisk sygdom. Negativ kropsoptagelse viste sig især at være associeret med *restrained eating*, også blandt normalvægtige børn. Der var højere forekomst af emotionelle forstyrrelser hos børn med *restrained eating*, og højere forekomst af neuro-udviklingsforstyrrelser hos børn med *external eating*. Blandt børn med *emotional eating*, sås en højere forekomst af såvel emotionelle forstyrrelser, som neuro-udviklingsforstyrrelser, men kun signifikant hos piger.

I studie III, undersøgte vi potentielle risikofaktorer og prædiktorer for udvikling af problematisk spiseadfærd. Vi fandt sammenhænge mellem socioøkonomiske vanskeligheder og senere udvikling af problematisk spiseadfærd. Dette viste sig især at være gældende for *restrained eating*. Lavt uddannelsesniveau hos moderen og lav husstandsindkomst omkring fødselstidspunktet og ved barnets 9-10 års alder viste sig at være prædiktiv for *restrained eating* i 11-12 års alderen. Blandt forældre-rapporteret spiseproblemer hos barnet i 5-7 års alderen fandt vi overspisning associeret med barnets selv-rapportering af *restrained eating* i 11-12 års alderen.

Resultaterne peger på, at problematisk spiseadfærd i tiden omkring puberteten er forbundet med andre samtidige problemer, som i sig selv berettiger til klinisk



opmærksomhed og intervention. Resultaterne tyder endvidere på mulige udviklingsmæssige forløb af problematisk spisning, som bør udforskes yderligere.

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# Papers

## Paper I

Article

### Validation of the Eating Pattern Inventory for Children in a General Population Sample of 11- to 12-Year-Old Children

Assessment  
1–10  
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#### Abstract

Previous research suggests that the Eating Pattern Inventory for Children (EPI-C) is best conceptualized as comprising four factors: dietary restraint, emotional, external eating and parental pressure to eat. This study aims to examine the psychometric properties of the EPI-C and to test gender and weight group differences. The population-based study sample comprised 1,939 children aged 11 to 12 years from the Copenhagen Child Cohort (CCC2000). Psychometric properties were evaluated using multigroup categorical data in confirmatory factor analysis (CFA) and differential item functioning (DIF) tests. CFA supported the four-factor solution for the EPI-C. Reliability estimates were satisfactory for three of the four scales. DIF with regard to weight was found for an item on weight loss intention. Girls reported higher restrained and emotional eating; overweight children reported higher restrained, emotional and external eating, while underweight children reported higher parental pressure to eat. The results support the use of EPI-C for measuring eating behaviors in preadolescence.

#### Keywords

eating behaviors, CCC2000, preadolescence, EPI-C, validity, psychometrics

Childhood eating and weight problems are important public health concerns (Ogden, Carroll, Kit, & Flegal, 2012; Swanson, Crow, Le Grange, Swendsen, & Merikangas, 2011). However, little is known about the trajectories of these problems, albeit they seem to be related to both disordered eating and obesity later in life (Marchi & Cohen, 1990; Stice, Marti, Shaw, & Jaconis, 2009). Thus, a better understanding of eating behaviors at different developmental stages in childhood may be of particular importance when attempting to identify developmental pathways for disordered eating and obesity. Preadolescence is considered a particularly important period concerning the development of eating attitudes and behaviors (Ricciardelli, McCabe, Holt, & Finemore, 2003). Children at this age are still highly influenced by parental eating attitudes and weight-related norms (Houldcroft, Farrow, & Haycraft, 2014; Salvy, de la Haye, Bowker, & Hermans, 2012), although it is a time of growing independence (Boutelle, Lytle, Murray, Birnbaum, & Story, 2001).

Body dissatisfaction and weight concerns have been found to emerge already in preadolescence (Davison, Markey, & Birch, 2003; Schur, Sanders, & Steiner, 2000; Shunk & Birch, 2004), both of which may contribute to the

development of problematic eating behaviors and attitudes in the period prior to adolescence. Given the knowledge that problematic eating behaviors in childhood and preadolescence may carry a risk of more severe eating pathology in the adolescent years (Marchi & Cohen, 1990; Stice et al., 2009), a better understanding of eating behaviors in this particular age group is needed in order to identify children at risk of developing later obesity or disordered eating.

Among the questionnaires developed for the purpose of investigating children's eating behaviors, the majority have

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focused on symptoms of eating disorders such as the Eating Disorder Inventory for Children (Garner, 1991), Children's Eating Attitudes Test (Maloney, McGuire, Daniels, & Specker, 1989), and Children's Eating Disorder Examination Questionnaire (Bryant-Waugh, Cooper, Taylor, & Lask, 1996), or have primarily been parent-report measures such as Children's Eating Behaviour Questionnaire (Archer, Rosenbaum, & Streiner, 1991) and Children's Eating Behaviour Inventory (Wardle, Guthrie, Sanderson, & Rapoport, 2001). To our knowledge, only two self-report measures assessing a broader spectrum of eating behaviors have been developed specifically for children and preadolescents. The Dutch Eating Behaviour Questionnaire for Children (van Strien & Oosterveld, 2008) is a modified adult measure assessing restrained, emotional and external eating. The Dutch Eating Behaviour Questionnaire for Children has only been used in few studies so far; however, the factorial validity and internal consistency seem to be satisfactory for the use in 10 to 12 year olds (van Strien & Oosterveld, 2008). The Eating Pattern Inventory for Children (EPI-C) is another promising measure designed to assess general psychological dimensions of eating behaviors in preadolescent children including restrained, emotional and external eating as well as parental pressure to eat (Schacht, Richter-Appelt, Schulte-Markwort, Hebebrand, & Schimmelmann, 2006).

Restrained eating reflects weight concerns and dietary restriction in order to lose or maintain weight; however, this behavior may also lead to episodes of overeating (Herman & Polivy, 1980; Polivy & Herman, 1985). Emotional eating is described as a coping mechanism to reduce negative emotions or emotional distress, such as anxiety, loneliness, and anger (Macht & Simon, 2011). Emotional eating seems to be associated with both under- and overeating tendencies, and emotional overeating tends to increase with age (Wardle et al., 2001). External eating is a behavior characterized by eating in response to external stimuli (e.g., taste, visibility and accessibility of food, and other people eating) regardless of internal state of feelings of hunger or satiety (Schachter & Rodin, 1974). External eating also refers to overeating tendencies (Brignell, Griffiths, Bradley, & Mogg, 2009). Several studies suggest a positive association between these potentially problematic eating behaviors (restrained, emotional and external eating) and overweight status in preadolescence and early adolescence (Field et al., 2003; Forrester-Knauss, Perren, & Alsaker, 2012; Haines, Neumark-Sztainer, Wall, & Story, 2007; Neumark-Sztainer et al., 2007; Schacht et al., 2006; Snoek, Engels, van Strien, & Otten, 2013; Snoek, van Strien, Janssens, & Engels, 2007). Parental pressure to eat is characterized by a tendency of parents to pressure the child to eat more, whereby parents directly influence what and how much their children eat (Birch et al., 2001). Parental pressure to eat is a common practice of parents' controlling the feeding of the

younger child; however, parental pressure to eat has also been found to be associated with restrained, emotional and external eating in preadolescence (Houldcroft et al., 2014; van Strien & Bazelier, 2007).

The EPI-C has been developed by Schacht et al. (2006). Initial explorative factor analysis have suggested satisfactory psychometric properties in a population-based sample of 373 German preadolescents aged 7-11 years (Schacht et al., 2006). Recently, Hirsch et al. (2014) replicated the factorial structure of the German version of EPI-C in a sample of 8-year-old children ( $N = 521$ ). However, the psychometric properties of the German version do not necessarily generalize to translated versions or studies of older children. Thus, there is a need of an evaluation of the psychometric properties of translated versions and an investigation of the validity of the instrument for the use in older children.

The present study aimed to validate the EPI-C in 11- to 12-year-old Danish children (fifth graders) using confirmatory factor analysis (CFA). Additionally, we aimed to investigate gender and weight group differences in preadolescent eating behaviors using the EPI-C. We hypothesized that the four-factor structure proposed by Schacht et al. (2006) could be replicated in our sample of Danish children. Furthermore, in line with previous findings (Schacht et al., 2006; Schuetzmann, Richter-Appelt, Schulte-Markwort, & Schimmelmann, 2008; Snoek et al., 2007), we hypothesized that eating behaviors would be associated with overweight; in particular, we expected an association between restrained eating and overweight.

## Method

### Procedure

The current study was conducted from May 1, 2011 to October 1, 2012 as part of the 11- to 12-year follow-up study of the Copenhagen Child Cohort (CCC2000) - an ongoing longitudinal prospective birth cohort study of the 6,090 children born in year 2000 in the area around Copenhagen, Denmark (Skovgaard et al., 2005). The cohort has been shown to be largely representative of all children born in Denmark that year regarding key perinatal characteristics (Olsen et al., 2005).

The children in the cohort were traced through the Danish Central Civil Registration System (Pedersen, 2011; Pedersen, Gotzsche, Moller, & Mortensen, 2006) in which all citizens in Denmark are registered with a personal identification number (10 digit CPR number) making linkage between Danish population registries possible. A total of 4,847 children were identified at the time of the current follow-up; 1,243 children were lost to follow-up (14 were not traceable, 19 had deceased, 217 had emigrated and 993 had claimed research protection). As part of the follow-up,

the eligible children were invited to fill in web-based questionnaires using personalized logins. Also, the children were invited to a subsequent face-to-face assessment, where height and weight were measured.

### Ethical Approval

The study was approved by the Danish Data Protection Agency (J.nr. 2010-41-4438) and by the Capital Region of Denmark (J.nr. 2007-58-0015); and the National Committee on Health Research Ethics was consulted (J.nr. H-C-FSP-2010-09). Participation was voluntary and data were kept confidential.

### Measures

**The Eating Pattern Inventory for Children.** The EPI-C is a 20-item self-report measure of psychological dimensions of children's eating behaviors. The EPI-C is derived from the German Eating Behavior and Weight Problems Inventory for children (EWI-C; Diehl, 1999), which has been used in adolescent samples only. The EWI-C consists of 10 scales with 6 subscales assessing eating behavior and 4 subscales assessing related attitudes and body dissatisfaction. The EPI-C is only based on the 6 subscales assessing eating behaviors comprising 39 items. To match preadolescents' reading and comprehension levels, some of the items were reworded. Principal component analysis led to the reduced 20-item EPI-C. In total, 19 items were excluded - 4 were not comprehensible and 15 items did not fulfill the criteria for item selection based on factor loadings, overlap of variance, item discrimination indices and item difficulties (Schacht et al., 2006). Schacht et al. (2006) suggest that the EPI-C can be conceptualized as comprising four scales: the *dietary restraint* scale (eight items), the *emotional eating* scale (four items), the *external eating* scale (five items), and the *parental pressure to eat* scale (three items).

The original German version of the EPI-C by Schacht et al. (2006) has been shown to have satisfactory internal consistency - 0.93 for dietary restraint, 0.80 for emotional eating, 0.74 for external eating and 0.72 for parental pressure to eat in a population of 8- to 11-year-old children. Among second-grade children (aged 8 years), the internal consistency reliabilities were lower: 0.87 for dietary restraint, 0.79 for emotional eating, 0.71 for external eating and 0.60 for parental pressure to eat (Hirsch et al., 2014).

The version of the EPI-C used in the current study was translated from English to Danish and back-translated into English and approved by the research team. Response choices of the EPI-C items were listed in a 5-point Likert-type scale format: 1 = *Not at all*; 2 = *A little*; 3 = *Sometimes*; 4 = *Mostly*; 5 = *Always*.

**Weight and Height.** Trained research staff measured height and weight using a Sohnle Professional height measuring

rod to the nearest 0.1 cm and a digital scale to the nearest 0.1 kg, respectively. The children were assessed without shoes. Body mass index (BMI) was estimated on the basis of the child's height and weight:  $BMI = \text{weight (kg)} / \text{height (m)}^2$ . The children were classified into BMI categories of underweight, normal weight or overweight/obese using the age- and gender-specific BMI cutoffs provided by the International Obesity Task Force (IOTF; Cole, Bellizzi, Flegal, & Dietz, 2000; Cole, Flegal, Nicholls, & Jackson, 2007).

**Data From Registers.** Register-based data were used for attrition analysis. Data on sociodemographics was obtained from the Integrated Database for Labor Market Research (DS, 1991), and data on perinatal factors, such as birth weight, gestational age and perinatal complications, was obtained from the Danish Medical Birth Register (Knudsen & Olsen, 1998).

### Statistical Analyses

Prior to CFA, the distribution of scores on each subscale was calculated by mean (*M*), standard deviation (*SD*), skewness and kurtosis. As part of the data description and as an initial evaluation of dimensionality, an eigen value analysis of the polychoric correlation matrix was performed (Muthén & Muthén, 2010). To test the factorial validity of the EPI-C, CFA were performed using Mplus version 5. To handle the ordinal items and in anticipation of skewed item distributions, factor analytic models for ordinal categorical data were used, applying probit regressions estimated by a robust weighted least squares estimator with mean and variance adjustment (Beauducel & Herzberg, 2006; Muthén & Muthén, 2010). The fit of the factor model was assessed by overall goodness-of-fit statistics including the comparative fit index (CFI), the nonnormed fit index (NNFI), and the root mean square error of approximation (RMSEA), where  $CFI > 0.95$ ,  $NNFI > 0.95$ , and  $RMSEA < 0.08$  were regarded as appropriate fit (Bentler, 1990; Browne & Cudeck, 1993; Hu & Bentler, 1999; Reeve, 2007; Steiger, 1990). We also present model  $\chi^2$  and degrees of freedom (*df*). The hypothesized factor model was based on the four-factor structure identified in the study by Schacht et al. (2006).

In addition to the main analysis, we tested robustness of the factor model in three ways: (1) To evaluate whether an exploratory analyses would point to another factor solution in our sample, we split the data into two random subsamples, performed exploratory factor analysis in one subsample and tested the resulting factor solution in the other subsample. (2) To test robustness of our factor solution across gender, we performed a multigroup CFA (Muthén & Christofferson, 1981), fixing factor loadings and item category thresholds across gender and weight groups. (3) As a further test of measurement invariance, we tested for differential item functioning (DIF) using logistic regression



**Table 1.** Mean Subscale Scores.

| Scale name               | Gender ( <i>N</i> = 1,939)   |      |                           |      | Classified by BMI categories in the subsample ( <i>N</i> = 1,567) |      |                                      |      |                                 |      |
|--------------------------|------------------------------|------|---------------------------|------|-------------------------------------------------------------------|------|--------------------------------------|------|---------------------------------|------|
|                          | Girls<br>( <i>n</i> = 1,017) |      | Boys<br>( <i>n</i> = 922) |      | Underweight<br>( <i>n</i> = 150)                                  |      | Normal weight<br>( <i>n</i> = 1,164) |      | Overweight<br>( <i>n</i> = 253) |      |
|                          | Mean                         | SD   | Mean                      | SD   | Mean                                                              | SD   | Mean                                 | SD   | Mean                            | SD   |
| Dietary restraint        | 1.56                         | 0.80 | 1.38                      | 0.64 | 1.09                                                              | 0.28 | 1.37                                 | 0.61 | 2.13                            | 0.91 |
| Emotional eating         | 1.20                         | 0.53 | 1.11                      | 0.35 | 1.13                                                              | 0.35 | 1.13                                 | 0.41 | 1.24                            | 0.62 |
| External eating          | 1.81                         | 0.63 | 1.81                      | 0.62 | 1.85                                                              | 0.54 | 1.78                                 | 0.61 | 1.90                            | 0.71 |
| Parental pressure to eat | 2.86                         | 0.74 | 2.95                      | 0.75 | 2.94                                                              | 0.96 | 2.58                                 | 1.00 | 2.43                            | 1.03 |

Note. BMI = body mass index.

methods (Zumbo, 1999). Evaluation of significant DIF was based on statistical significance and magnitude of effect as evaluated by a Nagelkerke  $R^2$  difference  $>2\%$  (Bjorner, Kosinski, & Ware, 2003).

The reliability was evaluated using Cronbach's alpha, and average interitem correlations were calculated. A Cronbach's alpha value of  $>.70$  was considered desirable. Some researchers have questioned the use of alpha coefficients to evaluate internal consistency in skewed data, and thus we also present Theta reliability coefficients as an alternative indicator of the internal consistency (Ferketich, 1990; Helms, Henze, Sass, & Mifsud, 2006). In order to investigate differences in eating behaviors between girls and boys and between underweight, normal, and overweight preadolescents, the CFA model was expanded to a structural equations model by including the covariates (gender and weight groups) as independent variables in the model. In this way, differences in eating behavior across gender and weight groups were assessed through a latent regression analysis (Muthén & Muthén, 2010). An advantage of this approach is the ability to handle nonnormality in the observed data through the probit model for the item loadings. Again, fit was evaluated using CFI, RMSEA, and NNFI.

## Results

### Participants

A total of 1,939 children (40% of those eligible) completed the EPI-C. Of these children, a subsample of 1,567 children were also assessed face-to-face, providing data on height and weight on 80% (1,567/1,939) of the participating children. The mean age of the children was 11.5 years ( $SD \pm 0.4$ ) and 52.4% of the children were girls. Compared to all nonparticipants in the cohort alive at the age of 11 to 12 years ( $N = 4,132$ ), the group of participants ( $N = 1,939$ ) included more girls, more children born at term, more children of Danish ethnicity, and more children living in stable families with better-educated parents and families with

higher annual household income (see online appendix, Table A; available online at <http://asm.sagepub.com/supplemental>). No significant differences were found regarding birth weight and Apgar score.

### Descriptives

For the children ( $N = 1,939$ ) providing responses, no missing data occurred. Descriptive statistics showed nonnormal distribution for all EPI-C items (mean item score = 1.71; range = 1-5;  $SD = 0.43$ ; skewness = 1.61; kurtosis = 3.46). Descriptive data for the scales by gender and weight status are presented in Table 1.

### Confirmatory Factor Analysis

Eigen value analysis resulted in four eigenvalues above 1: 7.89, 3.20, 1.76, and 1.63. Subsequent eigenvalues were 0.77, 0.66, and 0.62. In the CFA, all factor loadings were within acceptable range ( $>.40$ ) and the model explained 64.8% of the total item variance. Mean item scores and factor loadings are listed in Table 2. Model fit statistics indicated very good model fit ( $\chi^2 = 759$ ;  $df = 164$ ; RMSEA = 0.055; CFI = 0.977; NNFI = 0.982). In supplementary analyses, an exploratory factor analysis in the first random subsample found exactly the same factor structure as was used in the main analysis. This model was also replicated in the second random subsample with good model fit. In multigroup CFA, excellent fit was found for models specifying equal loading and thresholds across gender and across weight groups. No DIF was found for gender, but one item in the dietary restraint scale, "I should try harder to lose weight," showed significant DIF across weight groups ( $p < .0001$ ,  $R^2$  difference = 5%). This item showed a stronger association with weight group (i.e., stronger intention to lose weight in the overweight group) than the rest of the scale.

**Correlation Between Factors.** The factors were allowed to correlate in our model. However, most intercorrelations

**Table 2.** Item Descriptive Statistics and Factor Loadings.

| Scale name and items                                                     | Mean | SD   | Factor 1 |       | Factor 2 |       | Factor 3 |       | Factor 4 |       |
|--------------------------------------------------------------------------|------|------|----------|-------|----------|-------|----------|-------|----------|-------|
|                                                                          |      |      | Loading  | SE    | Loading  | SE    | Loading  | SE    | Loading  | SE    |
| Dietary restraint (Factor 1; 30.8% variance)                             |      |      |          |       |          |       |          |       |          |       |
| I am very afraid of putting on weight                                    | 1.64 | 1.04 | 0.921    | 0.007 |          |       |          |       |          |       |
| When I am finished eating I worry about getting too fat                  | 1.59 | 0.99 | 0.891    | 0.009 |          |       |          |       |          |       |
| I try to eat as little as possible so I don't put on any more weight     | 1.33 | 0.77 | 0.877    | 0.011 |          |       |          |       |          |       |
| While eating, I am always afraid of putting on weight                    | 1.43 | 0.86 | 0.899    | 0.009 |          |       |          |       |          |       |
| It is always on my mind that I weight too much                           | 1.32 | 0.80 | 0.914    | 0.009 |          |       |          |       |          |       |
| I should try harder to lose weight                                       | 1.53 | 0.77 | 0.853    | 0.011 |          |       |          |       |          |       |
| To keep my weight, I often eat less than I would actually like to        | 1.68 | 1.03 | 0.821    | 0.012 |          |       |          |       |          |       |
| I have already tried a couple of times to eat less                       | 1.28 | 0.68 | 0.834    | 0.014 |          |       |          |       |          |       |
| Emotional eating (Factor 2; 16.8% variance)                              |      |      |          |       |          |       |          |       |          |       |
| When I am afraid or worried I eat something                              | 1.12 | 0.48 |          |       | 0.951    | 0.010 |          |       |          |       |
| I eat when I am unhappy                                                  | 1.13 | 0.51 |          |       | 0.951    | 0.012 |          |       |          |       |
| When I am lonely, I comfort myself with food                             | 1.13 | 0.48 |          |       | 0.907    | 0.014 |          |       |          |       |
| Eating helps me when I am disappointed                                   | 1.24 | 0.65 |          |       | 0.862    | 0.015 |          |       |          |       |
| External eating (Factor 3; 11.2% variance)                               |      |      |          |       |          |       |          |       |          |       |
| When I see food I get hungry right away even if it not mealtime yet      | 1.78 | 0.93 |          |       |          |       | 0.728    | 0.020 |          |       |
| I often think about food during the day                                  | 1.84 | 0.91 |          |       |          |       | 0.651    | 0.021 |          |       |
| When I see someone eat, I also get hungry                                | 2.23 | 0.89 |          |       |          |       | 0.581    | 0.023 |          |       |
| I am often that hungry that I immediately have to eat something          | 1.79 | 0.98 |          |       |          |       | 0.703    | 0.023 |          |       |
| When I am together with someone who eats a lot, I eat a lot too          | 1.42 | 0.78 |          |       |          |       | 0.671    | 0.027 |          |       |
| Parental pressure to eat (Factor 4; 6.0% variance)                       |      |      |          |       |          |       |          |       |          |       |
| At home I must eat whatever is put on the table                          | 2.82 | 1.35 |          |       |          |       |          |       | 0.662    | 0.030 |
| My parents always want me to eat up everything that is on my plate       | 2.44 | 1.36 |          |       |          |       |          |       | 0.744    | 0.030 |
| At home I am allowed to leave food I don't like on my plate <sup>a</sup> | 2.52 | 1.34 |          |       |          |       |          |       | 0.456    | 0.025 |
| Factor correlations                                                      |      |      |          |       |          |       |          |       |          |       |
| Factor 2                                                                 |      |      | 0.428**  | 0.035 |          |       |          |       |          |       |
| Factor 3                                                                 |      |      | 0.288**  | 0.029 | 0.520**  | 0.034 |          |       |          |       |
| Factor 4                                                                 |      |      | -0.007   | 0.034 | 0.100*   | 0.042 | 0.163**  | 0.031 |          |       |

<sup>a</sup>Item reverse coded to concur with the scoring direction of the scale.

\*\*Correlation significant at the .01 level (2-tailed). \*Correlation significant at the .05 level (2-tailed).

were low (<.30), except for the correlation between restrained and emotional eating (0.43), and between emotional and external eating (0.52). For details, see Table 2.

**Reliability.** As shown in Table 3, Cronbach's alpha was 0.92 for dietary restraint, 0.87 for emotional eating, and 0.73 for external eating. The scale "Parental pressure to eat" had fairly low (0.59) Cronbach's alpha reliability. We tried to eliminate the item with the lowest factor loading ("At home I am allowed to leave food I don't like on my plate"), but this did not improve alpha (Cronbach's  $\alpha = 0.58$ ).

We also calculated Theta coefficients as alternative indicators of internal consistency; however, as shown in Table 3, these estimates were almost the exact same as the alpha coefficients. All inter-item correlations were above 0.30.

### Gender Differences in Eating Behaviors

As shown in Table 4, a latent regression analysis identified significant gender differences in eating behaviors, with girls reporting higher scores of restrained and emotional eating. Significantly higher scores of parental pressure to eat were

**Table 3.** Internal Reliability of the EPI-C.

| Scale name               | No. of items | Results of the present study |                               |                   | Schacht et al. (2006) |
|--------------------------|--------------|------------------------------|-------------------------------|-------------------|-----------------------|
|                          |              | Cronbach's $\alpha$          | Average interitem correlation | Theta coefficient | Cronbach's $\alpha$   |
| Dietary restraint        | 8            | 0.92                         | 0.61                          | 0.93              | 0.93                  |
| Emotional eating         | 4            | 0.87                         | 0.65                          | 0.88              | 0.80                  |
| External eating          | 5            | 0.73                         | 0.35                          | 0.73              | 0.74                  |
| Parental pressure to eat | 3            | 0.59                         | 0.33                          | 0.59              | 0.72                  |

Note. EPI-C = Eating Pattern Inventory for Children.

**Table 4.** Latent Regression Analysis of Gender Differences in Eating Behaviors ( $N = 1,939$ ).

| Scale name               | Estimate <sup>a</sup> | SE    | $p$   |
|--------------------------|-----------------------|-------|-------|
| Dietary restraint        | 0.354                 | 0.055 | <.001 |
| Emotional eating         | 0.334                 | 0.074 | <.001 |
| External eating          | −0.011                | 0.054 | .845  |
| Parental pressure to eat | −0.213                | 0.054 | <.001 |

<sup>a</sup>Standardized regression coefficients. Reference = Boys ( $n = 922$ ). To achieve comparability of results, factors were identified by fixing the loading of the first item in each scale to the values shown in Table 2.

seen among the boys, whereas no gender difference was seen with respect to external eating.

#### BMI Group Differences in Eating Behaviors

On the basis of the IOTF age- and gender-specific BMI references, 9.6% of the participants (150/1,567) were classified as underweight, 74.3% (1,164/1,567) were classified as normal weight, and 16.1% (253/1,567) were classified as overweight. A latent regression analysis showed significant differences in eating behaviors between underweight, normal, and overweight children (Table 5). Overweight children reported significantly higher levels of restrained, emotional and external eating compared with normal weight children, while significantly higher levels of parental pressure to eat were seen among the underweight children. Largest effect sizes were found for restrained, where the underweight group scored one standard deviation lower and the overweight group one standard deviation higher than the normal weight group. Adjusting for DIF in the item “I should try harder to lose weight” (by allowing a direct effect of weight group on this item) had only minor impact on the results for the overall factor (regression estimate changed from −1.000 to −0.968 for the underweight group and from 0.988 to 0.911 for the overweight group).

#### Discussion

The present study established that the EPI-C adequately assesses eating behaviors in 11- to 12-year-old children. A

confirmative factor analysis revealed that the four-factor model originally proposed by Schacht et al. (2006) could be replicated in our sample of Danish children with the four factors explaining 64.8% of the total variance. The items loaded as expected and the factor loadings ranged from 0.46 to 0.95, roughly corresponding to the original model by Schacht et al. (2006; range = 0.64–0.85). The only exception was the item “At home, I am allowed to leave food I don’t like on my plate,” which had a loading of 0.456—lower than any other item. This item is in the opposite direction of the other items, in the sense that a high item score (e.g., 5: *Always*) indicates lack of parental pressure to eat. For this reason, this item is reverse coded before analysis. The fairly low loading for this item may be due to some respondents not reading the question carefully and therefore choosing a response category that is in line with previous responses, but wrong in relation to the item wording. The reliability estimates showed good internal consistencies for three scales (Cronbach’s  $\alpha = 0.73$ –0.92) comparable with the study by Schacht et al. (2006) (range = 0.74–0.93). A rather low reliability for the scale on “Parental pressure to eat” (Cronbach’s  $\alpha = 0.59$ ) was seen in our study; however, this finding is consistent with the study by Hirsch et al. (2014), with Cronbach’s alpha being 0.60 for the parental pressure to eat scale. The low alpha coefficient for this scale is partly driven by the low factor loading for the item (“At home I am allowed to leave food I don’t like on my plate”) and partly driven by the low number of items for this particular scale. Eliminating this item, however, did not improve alpha. Some research suggests Cronbach’s alpha might underestimate internal consistency if item variances within a scale are unequal (Ferketich, 1990; Helms et al., 2006) and suggest using Theta coefficients as alternative indicators of internal consistency (Ferketich, 1990). However, these estimates were almost exactly same as the alpha coefficients.

Except for the correlation between dietary restraint and parental pressure to eat, the factors were positively intercorrelated. The predominantly weak-to-moderate factor correlations and the lack of item cross-loadings support the distinction between the four hypothesized constructs. The strongest correlation was found between the emotional and

**Table 5.** Latent Regression Analysis of BMI Group Differences in Eating Behaviors in Subsample ( $N = 1,567$ ).

| Scale name               | Underweight ( $n = 150$ ) |       |       | Normal weight<br>( $n = 1,164$ ) | Overweight ( $n = 253$ ) |       |       |
|--------------------------|---------------------------|-------|-------|----------------------------------|--------------------------|-------|-------|
|                          | Estimate                  | SE    | $p$   |                                  | Estimate                 | SE    | $p$   |
| Dietary restraint        | -1.000                    | 0.136 | <.001 | Ref                              | 0.988                    | 0.072 | <.001 |
| Emotional eating         | -0.044                    | 0.141 | .757  | Ref                              | 0.265                    | 0.099 | .007  |
| External eating          | 0.126                     | 0.101 | .210  | Ref                              | 0.179                    | 0.079 | .023  |
| Parental pressure to eat | 0.438                     | 0.104 | <.001 | Ref                              | -0.229                   | 0.076 | .003  |

Note. BMI = body mass index. Standardized regression coefficients. Reference = normal weight ( $n = 1,164$ ). To achieve comparability of results, factors were identified by fixing the loading of the first item in each scale to the values shown in Table 2.

external scales ( $r = 0.52$ ;  $p < .001$ ) in line with previous studies (Hirsch et al., 2014; Schacht et al., 2006).

We further demonstrated significant gender differences in eating behaviors. Compared with the few other studies that have used the EPI-C and of comparable age, our findings with girls reporting significantly higher levels of restrained and emotional eating are in line with the study by Forrester-Knauss et al. (2012). However, our findings are contradictory to the findings by Schacht et al. (2006), where boys reported higher scores than girls on all eating behaviors (restrained, emotional, and external eating). In another study using the EPI-C, Houldcroft et al. (2014) found emotional and external eating to be higher in boys, whereas no gender differences were seen in restrained eating (Houldcroft et al., 2014). Farrow and colleagues also found significantly higher external eating in boys compared to girls (Farrow, Haycraft, & Meyer, 2011), but did not find any gender differences in restrained or emotional eating. No gender difference was found for external eating in our sample; however, as shown above the results regarding gender differences in eating behaviors in this age group are mixed. In regard to parental pressure to eat, boys indicated significantly more parental pressure to eat compared to girls. The few other studies (Houldcroft et al., 2014; Schacht et al., 2006; van Strien & Bazelier, 2007) that have investigated preadolescents' perceptions of their parents pressuring feeding practice using the EPI-C did not find any significant gender differences for perceived parental pressure to eat.

Finally, we demonstrated that eating behaviors are associated with weight-group differences. Comparisons of eating behaviors of underweight, normal and overweight children revealed that the overweight children reported significantly higher scores on restrained eating and lower scores concerning parental pressure to eat compared to normal and underweight children, which is in line with findings from the study by Schacht et al. (2006). Additionally, we found emotional and external eating associated with being overweight. These results are in line with previous research indicating higher scores of emotional and external eating in overweight compared to normal weight children (Braet et al., 2008; Ledoux, Watson,

Baranowski, Tepper, & Baranowski, 2011; van Strien, Herman, & Verheijden, 2009). However, compared with other studies using the EPI-C, Schacht et al. (2006) found no association between weight status and emotional or external eating in preadolescents.

We found significant DIF with regard to weight group for one item in the dietary restraint scale - "I should try harder to lose weight" - caused by this item showing somewhat greater discrimination between weight groups than the other items. However, since adjusting for this DIF had only minor effect on the overall results, we conclude that the DIF can be ignored for practical purposes.

The strengths of the study are the large sample size ( $N = 1,939$ ) from a general child population - assessed at a narrow age span in preadolescence. Also, the use of objectively measured height and weight are a noteworthy strength. However, some limitations also have to be acknowledged, including the skewness of the EPI-C data. While we used categorical data for factor analysis to handle the skewed ordinal data (Muthén & Muthén, 2010), this skewness may have affected the reliability estimates. Ideally, we should have examined the convergent and discriminate validity; however, we did not have data available for such analyses. Moreover, the generalizability of our findings may be influenced by a higher participation rate for ethnic Danish preadolescents with fewer socioeconomic adversities in our sample.

The results of the study demonstrate the factorial validity of the EPI-C, and good reliability for three out of four scales. The confirmative factor analysis supports the conceptualization of the EPI-C with a four-factor solution as provided by Schacht et al. (2006). Significant gender differences in eating behaviors are present in preadolescence, and eating behaviors in this age group differ among underweight, normal, and overweight preadolescents.

Overall, the results support the use of the EPI-C as a psychometrically sound instrument for measuring eating behaviors in general population samples of preadolescents. Further exploration of the external and predictive validity of EPI-C will improve the conditions for research of developmental pathways of eating behaviors and disordered eating in young people.

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## Eating behaviours in preadolescence are associated with body dissatisfaction and mental disorders – Results of the CCC2000 study



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### ABSTRACT

Preadolescence is a key period in the early stages of eating disorder development. The aim of the present study was, firstly, to investigate restrained, emotional and external eating in a general population-based sample of 11–12 year olds. Secondly, we sought to explore how these eating behaviours are associated with possible predictors of eating disorders, such as body dissatisfaction, weight status and mental disorders. A subsample of 1567 children (47.7% boys; 52.3% girls) from the Copenhagen Child Cohort (CCC2000) completed web-based questionnaires on eating behaviours and body dissatisfaction using The Eating Pattern Inventory for Children (EPI-C) and The Children's Figure Rating Scale. Mental disorders were assessed using the online version of the Development and Well-Being Assessment (DAWBA) based on parental replies with final DSM-IV diagnoses determined by experienced child- and adolescent psychiatrists. Height and weight were measured at a face-to-face assessment. The results showed that restrained eating was significantly associated with overweight, body dissatisfaction and emotional disorders in both genders. Emotional eating showed similar associations with overweight and body dissatisfaction in both genders, but was only associated with mental disorders in girls. External eating was significantly associated with body dissatisfaction and neurodevelopmental disorders in both genders, but was only associated with overweight in girls. Our findings show that problematic eating behaviours can be identified in preadolescence, and co-exist with weight problems and mental disorders. Thus restrained, emotional and external eating was, in different ways, associated with overweight, body dissatisfaction and mental disorders. Our findings point to significant eating behaviours in preadolescence, which could constitute potential predictors of later eating disorder risk.

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Problematic eating behaviours in childhood and preadolescence may be pre-clinical manifestations of more severe eating problems in adolescence (Stice, Marti, Shaw, & Jaconis, 2009). A range of problematic eating behaviours has been described in non-clinical

populations in childhood with restrained, emotional and external eating being the most commonly researched behaviours (Marcus & Kalarchian, 2003; Herman & Mack, 1975; Schachter & Rodin, 1974; Macht, 2011). Restrained eating refers to weight concerns and restriction in eating (Herman & Mack, 1975), emotional eating is eating in response to emotional arousal rather than internal hunger and satiety cues (Macht, 2011) and external eating occurs when eating in response to external stimuli (e.g. taste, visibility and accessibility of food) regardless of internal state of hunger or satiety (Schachter & Rodin, 1974). These eating behaviours do not reflect

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disordered eating *per se*, but may be precursors of both obesity and eating disorders in adolescence (Marchi & Cohen, 1990) (Braet et al., 2008).

Previous research suggests that preadolescence is a key period regarding understanding the development of eating disorders (Ricciardelli, McCabe, Holt, & Finemore, 2003). Preadolescence is the transitional stage between childhood and adolescence and is usually defined as ranging from 8 to 12 years. The period is characterised by the onset of the pubertal development with the experience of physical and emotional changes (Susman & Dorn, 2009). Weight and shape concerns typically emerge during preadolescence (Davison, Markey, & Birch, 2003; Schur, Sanders, & Steiner, 2000; Shunk & Birch, 2004) and children at this age may be more vulnerable to body dissatisfaction and problematic eating behaviours. Previous studies suggest that body dissatisfaction is associated with problematic eating behaviours, particularly restrained and emotional eating (Forrester-Knauss, Perren, & Alsaker, 2012; Allen, Byrne, McLean, & Davis, 2008; Johnson & Wardle, 2005). Both weight concerns and body dissatisfaction are considered risk factors for developing eating pathology and obesity (Neumark-Sztainer et al., 2007).

The developmental changes experienced during the preadolescent years may also confer a particular psychological vulnerability (Graber, Brooks-Gunn, Paikoff, & Warren, 1994; Rutter, Caspi, & Moffitt, 2003) and preadolescence is considered a period of increasing risk of developing mental health problems (Jansen et al., 2013; Skovgaard et al., 2016; Ford, Goodman, & Meltzer, 2003). Previous studies indicate associations between problematic eating behaviours and specific mental disorders. For example Råstam et al. (Råstam et al., 2013) found restrained eating behaviours associated with ADHD and Autism-Spectrum-Disorders in a general population-based sample of 9–12 year olds ( $N = 12,366$ ); and Houldcroft et al. (Houldcroft, Farrow, & Haycraft, 2014) found restrained, emotional, and external eating associated with symptoms of anxiety and depression in a sample of 7–10 year olds ( $N = 356$ ). These findings resemble the patterns of psychiatric comorbidity found in clinical samples of adolescents with eating disorders (Cortese et al., 2007; Pallister & Waller, 2008; Santos, Richards, & Bleckley, 2007).

Problematic eating behaviours have also been associated with overweight status in preadolescence and early adolescence (Neumark-Sztainer et al., 2007; Snoek, van Strien, Janssens, & Engels, 2007; Field et al., 2003; Silva, Capurro, Saumann, & Slachevsky, 2013). Prior research has found that 8–11 year old overweight children more often report higher levels of restrained eating compared to normal weight children (Schacht, Richter-Appelt, Schulte-Markwort, Hebebrand, & Schimmelmann, 2006), while others have found higher scores of emotional and external eating in overweight compared to normal weight children of comparable age (Braet et al., 2008; Ledoux, Watson, Baranowski, Tepper, & Baranowski, 2011).

Previous research also indicates gender differences in eating behaviours in preadolescence, however with inconsistent results. Some research suggests higher levels of restrained and emotional eating in girls than in boys (Forrester-Knauss et al., 2012; Snoek et al., 2007), while other studies found boys scoring higher on these eating behaviours (Schacht et al., 2006). Regarding external eating, some studies suggest higher levels of external eating in boys (Houldcroft et al., 2014; Schacht et al., 2006; Farrow, Haycraft, & Meyer, 2011) compared to girls, while others found no gender differences in external eating (Hirsch et al., 2014).

Despite a growing interest in the field of childhood eating problems, there is still a need to increase knowledge of how problematic eating behaviour in preadolescence predicts later eating disorder risk. Also, a better understanding of co-morbidities

in this particular developmental period is imperative for early prevention and targeted interventions (Nicholls & Bryant-Waugh, 2009). Thus, the aim of the current study was to investigate problematic eating behaviours (restrained, emotional and external eating) in a population-based sample of 11–12-years-old children using cross-sectional data. Additionally, the study aimed to explore associations between these problematic eating behaviours and mental disorders (according to DSM-IV diagnoses), body dissatisfaction and weight status. Based on previous findings we hypothesised that problematic eating behaviours would be: 1) associated with overweight and body dissatisfaction (Forrester-Knauss et al., 2012; Allen et al., 2008); 2) more prevalent in girls (Forrester-Knauss et al., 2012; Snoek et al., 2007); and 3) would be differentially associated with mental disorders (Råstam et al., 2013; Houldcroft et al., 2014; Micali, Ploubidis, De Stavola, Simonoff, & Treasure, 2014).

## 1. Methods

### 1.1. Study population

We studied a subsample of children from the general population birth cohort, The Copenhagen Child Cohort (CCC2000). The CCC2000 study is an on-going longitudinal birth cohort study designed to investigate determinants of risk factors and early signs of psychopathology (Skovgaard et al., 2005). The initial cohort comprised all 6090 children born in year 2000 in the former County of Copenhagen, Denmark. The cohort has been found representative of all children born in Denmark that year regarding key perinatal characteristics (Skovgaard et al., 2005; Olsen et al., 2005).

### 1.2. Procedure

The current study was conducted from May 1st, 2011 till October 1st, 2012 as part of the 11–12 year follow-up study of the CCC2000. The children were traced through the Danish Central Civil Registration System (Pedersen, Gotzsche, Møller, & Mortensen, 2006; Pedersen, 2011) in which all citizens in Denmark are registered with a personal identification number (CPR-number). A total of 4847 children of the initial cohort sample were identified at the time of the current follow-up. 1243 children were lost to follow-up, of which: 14 were not traceable; 19 were deceased; 217 had emigrated; and 993 families had claimed 'research protection' (an option used in Denmark at that time to state that the citizen did not want requests for statistical and scientific use). Letters announcing the 11–12 year follow up were sent to all eligible children and their parents. They were asked to fill in web-based questionnaires using personalised logins for each of the informants in order to encourage independent answers. The children were also invited to a face-to-face clinical assessment, where height and weight were measured, and children and parents who had not completed the questionnaire prior to the assessment were helped to do so. A total of 1939 children completed the questionnaires, with 1567 of those also attending the subsequent face-to-face assessment. Only children completing both the questionnaires and the face-to-face assessment were included in the current analysis.

### 1.3. Data from registers

Information from the Danish National Health Registries was used to describe background characteristics of the children in the cohort and to compare participants with non-participants. Information on perinatal child factors and socio-economic status was obtained from the Danish Medical Birth Register (Knudsen & Olsen, 1998) and the Integrated Database for Labour Market

Research (DS, 1991).

#### 1.4. Ethics

The study was approved by The Danish Data Protection Agency (J.nr.2010-41-4438) and by the Capital Region of Denmark (J.nr.: 2007-58-0015). The National Committee on Health Research Ethics was also consulted (J.nr.H-C-FSP-2010-09). Participation was voluntary and all data was kept confidential.

#### 1.5. Measures

##### 1.5.1. Eating behaviours

The Eating Pattern Inventory for Children (EPI-C) was used to assess psychological dimensions of eating behaviours (Schacht et al., 2006). It is a 20 item self-report based on The Eating Behaviour and Weight Problems Inventory for Children (Diehl, 1999) and consists of the following 4 scales: the *dietary restraint* scale (8 items related to weight concerns and restriction in eating); the *emotional eating* scale (4 items describing eating as coping with emotional distress); the *external eating* scale (5 items related to eating in response to external stimuli regardless of internal state of hunger) and the *parental pressure to eat* scale (3 items concerning the children's perceptions of parental behaviour in relation to the child's eating). The latter subscale (parental pressure to eat) does not, however, provide information about children's eating behaviour and was therefore not included in the current study.

The EPI-C is developed by Schacht et al. (2006) and has shown good validity and reliability for the use in preadolescent samples (Schacht et al., 2006). For the current study, the EPI-C was translated into Danish and translated back into English by a professional translator and approved by the research team. Response choices were listed in a 5-point Likert Scale format: 'not at all' (Stice et al., 2009), 'a little' (Marcus & Kalarchian, 2003), 'sometimes' (Herman & Mack, 1975), 'mostly' (Schachter & Rodin, 1974) and 'always' (Macht, 2011).

Previously, we performed a confirmatory factor analytic investigation of the Danish version of the EPI-C (Munkholm et al., 2016) and the results revealed that the 4-factor model of the EPI-C originally proposed by Schacht et al. (2006) (Schacht et al., 2006) could be replicated in our sample. In the present sample the internal reliability coefficients (Cronbach's alphas) were 0.92 for dietary restraint; 0.87 for emotional eating; 0.73 for external eating; and 0.59 for parental pressure to eat indicating good levels of internal consistency. These factors explained 64.8% of the total item variance, which is consistent with the findings by Schacht et al. (2006) (Schacht et al., 2006). Subscale scores were calculated by dividing the total subscale sum by the number of items in the respective subscales. Higher subscale scores indicated higher presence of an eating behaviour.

##### 1.5.2. Body dissatisfaction

The Children's Figure Rating Scale was used to assess body dissatisfaction in the children (Tiggemann, 2005). Nine same-sex silhouette drawings ranging from very underweight (Stice et al., 2009) to very overweight (Susman & Dorn, 2009) were presented to the child. The child then selected *a) the drawing that they considered most resembled their own body* (perceived body size), and *b) the drawing that they most wished to resemble* (ideal body size). Body dissatisfaction was calculated by subtracting ideal body size from perceived body size. Higher scores indicated higher body dissatisfaction.

##### 1.5.3. Mental disorders

The online version of the Development and Well-Being

Assessment (DAWBA) was used to assess child mental disorders. DAWBA is a validated diagnostic interview administered to parents and children. Structured questions cover the operationalized criteria of several mental disorders, such as Pervasive Developmental Disorders (PDD) including Autism-Spectrum Disorders (ASD), Attention Deficit Hyperactivity Disorders (ADHD), Conduct disorders (CD), Tics, Psychosis, Anxiety Disorder (AD), Depressive Disorders (DD) and Obsessive Compulsive Disorders (OCD). Additionally, open-ended questions record the respondent's own description of the child's problems. A computerized algorithm generates preliminary diagnoses and subsequently, experienced child and adolescent psychiatrists review all available information (e.g. preliminary diagnoses and the children's and parents description of the child's problem) and determine whether the child meets the criteria for a DSM-IV diagnosis (Goodman, Ford, Richards, Gatward, & Meltzer, 2000). In the present study, the inter-rater reliability for any DSM-IV diagnosis was high (kappa 0.81) (Jeppesen et al., 2015).

Due to small numbers within the specific diagnoses, we grouped the mental disorders into two groups: neuro-developmental disorders (PDD, ADHD, CD, Tics and Psychosis) and emotional disorders (AD, DD and OCD).

##### 1.5.4. Measurements of weight, height and puberty

Trained research staff measured height and weight at the research clinic. Height was measured without shoes (using a Soehnle Professional Height Measuring Rod to the nearest 0.1 cm) and weight was measured without shoes to the nearest 0.1 kg on a digital Scale (OBH Nordica exact/personal scale Type 6295). Body Mass Index (BMI) was calculated using the formula:  $BMI = \text{weight (kg)} / \text{height (m)}^2$  and classified using The International Obesity Task Force (IOTF) BMI cut-off points for thinness, overweight and obesity (Cole, Bellizzi, Flegal, & Dietz, 2000, 2007). Due to small numbers, the obese children ( $N = 4$ ) were included in the overweight group.

Pubertal development was included as a possible important confounding factor, as puberty might be independently associated with problematic eating behaviours, body dissatisfaction, weight status and mental disorders. Puberty was determined by self-report, using the Tanner Stages of development, which is the most frequently used classification of pubertal stages. Self-report of the Tanner stages has been shown to be a reasonably reliable indicator of pubertal development (Coleman & Coleman, 2002). Thus, the children in our study were presented to the gender-specific drawings of the developmental stages (Tanner stage 1–4) and were asked to point out the drawing most resembling themselves (Rapkin, Tsao, Turk, Anderson, & Zeltzer, 2006; Slora et al., 2009). The onset of pubertal development was defined as Tanner stages above stage 1.

#### 1.6. Statistical analyses

Analyses were carried out using the Statistical Package for the Social Sciences software (SPSS version 22 for Mac, 2012, SPSS Inc.) (SPSS, 2012). Analyses of attrition were based on the whole cohort alive at age 11 years ( $N = 6071$ ) comparing participants ( $N = 1567$ ) versus non-participants ( $N = 4505$ ). Descriptive statistics were used to analyse sample characteristics, and between groups comparisons were performed using  $\chi^2$  for categorical outcomes and Mann Whitney U-test for continuous outcomes.

Given that the EPI-C does not have specified cut-offs to differentiate 'normal' versus 'problematic' eating behaviors, we used an EPI-C subscale score  $\geq 90^{\text{th}}$  percentile (the top 10%) within each subscale as indicative of a problematic eating behaviour in our study. Outcome measures were dichotomised into: 1) 'Restrained eating' vs. 'No restrained eating'; 2) 'Emotional eating' vs. 'No

emotional eating'; and 3) 'External eating' vs. 'No external eating'.

All univariate analyses were conducted stratified by gender enabling us to investigate potential gender-specific associations. Multiple logistic regression analyses were performed to investigate the effect of body dissatisfaction on eating behaviours. To avoid over-fitting, only three additional explanatory variables (gender, puberty and weight status) were included in the models. The significance level was set to a p-value of <0.05 (two-sided) in all association analyses and <0.01 in the attrition analyses.

## 2. Results

### 2.1. Sample

In total, 1567 children (32.3% of the 4847 eligible children) both completed the questionnaires and attended the face-to-face assessment (47.7% boys and 52.3% girls with a mean age of 11.6 years (range 10.8–12.7 years). Compared with all the non-participants alive at age 11 years (N = 4504), the group of participants (N = 1567) more often had two Danish parents (79.8% vs 67.2%); had fewer family composition changes between 0 and 10 years (22.7% vs 31.3%); had more well-educated parents (highest education 2010 (15 + years) (maternal education level: 40.2% vs 25.8%; paternal education level: 32.3% vs 20.3%); and families with higher annual household income (33.6% vs 20.1%). All p-values <0.001.

### 2.2. Descriptives

Table 1 shows the frequencies of the variables used in the study. The distribution of problematic eating behaviours stratified by gender is shown in Table 2.

### 2.3. Eating behaviours across weight status and gender

According to the criteria described above, a total of 26.5% of the children (416/1567) reported a score of restrained, emotional and/or external eating  $\geq 90^{\text{th}}$  percentile (for details see Table 2).

#### 2.3.1. Restrained eating

Among the children reporting restrained eating (10.3%; 162/1567) a significant gender difference was seen (64.2% girls vs. 35.8%

boys; OR = 1.73; 95%CI 1.23–2.43;  $p = 0.001$ ). The children were mostly normal weight (49.4%; N = 80) or overweight (49.4%; N = 80) with only a few being underweight (1.2%; N = 2). Strong associations were found between restrained eating and overweight in both genders (Tables 3 and 4).

#### 2.3.2. Emotional eating

Among children reporting eating as a way of coping with emotional distress (11.9%; 187/1567) a similar gender difference was found (64.2% girls vs. 35.8% boys; OR = 1.75; 95%CI 1.27–2.40;  $p = 0.001$ ). Also, emotional eating was associated with overweight in both genders (Tables 3 and 4). However, most of the emotional eating children were normal weight (65.8%; N = 123), while 23.5% (N = 44) were overweight and 10.7% (N = 20) were underweight.

#### 2.3.3. External eating

Contrary to restrained and emotional eating, no gender difference was seen (55.3% girls vs. 44.7% boys;  $\chi^2 = 0.90$ ; OR = 1.15; 95% CI 0.86–1.55;  $p = 0.34$ ) among the children reporting eating in response to external stimuli regardless of internal state of hunger (13.1%; 206/1567). Uniquely among girls, a significant association was also found between external eating and overweight (Table 3). Also, most of the external eating children were normal weight (68.9%; N = 142), while 22.8% (N = 47) were overweight and 8.3% (N = 17) were underweight.

### 2.4. Eating behaviours and body dissatisfaction

Restrained eating was significantly associated with body dissatisfaction in both girls (OR = 2.81; 95% CI 2.26–3.50;  $p < 0.0001$ ) and boys (OR = 3.66; 95% CI 2.74–4.88;  $p < 0.0001$ ), while external eating was only associated with body dissatisfaction in boys (OR = 1.24; 95% CI 1.01–1.52;  $p = 0.04$ ). In regression analyses, adjusting for puberty and overweight, restrained eating remained significantly associated with body dissatisfaction in both genders (girls: adjusted OR = 2.44; 95% CI 1.93–3.10;  $p < 0.0001$  and boys: adjusted OR = 2.98; 95% CI 2.14–4.15;  $p < 0.0001$ ). Uniquely among boys, the adjusted analyses showed that the association between restrained eating and body dissatisfaction was also influenced by overweight (Table 5).

Among the children with a discrepancy between perceived and ideal body size, 14.5% (227/1567) indicated an ideal body size two

**Table 1**  
Frequencies of variables used in the study stratified by gender.

|                                           | Girls (N = 819)    | Boys (N = 748)     | Total (N = 1567)   | Statistics    |         |
|-------------------------------------------|--------------------|--------------------|--------------------|---------------|---------|
|                                           | N (%)              | N (%)              | N (% of total)     | $\chi^2$ (df) | p-value |
| Pubertal development                      |                    |                    |                    |               |         |
| Stage 1                                   | 145 (17.7%)        | 193 (25.8%)        | 338 (21.6%)        | 50.81 (4)     | <0.001  |
| Stage 2                                   | 402 (49.1%)        | 400 (53.5%)        | 802 (51.2%)        |               |         |
| Stage 3                                   | 223 (27.2%)        | 125 (16.7%)        | 348 (22.2%)        |               |         |
| Stage 4                                   | 37 (4.5%)          | 9 (1.2%)           | 46 (2.9%)          |               |         |
|                                           | Missing 12 (1.5%)  | Missing 21 (2.8%)  | Missing 33 (2.1%)  |               |         |
| BMI (kg/m <sup>2</sup> )                  |                    |                    |                    |               |         |
| Mean ( $\pm$ SD)                          | 18.5 ( $\pm$ 3.01) | 18.4 ( $\pm$ 2.94) | 18.4 ( $\pm$ 2.98) | 7.44 (2)      | 0.03    |
| Underweight                               | 94 (11.5%)         | 56 (7.5%)          | 150 (9.6%)         |               |         |
| Normal weight                             | 592 (72.3%)        | 572 (76.5%)        | 1164 (74.3%)       |               |         |
| Overweight <sup>a</sup>                   | 133 (16.2%)        | 120 (16.0%)        | 253 (16.1%)        |               |         |
| Body dissatisfaction                      |                    |                    |                    |               |         |
| Range                                     | –6–7               | –4–4               | 0–7                | 40.73 (12)    | <0.0001 |
| Mean ( $\pm$ SD)                          | 0.46 (1.18)        | 0.30 (1.07)        | 0.38 (1.13)        |               |         |
| Mental health problems (DSM IV-diagnoses) |                    |                    |                    |               |         |
| Any DSM-IV disorder                       | 97 (11.8%)         | 109 (14.6%)        | 206 (13.1%)        | 2.55 (1)      | 0.11    |
| Any DSM-IV neurodevelopmental disorder    | 31 (3.8%)          | 65 (8.7%)          | 96 (6.1%)          | 16.35 (1)     | <0.001  |
| Any DSM-IV emotional disorder             | 76 (9.3%)          | 55 (7.4%)          | 131 (8.4%)         | 1.89 (1)      | 0.17    |

<sup>a</sup> Only four children were classified as obese and were encountered in the overweight group.

**Table 2**  
Distribution of problematic eating behaviors stratified by gender.

| Problematic eating behaviour <sup>a</sup>        | Mean subscale scores |      |       | Girls (N = 819) | Boys (N = 748) | Total (N = 1567) | Statistics    |         |
|--------------------------------------------------|----------------------|------|-------|-----------------|----------------|------------------|---------------|---------|
|                                                  | Girls                | Boys | Total | N (% of total)  | N (% of total) | N (% of total)   | $\chi^2$ (df) | p-value |
| Type of problematic eating                       |                      |      |       |                 |                |                  |               |         |
| Dietary restraint                                | 1.55                 | 1.37 | 1.46  | 104 (12.7%)     | 58 (7.8%)      | 162 (10.3%)      | 10.31 (1)     | 0.001   |
| Emotional eating                                 | 1.19                 | 1.10 | 1.15  | 120 (14.7%)     | 67 (9.0%)      | 187 (11.9%)      | 12.06 (1)     | 0.001   |
| External eating                                  | 1.82                 | 1.79 | 1.81  | 114 (13.9%)     | 92 (12.3%)     | 206 (13.1%)      | 0.90 (1)      | 0.34    |
| No. of problematic eating behaviors <sup>a</sup> |                      |      |       |                 |                |                  |               |         |
| One                                              |                      |      |       | 172 (21.0)      | 126 (16.8%)    | 298 (19.0%)      | 14.26 (3)     | 0.003   |
| Two                                              |                      |      |       | 59 (7.2)        | 38 (5.1%)      | 97 (6.2%)        |               |         |
| Three                                            |                      |      |       | 16 (2.0%)       | 5 (0.7%)       | 21 (1.3%)        |               |         |
| None                                             |                      |      |       | 572 (69.8%)     | 579 (77.4%)    | 1151 (73.5%)     |               |         |
| Any problematic eating behaviors <sup>a</sup>    |                      |      |       |                 |                |                  |               |         |
| Yes                                              |                      |      |       | 247 (30.2%)     | 169 (22.6%)    | 416 (26.5%)      | 11.47 (1)     | 0.001   |

<sup>a</sup> The 10% highest subscale scores ( $\geq 90$  percentile) was used as indicative of problematic eating behaviors.

or more sizes thinner than perceived. Among these children 94 (41.4%) were normal weight and 133 (58.6%) were overweight. Approximately one third ( $N = 36$ , 69% girls; 31% boys) of these normal weight children expressing body dissatisfaction also reported restrained eating.

### 2.5. Co-occurrence between eating behaviours and mental disorders

Based on the DAWBA, 13.1% (206/1567) of the participants met the criteria for a specific DSM-IV mental disorder. Of these: 36.4% (75/206) were diagnosed with a neurodevelopmental disorder (PDD, ADHD, CD, Tics or Psychosis); 53.4% (110/206) were diagnosed with an emotional disorder (AD, DD or OCD); and 10.2% (21/206) were diagnosed with both a neurodevelopmental and an emotional disorder. Neurodevelopmental disorders were significantly more common in boys, whereas no significant gender differences were seen in emotional disorders diagnoses (Table 1). Among all the children with problematic eating behaviours, 19.2% (80/416) were diagnosed with a DSM-IV mental disorder (Table 3). Independent of gender, restrained eating was associated with emotional disorders, while external eating was associated with neurodevelopmental disorders. Emotional eating in girls was significantly associated with both neurodevelopmental disorders ( $p = 0.005$ ) and emotional disorders ( $p < 0.001$ ); whereas only a near significant trend of associations between emotional eating and emotional disorders was seen in boys ( $p = 0.046$ ) (For details, see Tables 3 and 4).

### 3. Discussion

The current study investigated eating behaviours in a large general population-based study of 11–12-year-old children from the Danish birth cohort study CCC2000. Our findings indicate that problematic eating behaviours are cross-sectionally associated with overweight, body dissatisfaction and mental disorders in preadolescence.

The association between problematic eating behaviours and overweight is in line with findings from other but smaller cross-sectional studies of preadolescents (Forrester-Knauss et al., 2012; Schacht et al., 2006; Schuetzmann, Richter-Appelt, Schulte-Markwort, & Schimmelmann, 2008). In particular, we found restrained eating significantly associated with overweight in our sample. This may be explained by overweight children being more likely to restrain their eating compared to normal weight children in order to lose weight (Field & Colditz, 2001). In line with this, some studies (Shunk & Birch, 2004; Snoek, van Strien, Janssens, & Engels, 2008) suggest that overweight may lead to restrained eating due to

weight concerns and body dissatisfaction. However, others argue that restrained eating may itself cause weight gain and overweight due to altering periods of overeating and failed weight loss attempts (Field et al., 2003; Neumark-Sztainer, Wall, Story, & Stanchish, 2012; Haines, Neumark-Sztainer, Wall, & Story, 2007). Due to the use of cross-sectional data, the causal direction cannot be assessed in the present study. However our results corroborate that restrained eating is a significant eating behaviour in preadolescence (Schacht et al., 2006), which could be a potential predictor of later eating disorder risk, worth monitoring.

We further demonstrated that problematic eating behaviours were associated with body dissatisfaction. This finding is consistent with several other studies (Allen et al., 2008; Johnson & Wardle, 2005; Stice & Shaw, 2002; Micali et al., 2015) which identified a significant association between body dissatisfaction, emotional eating (Johnson & Wardle, 2005) and restrained eating (Allen et al., 2008) in children at comparable ages (8–12 years). Similar to studies of adolescents (Eisenberg, Neumark-Sztainer, & Paxton, 2006), we also found a significant gender difference in body dissatisfaction, with girls expressing higher levels of body dissatisfaction than boys. In general, overweight children are more likely to experience concerns about weight and shape than normal weight children (Tanofsky-Kraff et al., 2004). Some studies suggest that a certain degree of body dissatisfaction may serve as a motivator of healthy behaviour in overweight populations (Heinberg, Thompson, & Matzon, 2001). In our study, the majority of children indicating an ideal body size at least 2 sizes thinner than perceived, were overweight (58.6%). However, 41.4% of the children were normal weight. This trend of 'feeling fat', even in a healthy weight range, is well known in studies of adolescents (Neumark-Sztainer, Story, Hannan, Perry, & Irving, 2002), and our findings indicate that this trend may be a factor of significance that needs to be considered already in preadolescence.

Finally we found that problematic eating behaviours were associated with mental disorders. Almost one fifth of the children with problematic eating behaviours in our study fulfilled the criteria for a contemporaneous DSM-IV mental disorder. A recent study of 13–15 year old children (Micali et al., 2014) suggests that overeating tendencies are associated with emotional and behavioural disorders. Our results indicate similar associations, however external eating was only significantly associated with neurodevelopmental disorders in our study. Also supporting prior research of 7–10 year old children (Houldcroft et al., 2014) where significant associations between problematic eating behaviours and emotional disorders were demonstrated, we found restrained and emotional eating being associated with emotional disorders. However, in our study, only emotional eating in girls was associated with emotional disorders. The co-occurrence of problematic eating

/ses: Associations of eating behaviors in girls (N = 819).

|                               | Dietary restraint      |                   |                       | Emotional eating       |                   |                       | External eating        |                   |                       |
|-------------------------------|------------------------|-------------------|-----------------------|------------------------|-------------------|-----------------------|------------------------|-------------------|-----------------------|
|                               | Problematic<br>N = 104 | Normal<br>N = 715 | Or (95%CI)<br>p-value | Problematic<br>N = 120 | Normal<br>N = 699 | Or (95%CI)<br>p-value | Problematic<br>N = 114 | Normal<br>N = 705 | Or (95%CI)<br>p-value |
| ses >1                        | 95 (93.1%)             | 567 (80.4%)       | 3.30 (1.50–7.28)      | 101 (84.9%)            | 561 (81.5%)       | 1.27 (0.74–2.17)      | 105 (92.9%)            | 557 (80.3%)       | 3.23 (1.54–6.79)      |
| it                            | 2 (1.9%)               | 92 (12.9%)        | 0.13 (0.03–0.55)      | 12 (10.0%)             | 82 (11.7%)        | 0.84 (0.44–1.56)      | 11 (9.6%)              | 83 (11.8%)        | 0.80 (0.41–1.55)      |
| ght                           | 56 (53.8%)             | 536 (75.0%)       | 0.39 (0.26–0.59)      | 81 (67.5%)             | 511 (73.1%)       | 0.76 (0.50–1.16)      | 76 (66.7%)             | 516 (73.2%)       | 0.73 (0.48–1.12)      |
| action                        | 46 (44.2%)             | 87 (12.2%)        | 5.73 (3.66–8.95)      | 27 (22.5%)             | 106 (15.2%)       | 1.62 (1.01–2.61)      | 27 (23.7%)             | 106 (15.0%)       | 1.75 (1.09–2.83)      |
| sgv                           |                        | 2.81 (2.26–3.50)  | <0.0001               |                        | 1.11 (0.99–1.30)  | 0.20                  |                        | 1.07 (0.91–1.26)  | 0.45                  |
| /disorder <sup>a</sup>        | 24 (23.1%)             | 73 (10.2%)        | 2.64 (1.57–4.42)      | 32 (26.7%)             | 65 (9.3%)         | 3.55 (2.20–5.72)      | 22 (19.3%)             | 75 (10.6%)        | 2.01 (1.19–3.39)      |
| irodev. disorder <sup>b</sup> | 1 (1.0%)               | 30 (4.2%)         | 0.22 (0.03–1.64)      | 10 (8.3%)              | 21 (3.0%)         | 2.94 (1.35–6.40)      | 10 (8.8%)              | 21 (3.0%)         | 3.13 (1.44–6.84)      |
| otional disorder <sup>c</sup> | 23 (22.1%)             | 53 (7.4%)         | 3.55 (2.07–6.09)      | 26 (21.7%)             | 50 (7.2%)         | 3.59 (2.13–6.04)      | 16 (14.0%)             | 60 (8.5%)         | 1.76 (0.97–3.17)      |

sis: Anxiety, Depression, OCD, ADHD, conduct disorder, Tics, ASD or Psychosis.  
 opmental disorders: ADHD, conduct disorder, Tics, ASD or Psychosis.  
 lisorders: Anxiety, Depression or OCD.

/ses: Associations of eating behaviors in boys (N = 748).

|                               | Dietary restraint     |                   |                       | Emotional eating      |                   |                       | External eating       |                   |                       |
|-------------------------------|-----------------------|-------------------|-----------------------|-----------------------|-------------------|-----------------------|-----------------------|-------------------|-----------------------|
|                               | Problematic<br>N = 58 | Normal<br>N = 690 | Or (95%CI)<br>p-value | Problematic<br>N = 67 | Normal<br>N = 681 | Or (95%CI)<br>p-value | Problematic<br>N = 92 | Normal<br>N = 656 | Or (95%CI)<br>p-value |
| ses >1                        | 42 (73.7%)            | 492 (73.4%)       | 1.10 (0.55–1.87)      | 49 (76.6%)            | 485 (73.2%)       | 1.20 (0.66–2.19)      | 68 (75.6%)            | 466 (73.2%)       | 1.13 (0.68–1.89)      |
| it                            | 0                     | 56 (8.1%)         | 0.92 (0.90–0.94)      | 8 (11.9%)             | 48 (7.0%)         | 1.79 (0.81–3.96)      | 6 (6.5%)              | 50 (7.6%)         | 0.85 (0.35–2.03)      |
| ght                           | 24 (41.4%)            | 548 (79.4%)       | 0.18 (0.11–0.32)      | 42 (62.7%)            | 530 (77.8%)       | 0.48 (0.28–0.81)      | 66 (71.7%)            | 506 (77.1%)       | 0.75 (0.46–1.23)      |
| action                        | 34 (58.6%)            | 86 (12.5%)        | 9.95 (5.63–17.58)     | 17 (25.4%)            | 103 (15.1%)       | 1.91 (1.06–3.44)      | 20 (21.7%)            | 100 (15.2%)       | 1.54 (0.90–2.65)      |
| sgv                           |                       | 3.66 (2.74–4.88)  | <0.0001               |                       | 1.26 (1.00–1.58)  | 0.05                  |                       | 1.24 (1.01–1.52)  | 0.04                  |
| /disorder <sup>a</sup>        | 16 (27.6%)            | 93 (13.5%)        | 2.45 (1.32–4.53)      | 16 (23.9%)            | 93 (13.7%)        | 1.98 (1.09–3.62)      | 19 (20.7%)            | 90 (13.7%)        | 1.64 (0.94–2.84)      |
| irodev. disorder <sup>b</sup> | 9 (15.5%)             | 56 (8.1%)         | 2.08 (0.97–4.45)      | 8 (11.9%)             | 57 (8.4%)         | 1.48 (0.68–3.26)      | 15 (16.3%)            | 50 (7.6%)         | 2.36 (1.27–4.41)      |
| otional disorder <sup>c</sup> | 9 (15.5%)             | 46 (6.7%)         | 2.57 (1.19–5.56)      | 9 (13.4%)             | 46 (6.8%)         | 2.14 (1.00–4.60)      | 6 (6.5%)              | 49 (7.5%)         | 0.86 (0.36–2.08)      |

sis: Anxiety, Depression, OCD, ADHD, conduct disorder, Tics, ASD or Psychosis.  
 opmental disorders: ADHD, conduct disorder, Tics, ASD or Psychosis.  
 lisorders: Anxiety, Depression or OCD.



**Table 5**  
Multivariate analyses: Logistic regression models of body dissatisfaction on eating behaviors.

|                               | Girls (N = 104) |           |         | Boys (N = 58) |           |         | Total (N = 162) |           |         |
|-------------------------------|-----------------|-----------|---------|---------------|-----------|---------|-----------------|-----------|---------|
|                               | Or              | 95% CI    | p-value | Or            | 95% CI    | p-value | Or              | 95% CI    | p-value |
| Body dissatisfaction (yes)    | 2.44            | 1.93–3.10 | <0.0001 | 2.98          | 2.14–4.15 | <0.0001 | 2.62            | 2.16–3.18 | <0.0001 |
| Gender (female)               |                 |           |         |               |           |         | 1.60            | 1.09–2.35 | 0.02    |
| Onset of puberty (yes)        | 2.28            | 1.04–5.94 | 0.42    | 0.69          | 0.34–1.39 | 0.30    | 1.23            | 0.73–2.09 | 0.43    |
| Overweight (yes) <sup>a</sup> | 2.08            | 1.22–3.55 | 0.07    | 2.63          | 1.32–5.26 | 0.006   | 2.32            | 1.52–3.54 | <0.0001 |

<sup>a</sup> Overweight is measured vs. normal- and underweight group of children.

behaviours and mental disorders seems to be established in clinical samples (Cortese et al., 2007; Pallister & Waller, 2008; Santos et al., 2007). Our findings indicate similar associations to be present in our population-based sample of preadolescents.

### 3.1. Strength and limitations

The main strength of the study is the use of a large population-based sample of preadolescents (N = 1567), examined at a very narrow age-range (10.8–12.8 years). A noteworthy strength of the study is also the use of objectively measured anthropometric data. Earlier studies often used parent reports of children's height and weight which should be interpreted with caution, as parents tend to underestimate their child's weight (Rietmeijer-Mentink, Paulis, van Middelkoop, Bindels, & van der Wouden, 2013). Another strength is use of DAWBA, a well-validated diagnostic interview measuring several child mental disorders including diagnostic classification by experienced child and adolescent psychiatrists with high inter-rater reliability.

However, some limitations have to be acknowledged. We used a relatively newly developed instrument, the EPI-C, to measure self-reported eating behaviours in children. The EPI-C has only been used in a few other and smaller samples (Forrester-Knauss et al., 2012; Houldcroft et al., 2014; Farrow et al., 2011; Hirsch et al., 2014; Schuetzmann et al., 2008; Ho et al., 2013), however the factor structure found by Schacht et al. (2006) was recently replicated in our sample adding evidence to the validity of the instrument (Munkholm et al., 2016). Also, the mean scores of the subscales of restrained, emotional and external eating in our study were generally comparable with the previous studies using the EPI-C in preadolescents (Houldcroft et al., 2014; Schacht et al., 2006; Farrow et al., 2011), albeit slightly lower. These slightly lower reports of problematic eating behaviours may be explained by a selection bias, as the participants primarily were children with favourable socio-economic characteristics.

The existing questionnaires measuring children's eating behaviour are mainly focused on disordered eating and are parent-report measures. The EPI-C is a self-report questionnaire suitable for preadolescent children measuring a broader spectrum of eating behaviours. However, a possible bias using self-reports of eating behaviours has to be considered, as children at this age may have difficulties comprehending what is being asked. On the other hand, considering the age of the participants (11–12 years), parents may not be the best informants regarding their child's specific eating behaviour (Steinberg et al., 2004; Tanofsky-Kraff, Yanovski, & Yanovski, 2005).

Finally, our definition of problematic eating behaviour also has to be discussed. Given that the EPI-C does not include specified cut-offs to differentiate 'normal' versus 'problematic' eating behaviours, we chose a pragmatic solution and used the top 10% highest subscale scores ( $\geq 90\%$  percentile) as indicative of a problematic eating behaviour. Among the other studies that have used the EPI-C, only one study has used a specific cut-off to differentiate 'normal' versus

'problematic' eating behaviors. Schuetzmann et al. (2008) classified the upper 15% of the subscale scores as deviant. However, they studied a much smaller sample (N = 373) with the need of a broader definition in order to ensure enough cases. However, in our view, a case-definition of 15% is likely to be over-inclusive. Thus, we chose to use the 10% highest subscale scores ( $\geq 90\%$  percentile) as indicative of problematic eating behaviours well aware that this does not necessarily reflect the occurrence of an actual eating problem, but represents a group of preadolescents reporting the highest levels of an eating behaviour that may be potentially problematic and of clinical significance. However, this 'case definition' is a pragmatic procedure and needs to be further explored by future research.

Even though the study sample was large, the cases having specific mental disorders were too low to allow for association analyses based on specific diagnoses. Therefore, we grouped mental disorders into two major groups: neuro-developmental disorders, and emotional disorders. Taking into account that a high rate of contemporary comorbidity has been shown within both of these groups (Costello, Mustillo, Erkanli, Keeler, & Angold, 2003), we considered it reasonable to analyse associations between problematic eating behaviours and mental disorders, using these two broad distinct groups.

### 4. Conclusion

The findings from this large general population-based study show that problematic eating behaviours can be identified in pre-adolescence. Thus, restrained eating was associated with overweight, body dissatisfaction and emotional disorders in both genders. Emotional eating was associated with overweight and body dissatisfaction in both genders; and with emotional and neurodevelopmental disorders uniquely in girls. External eating was associated with body dissatisfaction and neurodevelopmental disorders in both genders; and with overweight uniquely in girls. Our results emphasise the significant co-existence of problematic eating behaviours, weight problems and mental disorders already in preadolescence. Also our findings suggest clinically significant eating behaviours in preadolescence that should be considered as potential targets of interventions; and as putative predictors of later eating disorder risk.

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### Conflicts of interest

The funders had no role in the study design, data collection, analyses, interpretation of data or the decision to submit the manuscript for publication.

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## Original article

# Early Predictors of Eating Problems in Preadolescence—A Prospective Birth Cohort Study

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## A B S T R A C T

**Purpose:** The epidemiology of childhood eating problems is far from being fully described. The present study aims to explore early predictors of eating behavior problems in preadolescence.

**Methods:** The study sample comprised 1,939 children from the birth cohort study, the Copenhagen Child Cohort (CCC2000). Logistic regression models were used to investigate associations among infancy health, developmental and relational factors, maternal mental health problems, socioeconomic factors, parental reported eating behavior patterns in preschool age and eating behavior problems in preadolescence.

**Results:** A number of factors expressing socioeconomic disadvantage across childhood were associated with an increased risk of eating behavior problems at age 11–12 years. In addition, overeating patterns at age 5–7 years predicted restrained eating in preadolescence (odds ratio [OR] = 2.77; 95% confidence interval [CI] = 1.13–6.77;  $p = .03$ ), with overweight at age 11–12 years and low annual household income as strong explanatory factors (OR = 4.79; 95% CI = 2.81–8.17;  $p < .0001$  and OR = 2.06; 95% CI = 1.19–3.58;  $p = .02$ , respectively). No significant associations between perinatal, early child, and relational factors or maternal mental disorder and eating behavior problems in preadolescence were found.

**Conclusions:** Our results suggest that overeating at age 5–7 years is prospectively associated with restrained eating in preadolescence, with contemporaneous socioeconomic disadvantages and overweight as strong explanatory factors. Our findings might reflect successful public health interventions toward childhood obesity or might reflect a developmental course of problematic eating fluctuating between over- and undereating. Future studies should focus on the possible pathways from overeating to restrained eating and more severe eating pathology, including possible negative side effects of otherwise successful interventions aimed at reducing childhood obesity.

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## IMPLICATIONS AND CONTRIBUTION

Overeating patterns at age 5–7 years are prospectively associated with restrained eating in preadolescence, with socioeconomic disadvantage and overweight as strong explanatory factors. This might reflect successful public health interventions toward childhood obesity or might reflect a developmental course of problematic eating fluctuating between over- and undereating tendencies.

The epidemiology of childhood eating problems is far from being fully described, and specifically research addressing eating behaviors in preadolescence is currently limited. A range of eating behavior problems has been described in preadolescence [1]; however, the knowledge of the development and course of these problems are not well understood [2]. Preadolescence is the period preceding adolescence, where eating pathology most commonly emerges [3], and the preadolescent years may be a particular key development period of interest in relation to the development of eating behavior problems [4]. The existing literature points to a multifactorial nature of childhood eating problems that is based on an interaction of developmental, environmental, and social factors [1,5]. Factors such as preterm birth and low birth weight [5,6], early regulatory problems [7], disturbed mother–infant relationship [8,9], and maternal psychopathology [10] have all been suggested to have a role in the etiological mechanisms of early and middle childhood eating problems. However, few studies have investigated early developmental markers of eating problems in late childhood and early adolescence. McDermott et al. [11] found infancy problems of feeding and sleeping, high maternal age, and maternal anxiety to be associated with the persistence of irregular eating between age 6 months and 14 years in a large population-based sample ( $N = 4,554$ ). Hafstad et al. [12] found sleeping problems in early childhood predictive of eating problems in 16-year-olds ( $N = 373$ ), and Le Grange et al. [13] recently found that early gestational age, persistent temperamental difficulties, and high weight increased the vulnerability for eating behavior problems in a large sample of 15- to 16-year-olds ( $N = 1,300$ ). A number of socioeconomic factors have also been related to childhood eating behavior problems [14], and Cameron et al. [15] found maternal age, parental education, and income showing a strong negatively socioeconomic gradient in eating behaviors.

In spite of a growing literature in the field of childhood eating problems, there has been a call for well-designed longitudinal studies [2]. Most prospective studies in the field have been small, covering short-term follow-up periods or mainly clinical studies. The present study was a part of a large birth cohort study aimed to explore early predictors of eating behavior problems in preadolescence. We investigated early child factors and parentally perceived eating behavior patterns at age 5–7 years as possible predictors of self-reported eating behavior problems at age 11–12 years. We hypothesized that early regulatory and relational problems, maternal psychopathology, and socioeconomic disadvantages in early childhood would be differentially associated with eating behavior problems in preadolescence. In addition, we hypothesized that certain eating behavior patterns (i.e., overeating and picky eating) in early childhood would precede eating behavior problems at age 11–12 years.

## Methods

### Study population

The Copenhagen Child Cohort (CCC2000) study is a large general population birth cohort study designed to investigate determinants and early signs of psychopathology [16]. It comprises all 6,090 children born in Year 2000 in the former County of Copenhagen, Denmark [16]. The cohort has been followed prospectively because birth and the present study

included data from the following three waves of data collection: (1) baseline data (0–1 year); (2) 5–7 years; and (3) 11–12 years. An overview of the data collection is given in Figure 1.

### Procedure

The present study was part of the 11- to 12-year follow-up of the CCC2000 conducted from May 1, 2011 till October 1, 2012. The children in the cohort were traced through the Danish Central Civil Registration System [17,18]—the system in Denmark where all citizens are registered with a personal identification number (CPR number). A total of 4,847 children were identified at age 11–12 years, whereas 1,243 children were lost to follow-up (993 had claimed research protection—an option used in Denmark when citizens do not want to receive requests for statistical and scientific studies, 14 children were not traceable, 19 had deceased and 217 had emigrated). The children and their parents were invited by letter to participate in the 11- to 12-year follow-up by completing Web-based questionnaires. Of the eligible children ( $N = 4,847$ ) at age 11–12 years, data on child-reported eating behaviors were obtained on 1,939 (40.0%) children.

### Measures

**Data from first year of life.** Baseline variables included data systematically collected by community health nurses during the first year of life. Data from the health nurse assessments were collected using standardized records as part of four routine home visits conducted between child age 0 and 10 months: (1) first visit (1–5 weeks); (2) second visit (2–3 months); (3) third visit (4–6 months); and (4) fourth visit (8–10 months). At each visit, the health nurse measured length and weight, and assessed a variety of health-related items and concluded whether the development was normal or abnormal according to age. The variables used in the present study are presented in Table 1.

**Eating behaviors at age 5–7 years.** At age 5–7 years, eating behavioral patterns were assessed using the Childhood Eating Assessment Questionnaire [19]. The Childhood Eating Assessment Questionnaire is a 41-item parent-report questionnaire derived from the Child Eating Behaviour Questionnaire, the Childhood Eating Behaviour Inventory, and questions from the Stanford Feeding Questionnaire. Micali et al. [19] identified five eating behavioral patterns differentially associated with impact and psychopathology at age 5–7 years: (1) overeating/good appetite; (2) picky eating; (3) slow/poor eating; (4) delayed eating; and (5) snacking. Data on eating behaviors at age 5–7 years were available on 825 (42.5%) of the participating children at age 11–12 years ( $N = 1,939$ ). Owing to low frequency, delayed ( $N = 1/825$ ) and slow/poor eating ( $N = 6/825$ ) were not included in the present study.

**Height and weight measurements at age 11–12 years.** Body mass index (BMI) was calculated based on objectively measurements of height and weight at the 11- to 12-year follow-up as previously described [20]. The children were classified into BMI categories of underweight, normal weight, or overweight/obese using the age and gender-specific BMI cutoffs provided by the International Obesity Task Force [21,22].

## The Copenhagen Child Cohort 2000 study (CCC2000)

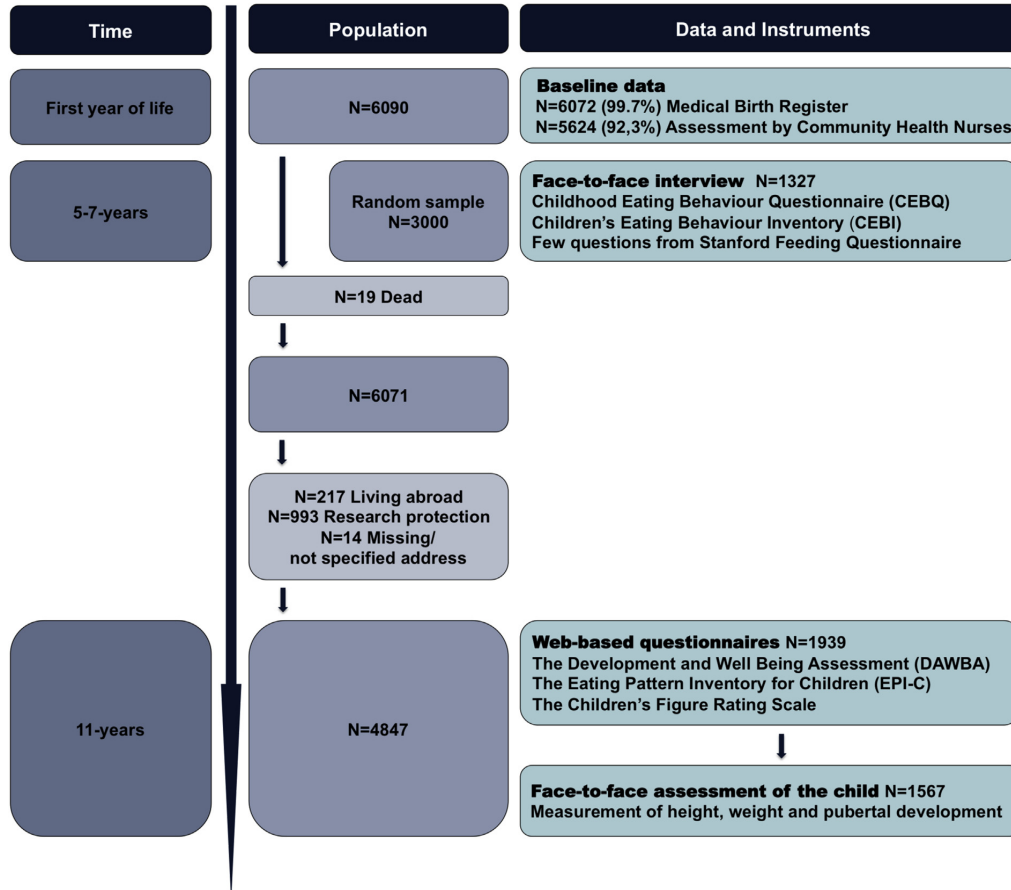


Figure 1. Flowchart of study population, data, and instruments at the three waves of data collection.

## Outcome measures

**Self-reported eating behaviors at age 11–12 years.** The Eating Pattern Inventory for children (EPI-C) [23] was used to assess eating behaviors of the children at the 11- to 12-year follow-up. The EPI-C is a 20-item self-report questionnaire assessing four psychological dimensions of eating behaviors: (1) *dietary restraint* (weight concerns and restriction in eating); (2) *emotional eating* (eating as coping with emotional distress); (3) *external eating* (eating in response to external stimuli regardless of internal state of hunger); and (4) *parental pressure to eat* (children's perceptions of parental behavior in relation to child eating). However, as the "parental pressure to eat" subscale does not assess the children's own eating behaviors, but only the children's perceptions of parental behavior, it was not used in the present study.

The EPI-C has been developed for the use in preadolescent samples and has shown good validity and reliability [23].

Recently, we investigated the factor structure of the Danish version of the EPI-C [20] and found that the four-factor structure of the EPI-C originally proposed by Schacht et al. [23] could be replicated in our sample. The internal consistency (Cronbach's alphas) for the present sample was .92, .87, and .73 for dietary restraint, emotional, and external eating, respectively.

Subscale scores were calculated by dividing the total scale score by the number of items in the respective subscales, and higher subscale scores thus indicated higher presence of an eating behavior. EPI-C subscale score  $\geq 90$ th percentile (the top 10%) within each subscale was used as an indicative of an eating behavior problem in our study. Thus, outcome measures were dichotomized into (1) "Restrained eating" versus "No restrained eating"; (2) "Emotional eating" versus "No emotional eating"; and (3) "External eating" versus "No external eating" to differentiate problematic (top 10%) versus normal (<90th percentile).

**Table 1**  
Description and frequency of variables used in the study (N = 1939)

|                                                                      | Frequency<br>N (%) | Missing<br>N (%) | Distribution<br>N (%)                                                                                              | Description                                                                                                                                 | Source                                         |
|----------------------------------------------------------------------|--------------------|------------------|--------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| <b>Child factors</b>                                                 |                    |                  |                                                                                                                    |                                                                                                                                             |                                                |
| Gestational age                                                      | 1,920 (99.0)       | 19 (1.0)         | <32 weeks: 5 (.3)<br>32–36 weeks: 73 (3.8)<br>≥37 weeks: 1,842 (95.9)                                              | Calculated from the first day of last menstruation                                                                                          | Medical Birth Register                         |
| Birth complications                                                  | 1,939 (100)        | 0                | No: 1,762 (90.9)<br>Yes: 177 (9.1)                                                                                 | One or more diagnoses given due to birth or perinatal complications                                                                         | Medical Birth Register                         |
| Birth weight                                                         | 1,893 (97.6)       | 46 (2.4)         | <1,500 g: 6 (.3)<br>1,500–2,499 g: 73 (3.9)<br>2,500–4,499 g: 1,739 (91.9)                                         | Weight at birth                                                                                                                             | Medical Birth Register                         |
| Failure to thrive (FTT)                                              | 1,477 (76.2)       | 462 (23.8)       | ≥4,500 g: 75 (4.0)<br>No: 1,406 (95.2)<br>Yes: 71 (4.8)                                                            | Constructed variable. Weight measurements 0–10 months. FTT defined as being among the slowest weight gaining 5% conditioned on birth weight | Health nurse records                           |
| Feeding problems <sup>a</sup>                                        | 1,814 (93.6)       | 125 (6.4)        | No: 1,438 (79.3)<br>Yes: 376 (20.7)                                                                                | Feeding problems at least at one visit (second, third, or fourth visit)                                                                     | Health nurse records                           |
| Sleeping problems <sup>a</sup>                                       | 1,815 (93.6)       | 124 (6.4)        | No: 1,486 (81.9)<br>Yes: 329 (18.1)                                                                                | Sleeping problems at least at one visit (second, third, or fourth visit)                                                                    | Health nurse records                           |
| Overall development                                                  | 1,820 (93.9)       | 119 (6.1)        | Normal: 1,585 (87.1)<br>Abnormal: 235 (12.9)                                                                       | The final conclusion by the health nurse concerning overall somatic and mental health development at the latest available visit             | Health nurse records                           |
| Mother–infant relationship                                           | 1,820 (93.9)       | 119 (6.1)        | Normal: 1,703 (93.6)<br>Abnormal: 117 (6.4)                                                                        | The quality of the mother–infant relationship concluded by the health nurse at one or more visits                                           | Health nurse records                           |
| <b>Maternal factors</b>                                              |                    |                  |                                                                                                                    |                                                                                                                                             |                                                |
| Pre-/perinatal psychological problems                                | 1,795 (92.6)       | 144 (7.4)        | No: 1,730 (96.4)<br>Yes: 65 (3.6)                                                                                  | Maternal self-reported psychological problems during pre- or perinatal period                                                               | Health nurse records                           |
| Postnatal psychiatric disorders diagnosed at child birth to 11 years | 1,939 (100)        | 0                | No: 1,725 (89.0)<br>Yes: 214 (11.0)                                                                                | Mother having any in- or outpatient contact to psychiatric hospital due to a psychiatric disorder (ICD-10 diagnoses)                        | National Psychiatric Central Register          |
| <b>Social factors</b>                                                |                    |                  |                                                                                                                    |                                                                                                                                             |                                                |
| Ethnicity                                                            | 1,935 (99.8)       | 4 (0.2)          | Two: 1,531 (79.1)<br>One: 207 (10.7)<br>None: 197 (10.2)                                                           | Number of parents born in Denmark                                                                                                           | Medical Birth Register                         |
| Maternal age at time of birth                                        | 1,935 (99.8)       | 4 (.2)           | 16–20 years: 27 (1.4)<br>21–30 years: 945 (48.8)<br>31–40 years: 934 (48.3)<br>41–46 years: 29 (1.5)               | Mothers age at birth                                                                                                                        | Medical Birth Register                         |
| Parents living together at time of birth                             | 1,935 (99.8)       | 4 (.2)           | No: 96 (5.0)<br>Yes: 1,839 (95.0)                                                                                  | Whether the parents were living together at the time of birth                                                                               | Medical Birth Register                         |
| Changes in family constitution from birth to 10 years                | 1,930 (99.5)       | 9 (.5)           | No: 1,492 (77.3)<br>Yes: 438 (22.7)                                                                                | Whether there has been changes in family constitution                                                                                       | Integrated Database for Labour Market Research |
| Maternal educational level at time of birth                          | 1,860 (95.9)       | 79 (4.1)         | Primary (0–10 years): 267 (14.4)<br>Secondary (11–14 years): 986 (53.0)<br>Tertiary (15 years or more): 607 (32.6) | Mothers highest educational level 2000                                                                                                      | Integrated Database for Labour Market Research |
| Maternal education level at child age 10 years                       | 1,911 (98.6)       | 28 (1.4)         | Primary (0–10 years): 223 (11.7)<br>Secondary (11–14 years): 928 (48.6)<br>Tertiary (15 years or more): 760 (39.8) | Mothers highest educational level 2010                                                                                                      | Integrated Database for Labour Market Research |
| Annual household income in the first year of living                  | 1,921 (99.1)       | 18 (.9)          | Lowest: 302 (15.7)<br>Lower middle: 439 (22.9)<br>Upper middle: 548 (28.5)<br>Highest: 632 (32.9)                  | Sum of annual household income in Year 2000 and 2001                                                                                        | Integrated Database for Labour Market Research |
| Annual household income at child age 9–10 years                      | 1,920 (99.0)       | 19 (1.0)         | Lowest: 312 (16.3)<br>Lower middle: 421 (21.9)<br>Upper middle: 548 (28.5)<br>Highest: 639 (33.3)                  | Sum of annual household income in Year 2009 and 2010                                                                                        | Integrated Database for Labour Market Research |

(continued on next page)

**Table 1**  
Continued

|                                                      | Frequency<br>N (%) | Missing<br>N (%) | Distribution<br>N (%)           | Description                                                                                                                              | Source           |
|------------------------------------------------------|--------------------|------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Eating patterns at age 5–7 years (subsample N = 825) |                    |                  |                                 |                                                                                                                                          |                  |
| Overeating/good appetite                             | 825 (100)          | 0                | No: 796 (96.5)<br>Yes: 29 (3.5) | Constructed variables.<br>Whether the child was having<br>an eating problem perceived by<br>the parents at the 5- to 7-year<br>follow-up | Parental reports |
| Picky eating                                         | 825 (100)          | 0                | No: 758 (91.9)<br>Yes: 67 (8.1) |                                                                                                                                          |                  |
| Snacking                                             | 825 (100)          | 0                | No: 802 (97.2)<br>Yes: 23 (2.8) |                                                                                                                                          |                  |

<sup>a</sup> As regular patterns of feeding and sleeping mostly begin around the second month of life in normally developing children (Chartoor & Ganiban, 2004) only assessments from the second, third, and fourth visit were included.

#### Register data

Information from the Danish national health registers was used to describe background characteristics of the children in the cohort. Data on early child and maternal factors were obtained from the Medical Birth Register [24]. Data on maternal psychiatric disorders were obtained from the Danish National Psychiatric Central Register [25] that covers all in- and outpatient contacts to psychiatric hospitals.

Socioeconomic factors were obtained from the Danish Integrated Database for Labour Market Research [26].

#### Statistical analyses

Analyses were carried out using SPSS (version 21) and Stata (version 13).

Differences between groups were tested using chi-square tests. Owing to multiple comparisons, a  $p$  value of  $<.01$  (two sided) was considered statistically significant in the univariate analyses. In the analyses of associations, restrained, emotional, and external eating were used as separate outcomes. Complete case analyses were used, and sample size thus varies depending on the completeness of data collection during first year of life and at age 5–7 years. Variables associated with the outcomes at a  $<.01$   $p$  level in the univariate analyses were subsequently included in a multivariable logistic regression analysis. Recently, we found both gender and contemporaneous overweight associated with eating behavior problems at age 11–12 years in this sample [20], and thus gender and overweight were included in the multivariable model as a priori confounders.

Annual household income at age 9–10 years was used as a proxy measure of socioeconomic status in the multivariate analyses. The number of available data varied slightly owing to missing data on some of the variables. Thus, multiple imputations with 30 imputation sets were imputed in Stata version 13, assuming all data missing at random. The imputation model included all variables used in the multivariable model (gender, BMI at age 11–12 years and annual house income at age 9–10 years). No differences in results were found when using complete cases versus when using the imputed data set. The results obtained using the imputed data are reported and presented as odds ratios (ORs) and 95% confidence interval (CI). A  $p$  value of .05 (two sided) was considered statistically significant in the multivariate analysis.

#### Ethics

The study was approved by the Danish Data Protection Agency (J.nr. 2010-41-4438), The Capital Region of Denmark

(J.nr. 2007-58-0015), and the Scientific Ethics Committee of Copenhagen County (KA-05103). Additionally, The National Committee on Health Research Ethics was consulted (J.nr. H-C-FSP-2010-09). All information was kept confidential.

#### Results

##### Attrition

Analyses of attrition were based on the whole cohort alive at age 11 years ( $N = 6,071$ ) comparing participants ( $N = 1,939$ ) versus nonparticipants ( $N = 4,132$ ). The participating children included more girls, more children born at term, living with both parents at the time of birth, having well-educated parents with higher annual household income, and fewer children with family changes before the age of 10 years. See [Appendix](#).

##### Sample

Of the 1,939 participating children (52.4% girls; median age = 11.5 years; standard deviation = .4), a total of 211 (10.9%) reported restrained eating, 240 (12.4%) reported emotional eating, and 261 (13.5%) reported external eating at age 11–12 years.

##### Predictors of eating behavior problems in preadolescence

The univariate analyses are presented in [Tables 2 and 3](#) showing associations between child and early relational factors, maternal mental health problems, eating behavioral patterns at age 5–7 years, social factors during childhood, and the three patterns of eating behavior problems at age 11–12 years.

**Child and early relational factors.** Birth weight, gestational age, and birth complications were not found to be associated with eating behavior problems in preadolescence, and no associations were seen with infancy developmental problems, early regulatory problems, failure to thrive, or abnormal mother–child relationship.

**Maternal mental health problems.** Neither maternal reported psychological problems in the pre- or perinatal period nor overall maternal psychiatric disorders diagnosed before the age of 11 years were found to be significantly associated with eating behavior problems in preadolescence.

**Feeding and eating problems in infancy and at age 5–7 years.** No associations were seen between feeding problems in infancy and



**Table 2**

Associations among child factors during infancy, eating behavior at 5–7 years, and eating behavior problems at 11–12 years

|                                    | Restrained eating | No restrained eating | Statistics    | Emotional eating | No emotional eating | Statistics    | External eating | No external eating | Statistics    |
|------------------------------------|-------------------|----------------------|---------------|------------------|---------------------|---------------|-----------------|--------------------|---------------|
|                                    | N = 211           | N = 1,728            |               | N = 240          | N = 1,699           |               | N = 261         | N = 1,678          |               |
|                                    | N (% of total)    | N (% of total)       | $\chi^2$ (df) | N (% of total)   | N (% of total)      | $\chi^2$ (df) | N (% of total)  | N (% of total)     | $\chi^2$ (df) |
| <b>Child factors</b>               |                   |                      |               |                  |                     |               |                 |                    |               |
| Gestational age                    |                   |                      |               |                  |                     |               |                 |                    |               |
| Preterm                            | 15 (7.2)          | 84 (4.9)             | 2.02 (1)      | 9 (3.8)          | 90 (5.3)            | .99 (1)       | 12 (4.6)        | 87 (5.2)           | .17 (1)       |
| Term                               | 193 (92.8)        | 1,628 (95.1)         | .16           | 227 (96.2)       | 1,594 (94.7)        | .32           | 247 (95.4)      | 1,574 (94.8)       | .68           |
| Birth complications                |                   |                      |               |                  |                     |               |                 |                    |               |
| No                                 | 195 (92.4)        | 1,567 (90.7)         | .68 (1)       | 233 (92.9)       | 1,539 (90.6)        | 1.38 (1)      | 236 (90.4)      | 1,526 (90.9)       | .07 (1)       |
| Yes                                | 16 (7.6)          | 161 (9.3)            | .41           | 17 (7.1)         | 160 (9.4)           | .24           | 25 (9.6)        | 152 (9.1)          | .79           |
| Birth weight                       |                   |                      |               |                  |                     |               |                 |                    |               |
| <1,500 g                           | 0 (0)             | 6 (4)                | 1.12 (3)      | 1 (4)            | 5 (3)               | 1.98 (3)      | 1 (4)           | 5 (3)              | .78 (3)       |
| 1,500–2,499 g                      | 7 (3.4)           | 66 (3.9)             | .77           | 7 (3.0)          | 66 (4.0)            | .58           | 11 (4.4)        | 62 (3.8)           | .85           |
| 2,500–4,499 g                      | 193 (93.2)        | 1,546 (91.7)         |               | 218 (94.0)       | 1,521 (91.65)       |               | 228 (90.5)      | 1,511 (92.1)       |               |
| ≥4,500 g                           | 7 (3.4)           | 68 (4.0)             |               | 6 (2.6)          | 69 (4.25)           |               | 12 (4.8)        | 63 (3.8)           |               |
| Failure to thrive                  |                   |                      |               |                  |                     |               |                 |                    |               |
| No                                 | 141 (95.3)        | 1,265 (95.2)         | .002 (1)      | 170 (95.0)       | 1,236 (95.2)        | .02 (1)       | 183 (95.8)      | 1,223 (95.1)       | .18 (1)       |
| Yes                                | 7 (4.7)           | 64 (4.8)             | .96           | 9 (5.0)          | 62 (4.8)            | .88           | 8 (4.2)         | 63 (4.9)           | .67           |
| Feeding problems                   |                   |                      |               |                  |                     |               |                 |                    |               |
| No                                 | 154 (77.8)        | 1,284 (79.5)         | .30 (1)       | 171 (76.3)       | 1,267 (79.7)        | 1.34 (1)      | 183 (75.6)      | 1,255 (79.8)       | 2.27 (1)      |
| Yes                                | 44 (22.2)         | 332 (20.5)           | .58           | 53 (23.7)        | 323 (20.3)          | .25           | 59 (24.4)       | 317 (20.2)         | .13           |
| Sleeping problems                  |                   |                      |               |                  |                     |               |                 |                    |               |
| No                                 | 152 (77.2)        | 1,334 (82.4)         | 3.31 (1)      | 180 (80.4)       | 1,306 (82.1)        | .40 (1)       | 198 (82.2)      | 1,288 (81.8)       | .02 (1)       |
| Yes                                | 45 (22.8)         | 284 (17.6)           | .07           | 44 (19.6)        | 285 (17.9)          | .53           | 43 (17.8)       | 286 (18.2)         | .90           |
| Overall development                |                   |                      |               |                  |                     |               |                 |                    |               |
| Normal                             | 182 (91.9)        | 1,527 (94.1)         | 1.52 (1)      | 205 (91.0)       | 1,504 (94.3)        | 3.49 (1)      | 229 (94.2)      | 1,480 (93.8)       | .06 (1)       |
| Abnormal                           | 16 (8.1)          | 95 (5.9)             | .22           | 20 (8.9)         | 91 (5.7)            | .06           | 14 (5.8)        | 97 (6.2)           | .81           |
| Abnormal mother–infant interaction |                   |                      |               |                  |                     |               |                 |                    |               |
| No                                 | 180 (9.9)         | 1,523 (93.9)         | 2.62 (1)      | 206 (91.6)       | 1,497 (93.9)        | 1.73 (1)      | 226 (93.0)      | 1,477 (93.7)       | .15 (1)       |
| Yes                                | 18 (9.1)          | 99 (6.1)             | .10           | 19 (8.4)         | 98 (6.1)            | .19           | 17 (7.0)        | 100 (6.3)          | .70           |
| Eating patterns at age 5–7 years   |                   |                      |               |                  |                     |               |                 |                    |               |
| Overeating                         |                   |                      |               |                  |                     |               |                 |                    |               |
| No                                 | 82 (89.1)         | 714 (97.4)           | 16.51 (1)     | 94 (94.0)        | 702 (96.8)          | 2.07 (1)      | 100 (93.5)      | 696 (96.9)         | 3.32 (1)      |
| Yes                                | 10 (10.9)         | 19 (2.6)             | <.0001        | 6 (6.0)          | 23 (3.2)            | .15           | 7 (6.5)         | 22 (3.1)           | .07           |
| Picky eating                       |                   |                      |               |                  |                     |               |                 |                    |               |
| No                                 | 88 (95.7)         | 670 (91.4)           | 1.98 (1)      | 92 (92.0)        | 666 (91.9)          | .002 (1)      | 96 (89.7)       | 662 (92.2)         | .77 (1)       |
| Yes                                | 4 (4.3)           | 63 (8.6)             | .16           | 8 (8.0)          | 59 (8.1)            | .96           | 11 (10.3)       | 56 (7.8)           | .38           |
| Snacking                           |                   |                      |               |                  |                     |               |                 |                    |               |
| No                                 | 89 (96.7)         | 713 (97.3)           | .09 (1)       | 96 (96.0)        | 706 (97.4)          | .62 (1)       | 102 (95.3)      | 700 (97.5)         | 1.61 (1)      |
| Yes                                | 3 (3.3)           | 20 (2.7)             | .77           | 4 (4.0)          | 19 (2.6)            | .43           | 5 (4.7)         | 18 (2.5)           | .20           |

The outcome measures were constructed based on Eating Pattern Inventory for children scores above the 90th percentile as indicative of restrained, emotional, and external eating, respectively.

Owing to multiple comparisons, a  $p$  value of <.01 (two sided) was considered statistically significant.

eating behavior problems in preadolescence. At age 5–7 years, parentally reported overeating was seen in 3.5% ( $N = 29$ ) of the subsample ( $N = 825$ ), picky eating in 8.1% ( $N = 67$ ), and snacking behaviors in 2.8% ( $N = 23$ ). Children who reported restrained eating at age 11–12 years were more likely to have been overeating at age 5–7 years compared with children with no or low levels of restrained eating (10.6% vs. 2.6%;  $OR = 4.47$ ; 95%  $CI = 2.01–9.94$ ;  $p < .0001$ ). None of the other eating patterns at age 5–7 years showed significant associations with eating behavior problems at age 11–12 years.

**Social factors.** Significant associations were found between socioeconomic adversities at the time of birth and later eating behavior problems, with social disadvantages being more pronounced in restrained eating. Factors such as two parents born outside Denmark, low maternal educational level, and low annual household income were also more pronounced in children with restrained eating at age 11–12 years ( $p$  values < .0001; Table 3). This social adversity remained a factor of significance throughout childhood with low maternal educational level and

low annual household income at age 9–10 years also being significantly associated with restrained eating at age 11–12 years ( $OR = 2.46$ ; 95%  $CI = 1.60–3.78$ ;  $p < .0001$  and  $OR = 2.74$ ; 95%  $CI = 1.66–3.69$ ;  $p < .0001$ , respectively). Significant associations were also seen between external eating and low maternal educational level at time of birth ( $OR = 1.91$ ; 95%  $CI = 1.27–2.89$ ;  $p = .002$ ) and between emotional eating and low annual household income both in first year of life and at age 9–10 years ( $OR = 1.99$ ; 95%  $CI = 1.35–2.95$ ;  $p = .001$  and  $OR = 1.95$ ; 95%  $CI = 1.34–2.85$ ;  $p = .001$ , respectively).

#### Multivariate analyses of childhood factors predicting eating behavior problems in preadolescence

Looking at the associations of our main variables of interest (infancy child and maternal factors and eating behaviors at age 5–7 years), we only found overeating behavioral patterns at age 5–7 years significantly associated with high scores of restrained eating at age 11–12 years. Thus, we only performed a multivariable regression analysis with restrained eating in

**Table 3**

Associations between maternal and social factors during infancy and eating behavior problems at age 11–12 years

|                                                   | Restrained eating | No restrained eating | Statistics    | Emotional eating | No emotional eating | Statistics    | External eating | No external eating | Statistics    |
|---------------------------------------------------|-------------------|----------------------|---------------|------------------|---------------------|---------------|-----------------|--------------------|---------------|
|                                                   | N = 211           | N = 1,728            |               | N = 240          | N = 1,699           |               | N = 261         | N = 1,678          |               |
|                                                   | N (% of total)    | N (% of total)       | $\chi^2$ (df) | N (% of total)   | N (% of total)      | $\chi^2$ (df) | N (% of total)  | N (% of total)     | $\chi^2$ (df) |
| Maternal mental health problems                   |                   |                      |               |                  |                     |               |                 |                    |               |
| Pre-/perinatal psychological problems             |                   |                      |               |                  |                     |               |                 |                    |               |
| No                                                | 185 (96.9)        | 1,545 (96.3)         | .14 (1)       | 211 (94.6)       | 1,519 (96.6)        | 2.26 (1)      | 231 (95.5)      | 1,499 (96.5)       | .69 (1)       |
| Yes                                               | 6 (3.1)           | 59 (3.7)             | .70           | 12 (5.4)         | 53 (3.45)           | .13           | 11 (4.5)        | 54 (3.5)           | .41           |
| Psychiatric diagnosis from birth to 11 years      |                   |                      |               |                  |                     |               |                 |                    |               |
| No                                                | 183 (86.7)        | 1,542 (89.2)         | 1.20 (1)      | 205 (85.4)       | 1,520 (89.5)        | 3.51 (1)      | 227 (87.0)      | 1,498 (89.3)       | 1.22 (1)      |
| Yes                                               | 28 (13.3)         | 186 (10.8)           | .27           | 35 (14.6)        | 179 (10.5)          | .06           | 34 (13.0)       | 180 (10.7)         | .27           |
| Social factors                                    |                   |                      |               |                  |                     |               |                 |                    |               |
| Ethnicity                                         |                   |                      |               |                  |                     |               |                 |                    |               |
| Two Danish parents                                | 132 (65.0)        | 1,385 (81.0)         | 48.11 (2)     | 172 (73.5)       | 1,345 (80.2)        | 7.11 (2)      | 188 (74.6)      | 1,329 (80.1)       | 7.25 (2)      |
| One Danish parents                                | 22 (10.8)         | 176 (10.3)           | <.0001        | 27 (11.5)        | 171 (10.2)          | .03           | 26 (10.3)       | 172 (10.4)         | .03           |
| No Danish parents                                 | 49 (24.1)         | 148 (8.7)            |               | 35 (15.0)        | 162 (9.7)           |               | 38 (15.1)       | 159 (9.6)          |               |
| Family constitution at time of birth              |                   |                      |               |                  |                     |               |                 |                    |               |
| Parents not living together                       | 16 (7.6)          | 80 (4.6)             | 3.53 (1)      | 12 (5.0)         | 84 (5.0)            | .002 (1)      | 19 (7.3)        | 77 (4.6)           | 3.51 (1)      |
| Parents living together                           | 194 (92.4)        | 1,645 (95.4)         | .06           | 227 (95.0)       | 1,612 (95.0)        | .96           | 241 (92.7)      | 1,598 (95.4)       | .06           |
| Changes in family constitution from 0 to 10 years |                   |                      |               |                  |                     |               |                 |                    |               |
| No                                                | 151 (71.9)        | 1,341 (78.0)         | 3.92 (1)      | 180 (75.6)       | 1,312 (77.5)        | .43 (1)       | 204 (79.7)      | 1,288 (76.9)       | .95 (1)       |
| Yes                                               | 59 (28.1)         | 379 (22.0)           | .05           | 58 (24.4)        | 380 (22.5)          | .51           | 52 (20.3)       | 386 (23.1)         | .33           |
| Maternal age at time of birth (years)             |                   |                      |               |                  |                     |               |                 |                    |               |
| 16–20                                             | 6 (2.9)           | 21 (1.2)             | 6.85 (3)      | 7 (2.9)          | 20 (1.2)            | 11.40 (3)     | 5 (1.9)         | 22 (1.3)           | 5.39 (3)      |
| 21–30                                             | 97 (46.2)         | 848 (49.2)           | .08           | 109 (45.6)       | 836 (49.3)          | .01           | 132 (50.8)      | 813 (48.5)         | .15           |
| 31–40                                             | 101 (48.1)        | 833 (48.3)           |               | 115 (48.1)       | 819 (48.3)          |               | 123 (47.3)      | 811 (48.4)         |               |
| 41–46                                             | 6 (2.9)           | 23 (1.3)             |               | 8 (3.3)          | 21 (1.2)            |               | 0               | 29 (1.7)           |               |
| Maternal education level at birth                 |                   |                      |               |                  |                     |               |                 |                    |               |
| Primary (0–10 years)                              | 45 (23.3)         | 222 (13.3)           | 16.59 (2)     | 35 (15.4)        | 232 (14.2)          | 1.27 (2)      | 47 (19.2)       | 220 (13.6)         | 10.21 (2)     |
| Secondary (11–14 years)                           | 101 (52.3)        | 885 (53.1)           | <.0001        | 126 (55.3)       | 860 (52.7)          | .53           | 137 (55.9)      | 849 (52.6)         | .006          |
| Tertiary (15 years or more)                       | 47 (24.0)         | 560 (33.6)           |               | 67 (29.4)        | 540 (33.1)          |               | 61 (24.9)       | 546 (33.8)         |               |
| Maternal education level 2010                     |                   |                      |               |                  |                     |               |                 |                    |               |
| Primary (0–10 years)                              | 40 (19.5)         | 183 (10.7)           | 17.48 (2)     | 30 (12.8)        | 193 (11.5)          | .72 (2)       | 33 (13.1)       | 190 (11.5)         | 5.03 (2)      |
| Secondary (11–14 years)                           | 103 (50.2)        | 825 (48.4)           | <.0001        | 117 (49.8)       | 811 (48.4)          | .70           | 135 (53.6)      | 793 (47.8)         | .08           |
| Tertiary (15 years or more)                       | 62 (30.2)         | 698 (40.9)           |               | 88 (37.4)        | 672 (40.1)          |               | 84 (33.35)      | 676 (40.7)         |               |
| Annual household income at birth                  |                   |                      |               |                  |                     |               |                 |                    |               |
| Lowest                                            | 49 (23.2)         | 257 (14.9)           | 20.41 (3)     | 58 (24.2)        | 248 (14.6)          | 17.15 (3)     | 55 (21.2)       | 251 (15.0)         | 9.86 (3)      |
| Lower middle                                      | 63 (29.9)         | 386 (22.4)           | <.0001        | 60 (25.0)        | 389 (23.0)          | .001          | 67 (25.9)       | 382 (22.8)         | .02           |
| Upper middle                                      | 43 (20.4)         | 490 (28.5)           |               | 53 (22.1)        | 480 (28.4)          |               | 65 (25.1)       | 468 (28.0)         |               |
| Highest                                           | 56 (26.5)         | 589 (34.2)           |               | 69 (28.7)        | 576 (34.0)          |               | 72 (27.8)       | 573 (34.2)         |               |
| Annual household income 2009/10                   |                   |                      |               |                  |                     |               |                 |                    |               |
| Lowest                                            | 58 (28.0)         | 254 (14.8)           | 39.66 (3)     | 55 (23.5)        | 257 (15.2)          | 13.01 (3)     | 49 (19.4)       | 263 (15.8)         | 3.24 (3)      |
| Lower middle                                      | 60 (29.0)         | 361 (21.1)           | <.0001        | 55 (23.5)        | 366 (21.7)          | .005          | 59 (23.3)       | 362 (21.7)         | .36           |
| Upper middle                                      | 35 (16.9)         | 513 (29.9)           |               | 62 (26.5)        | 486 (28.8)          |               | 70 (27.7)       | 478 (28.7)         |               |
| Highest                                           | 54 (26.1)         | 585 (34.2)           |               | 62 (26.5)        | 577 (34.2)          |               | 75 (29.6)       | 564 (33.8)         |               |

The outcome measures were constructed based on Eating Pattern Inventory for children scores above the 90% percentile as indicative of restrained, emotional, and external eating, respectively.

p value of <.01 (two sided) was considered statistically significant because of multiple comparison.

preadolescence as the outcome. Adjusting for potential confounding effects of female gender, overweight, and social adversity (measured as lowest annual household income at age 9–10 years), overeating at age 5–7 years remained a significant predictor of restrained eating at age 11–12 years, however, with a large decrease in strength of the association (OR = 2.77; 95% CI = 1.13–6.77;  $p = .03$ ). Both overweight at age 11–12 years and annual household income were strong explanatory variables for restrained eating in preadolescence, whereas female gender did not remain significantly associated with restrained eating, when controlling for overweight and annual household income (Table 4).

## Discussion

In this large general population study, we explored childhood predictors of restrained eating, emotional eating, and external eating in preadolescence. The children have been followed prospectively because birth enabling us to investigate antecedents and risk factors for childhood eating behavior problems. Our main findings were (1) socioeconomic disadvantages in early and late childhood were prospectively associated with eating behavior problems in preadolescence, particularly with restrained eating and (2) children described as having overeating patterns at age 5–7 years had a nearly three-fold increased risk

**Table 4**

Multivariable logistic regression analysis of predictors of restrained eating at ages 11–12 years (N = 825)

|                                                          | Restrained eating |                         |         |
|----------------------------------------------------------|-------------------|-------------------------|---------|
|                                                          | Odds ratio        | 95% Confidence interval | p value |
| Overeating at age 5–7 years                              |                   |                         |         |
| Yes                                                      | 2.77              | 1.13–6.77               | .03     |
| Gender                                                   |                   |                         |         |
| Girl                                                     | 1.39              | .87–2.22                | .17     |
| Overweight <sup>a</sup>                                  |                   |                         |         |
| Yes                                                      | 4.79              | 2.81–8.17               | <.0001  |
| Annual house income at child age 9–10 years <sup>b</sup> |                   |                         |         |
| Lowest                                                   | 2.06              | 1.19–3.58               | .02     |

A p value of &lt;.05 (two sided) was considered statistically significant.

<sup>a</sup> Reference group: normal and underweight group of children.<sup>b</sup> Reference group: upper three classes (lower middle, upper middle, highest).

of restrained eating at age 11–12 years when adjusting for overweight, low SES, and gender.

There is increasing public awareness of health disadvantages of being overweight and recommendations point to special attention toward overweight children. Our finding that overeating patterns at age 5–7 years predict that restrained eating in preadolescence might reflect a successful public health prevention strategy toward childhood obesity. However, it might also reflect a developmental course of problematic eating fluctuating between over and undereating in childhood. This has to be further explored.

Social- and family-related adversities in childhood, for example, two parents born outside Denmark, low maternal educational level, low annual household income, were also significantly associated with preadolescent eating behavior problems. As mentioned earlier, our study population was of relatively low social risk; however, our findings are in line with previous research showing childhood disadvantage being linked with disordered eating [27] and obesity-related behaviors [15].

Findings from prior research have yielded some early potential predictors of eating behavior problems in early adolescence including perinatal factors [13] and early regulatory problems [11,12]. However, in contrary to our hypotheses, we were unable to show similar associations in our study. This could be explained by insufficient power to detect possible associations as only a few children in this cohort were born preterm, or had low birth weight. Concerning feeding and sleeping problems in infancy, these variables partly relied on parentally perceived problems during infancy with up to 30% reporting problems. Thus, the possibility that these variables are overinclusive cannot be discounted.

Mother–infant relationship problems have been found associated with feeding difficulties in early childhood [28,29], and previous research has shown that insecure attachment toward the mother significantly increases the risk for restrained eating over a 1-year period during preadolescence [30]. Contrary to our hypothesis, we did not find mother–child relationship problems measured during infancy to be predictive of eating behavior problems in preadolescence. The lack of associations may be explained by effective interventions by community health nurses as a part of the general child health surveillance in Denmark [31], but the finding may also reflect, that the importance of the mother–child relationship in relation to children's eating differ according to the age and the developmental stage of the child.

Several studies have highlighted the importance of maternal mental health in relation to childhood eating problems [10,11,32–36]. Although maternal mental health problems were relatively prevalent in our study (11.0%), neither early self-reported psychological problems in the pre- and perinatal period nor psychiatric disorders diagnosed before the age of 11 years were associated with eating behavior problems in the preadolescent child. A possible explanation could be that early maternal psychological problems are temporary and may only have a short-term impact on child eating in early childhood. Another explanation could be differences in severity and type of disorders measured. Our variable “maternal psychiatric diagnoses,” included only disorders diagnosed at hospitals. These disorders are typically more severe disorders, for example, major depression, psychoses, and severe cases of eating disorders, whereas for example, anxiety disorders and mild-to-moderate depression more commonly are diagnosed and treated outside hospitals [37]. Thus, one might expect that not including these normally occurring maternal mental health problems treated outside hospitals might have influenced our results. Thus, this needs to be further explored.

#### Strengths and limitations

The main strength of this study is the large sample size. The participants were, however, more often of Danish origin and with fewer socioeconomic adversities compared with non-participants. This selective loss of more disadvantaged families is well known in longitudinal studies [38], albeit it may have affected the generalizability of our study. Despite this, social adversities were significantly associated with eating behavior problems in preadolescence, and we expect that a stronger association would have been found within the full cohort. Although our sample size was large, attrition issues has to be discussed. Attrition is of major concerns in longitudinal studies, and several factors have been found related to loss to follow-up, for example, educational level, social-economic position, and marital status. However, loss to follow-up in our study was mainly due to families that had claimed research protection. Nevertheless, attrition may cause loss of power and lead to biased estimates of associations between variables [39], and such attrition bias cannot be excluded in our study.

Another notable strength is the use of register-based data of maternal and social factors allowing a broad spectrum of exposures and putative predictors to be explored. We were also able to adjust for the possible confounding effect of overweight based on objectively measured height and weight at age 11–12 years, which is another noteworthy strength of the study [40]. Unfortunately, data on height and weight were not available throughout childhood, and therefore we were unable to study how weight contributes to the risk mechanism of eating behavior problems.

A particular strength of the study is also the prospectively collected data since birth diminishing the risk of recall bias. The data collection during infancy was embedded in an existing child health surveillance program in Denmark, where all infants and their families are receiving regularly visits by community health nurses between the age of 0 and 10 months irrespectively of family income, social class, or risk status. Baseline data were collected using standardized records that diminish the risk of method variance and reporter bias. However, the psychometric properties of the standardized records have not yet been



established, and the possibility of problems of inter-rater reliability cannot be discounted. Another limitation of the study is that some of the infancy variables were relatively rare, for example, preterm birth and low birth weight, which may have influenced our results because of low power to detect differences.

Finally, our definition of eating behavior problems in preadolescence needs to be discussed. Given that the EPI-C does not include specified cut points to differentiate “normal” versus “problematic” eating behavior, we chose to consider the highest 10% scores ( $\geq 90\%$  percentile) within each subscale as indicative of an eating behavior problem well aware that this does not reflect the occurrence of an actual eating problem according to DSM-IV diagnoses but represents the group of children with the highest level of an eating behavior, which may be potentially problematic and of clinical significance. However, the predictive validity of this “case” definition needs to be further investigated.

The results of the present study suggest that overeating at age 5–7 years is prospectively associated with restrained eating in preadolescence with contemporaneous socioeconomic disadvantages and overweight as strong explanatory variables. Our findings might reflect successful public health interventions toward childhood obesity or might reflect a developmental course of problematic eating fluctuating between over- and undereating in childhood. However, this needs to be further explored. Future studies should focus on the possible pathways from overeating to restrained eating and more severe eating pathology, including possible negative side effects of otherwise successful interventions aimed at reducing childhood obesity.

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#### Supplementary Data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.jadohealth.2016.01.006>.

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# Appendices

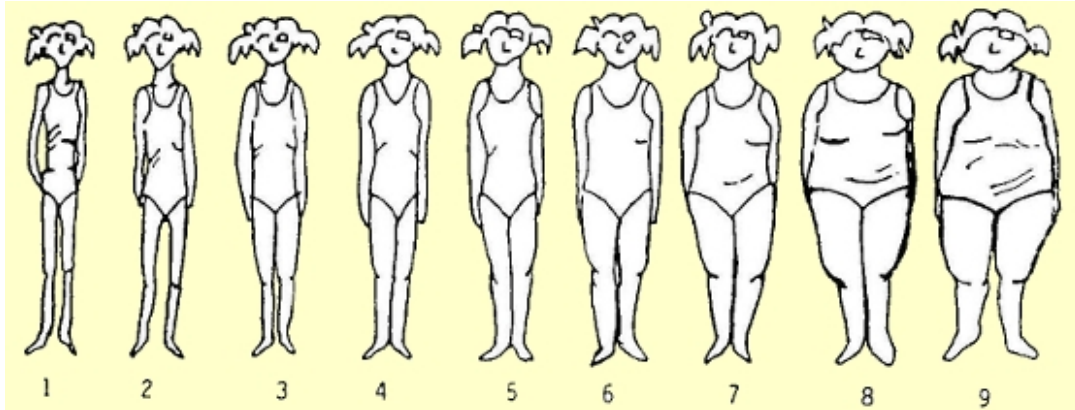
## Appendix A

### The Eating Pattern Inventory for Children

|     |                                                                       | Not at all               | A little                 | Some-times               | Often                    | Always                   |
|-----|-----------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1.  | When I see someone eat, I also get hungry.                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2.  | I have already tried a couple of times to eat less.                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3.  | My parents always want me to eat up everything that is on my plate.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4.  | When I am finished eating I worry about getting too fat.              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5.  | Eating helps me when I am disappointed.                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6.  | While eating, I am always afraid of putting on weight.                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7.  | When I am afraid or worried I eat something.                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8.  | When I am together with someone who eats a lot, I eat a lot too.      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9.  | At home I am allowed to leave food I don't like on my plate.          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. | I am very afraid of putting on weight.                                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. | I often think about food during the day.                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. | I eat when I am unhappy.                                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. | It is always on my mind that I weight too much.                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. | To keep my weight, I often eat less than I would actually like to.    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. | When I am lonely, I comfort myself with food.                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. | At home I must eat whatever is put on the table.                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. | When I see food I get hungry right away even if it not mealtime yet.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. | I try to eat as little as possible so I don't put on any more weight. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 19. | I should try harder to lose weight.                                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 20. | I am often that hungry that I immediately have to eat something.      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

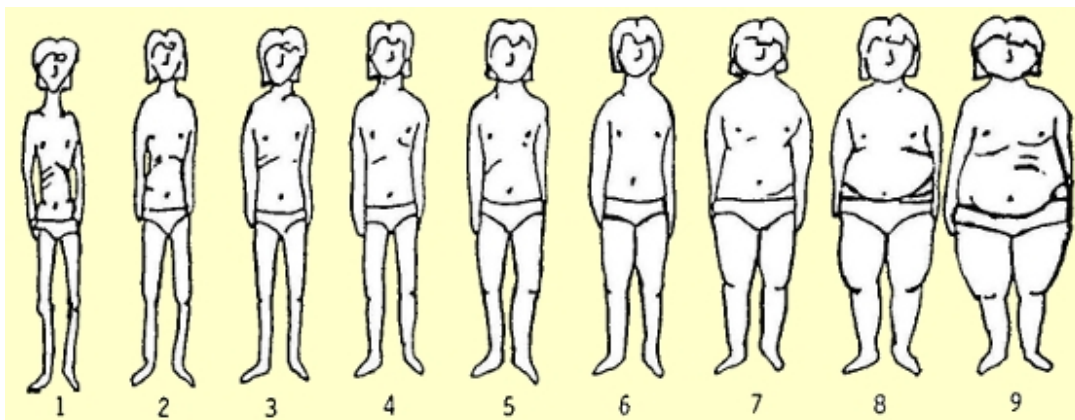
## Appendix B

### The Children's Figure Rating Scale



Please take a look at the silhouette drawings above. Each drawing has a number (1 to 9). Read the following questions and write the number of the drawing in the box, that you think best answer the question.

1. Which picture do you think look like you the most? ☐
2. Which picture will you most like to look like? ☐
3. Which picture do you think are most attractive to boys? ☐



Please take a look at the silhouette drawings above. Each drawing has a number (1 to 9). Read the following questions and write the number of the drawing in the box, that you think best answer the question.

1. Which picture do you think that look like you the most? ☐
2. Which picture will you most like to look like? ☐
3. Which picture do you think are most attractive to girls? ☐

## Appendix C

### Child characteristics of participants versus non-participants

|                                                                | Non-participants<br>N=4132 | Participants<br>N=1939 | Entire cohort<br>N=6071* | Statistics<br>$\chi^2$ (df), p-value |
|----------------------------------------------------------------|----------------------------|------------------------|--------------------------|--------------------------------------|
| Gender                                                         |                            |                        |                          |                                      |
| Boys                                                           | 2193 (53.1%)               | 922 (47.6%)            | 3115 (51.3%)             | $\chi^2=16.12$ (1)<br>p<0.001        |
| Girls                                                          | 1939 (46.9%)               | 1017 (52.4%)           | 2956 (48.7%)             |                                      |
| Gestational age                                                |                            |                        |                          |                                      |
| <32 weeks                                                      | 37 (0.9%)                  | 5 (0.3%)               | 42 (0.7%)                | $\chi^2= 12.33$ (3)<br>p= 0.006      |
| 32-36 weeks                                                    | 204 (4.9%)                 | 73 (3.8%)              | 277 (4.6%)               |                                      |
| ≥37 weeks                                                      | 3847 (93.1%)               | 1842 (95.0%)           | 5689 (93.7%)             |                                      |
|                                                                | Missing 1.1%               | Missing 0.3%           | Missing 1.0%             |                                      |
| Ethnicity                                                      |                            |                        |                          |                                      |
| Two Danish Parents                                             | 2760 (66.8%)               | 1517 (78.2%)           | 4277 (70.4%)             | $\chi^2= 97.29$ (3)<br>p<0.001       |
| One Danish Parent                                              | 494 (12.0%)                | 198 (10.2%)            | 692 (11.4%)              |                                      |
| No Danish Parents                                              | 747 (18.1%)                | 197 (10.2%)            | 944 (15.5%)              |                                      |
|                                                                | Missing 3.2%               | Missing 1.4%           | Missing 2.6%             |                                      |
| Parity                                                         |                            |                        |                          |                                      |
| One                                                            | 1450 (35.1%)               | 689 (35.5%)            | 2139 (35.2%)             | $\chi^2= 26.0$ (4)<br>p<0.001        |
| Two                                                            | 1579 (38.2%)               | 808 (41.7%)            | 2387 (39.3%)             |                                      |
| Three                                                          | 545 (13.2%)                | 240 (12.4%)            | 785 (12.9%)              |                                      |
| >Four                                                          | 248 (6.0%)                 | 61 (3.1%)              | 309 (5.1%)               |                                      |
|                                                                | Missing 7.5%               | Missing 7.3%           | Missing 7.4%             |                                      |
| Mother's age at time of birth                                  |                            |                        |                          |                                      |
| 16-20 years                                                    | 198 (4.8%)                 | 27 (1.4%)              | 225 (3.7%)               | $\chi^2=62.54$ (4)<br>p<0.001        |
| 21-30 years                                                    | 2179 (52.7%)               | 945 (48.7%)            | 3124 (51.5%)             |                                      |
| 31-40 years                                                    | 1687 (40.8%)               | 934 (48.2%)            | 2621 (43.2%)             |                                      |
| 41-46 years                                                    | 55 (1.3%)                  | 29 (1.5%)              | 84 (1.4%)                |                                      |
|                                                                | Missing 0.3%               | Missing 0.2%           | Missing 0.3%             |                                      |
| Father's age at time of birth                                  |                            |                        |                          |                                      |
| 16-20 years                                                    | 65 (1.6%)                  | 11 (0.6%)              | 76 (1.3%)                | $\chi^2= 46.31$ (5)<br>p<0.001       |
| 21-30 years                                                    | 1571 (38.0%)               | 6662 (34.1%)           | 2233 (36.8%)             |                                      |
| 31-40 years                                                    | 2045 (49.5%)               | 1087 (56.1%)           | 3132 (51.6%)             |                                      |
| 41-50 years                                                    | 314 (7.6%)                 | 146 (7.5%)             | 460 (7.6%)               |                                      |
| 51-61 years                                                    | 33 (0.8%)                  | 17 (0.9%)              | 50 (0.8%)                |                                      |
|                                                                | Missing 2.5%               | Missing 0.8%           | Missing 2.059            |                                      |
| Family constitution (Parents living together at time of birth) |                            |                        |                          |                                      |
| Yes                                                            | 3718 (90%)                 | 1839 (94.8%)           | 5557 (91.5%)             | $\chi^2= 40.39$ (2)<br>p<0.001       |
| No                                                             | 401 (9.7%)                 | 96 (5%)                | 497 (8.2%)               |                                      |
|                                                                | Missing 0.3%               | Missing 0.2%           | Missing 0.3%             |                                      |
| Changes in family constitution from birth to 10y               |                            |                        |                          |                                      |
| Yes                                                            | 329 (32.2%)                | 438 (22.6%)            | 1767 (29.1%)             | $\chi^2= 176.82$ (2)<br>p<0.001      |
| No                                                             | 2564 (62.1%)               | 1492 (76.9%)           | 4056 (66.8%)             |                                      |
|                                                                | Missing 5.8%               | Missing 0.5%           | Missing 4.1%             |                                      |
| Mother's highest education at child age 10y                    |                            |                        |                          |                                      |
| Primary (1-10 years)                                           | 891 (21.6%)                | 223 (11.5%)            | 1114 (18.3%)             | $\chi^2=242.988$ (3)<br>p<0.001      |
| Secondary (11-14 years)                                        | 1917 (46.4%)               | 928 (47.9%)            | 2845 (46.9%)             |                                      |
| Tertiary (15+ years)                                           | 1032 (25.0%)               | 760 (39.2%)            | 1792 (29.5%)             |                                      |
|                                                                | Missing 7.1%               | Missing 1.4%           | Missing 5.3%             |                                      |
| Father's highest education at child age 10y                    |                            |                        |                          |                                      |
| Primary (1-10 years)                                           | 829 (20.1%)                | 245 (12.6%)            | 1074 (17.75)             | $\chi^2=213.78$ (3)<br>p<0.001       |
| Secondary (11-14 years)                                        | 1773 (42.9%)               | 903 (46.6%)            | 2676 (44.1%)             |                                      |
| Tertiary (15+ years)                                           | 796 (19.3%)                | 624 (32.2%)            | 1420 (23.4%)             |                                      |
|                                                                | Missing 17.8%              | Missing 8.6%           | Missing 14.8%            |                                      |
| Annual household income at child age 9-10y                     |                            |                        |                          |                                      |
| Lowest                                                         | 1120 (27.1%)               | 312 (16.1%)            | 1432 (23.6%)             | $\chi^2=312.53$ (4)<br>p<0.001       |
| Lower middle                                                   | 1012 (24.5%)               | 421 (21.7%)            | 1433 (23.6%)             |                                      |
| Upper middle                                                   | 885 (21.3%)                | 548 (28.3%)            | 1433 (23.6%)             |                                      |
| Highest                                                        | 794 (19.2%)                | 639 (33.0%)            | 1433 (23.6%)             |                                      |
|                                                                | Missing 7.8%               | Missing 1.0%           | Missing 5.6%             |                                      |

\*Due to death of 19 children, the Cohort only consists of 6071 at the time of the present follow-up. No significant differences were found regarding birth weight and Apgar score.