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Children in treatment for obesity: Psychological perspectives, physical activity and diet

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La Familia (F. Botero)

**To my husband Asle
and my children
Eline, Odin and Lars**

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List of papers

Paper I (Study I)

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Paper II (Study II)

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Paper III (Study III)

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Paper IV (Study IV)

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Abbreviations

BMI	Body mass index
BMI SDS	Body mass index standard deviation score
BMR	Basal metabolic rate
CBCL	Child Behavior Checklist
DXA	Dual energy X-ray absorptiometry
E%	Percent of energy intake
EI	Energy intake
HRQOL	Health Related Quality of Life
IOTF	International Obesity Task Force
KINDL-R	Kinderlebensqualität Fragebogen (Questionnaire for Measuring Health-related Quality of Life in Children and Adolescents - Revised)
KCAL	Kilocalories
MUFA	Monounsaturated fatty acids
PUFA	Polyunsaturated fatty acids
QoL	Quality of Life
SES	Socioeconomic status
SFA	Saturated fatty acids
SHG	Self-help group
TLG	Therapist-led group
YSR	Youth Self Report

1.0. INTRODUCTION

1.1. Focus

The current dissertation examines changes in body fat, physical activity and diet in children participating in outpatient family-based treatment of obesity at St Olav`s University Hospital, Norway between 2005 and 2010. Mental health and quality of life were also examined, as well as parental health cognitions as predictors of change in children's total body fat during treatment. The study is a randomized controlled trial, and the efficiency of therapist-led and self-help groups of parents are compared.

1.2. Obesity as a world-wide epidemic

Obesity has been identified as a world-wide epidemic and one of the greatest health threats of our time (WHO, 2000). The epidemic has also reached Norway, with a significant increase in overweight and obesity in children during the last decades (Andersen et al., 2005; Holmback et al., 2007). In a comparison of weight-for-height in Norwegian children between 1971-4 and 2003-6, Juliusson et al. (2007) showed that the number of children above the ninety-seventh percentile tripled from 1971-4 to 2003-6. In a cohort of 6386 Norwegian children the prevalence of overweight including obesity (OWOB) in children aged two to nineteen was 13.8% whereas 2.3% were defined as obese according to the International Obesity Task Force (IOTF) cut-off values (Juliusson et al., 2010). The IOTF is a research-based think tank of international obesity experts and represents the advocacy arm of the International Association for the Study of Obesity (IOTF, 2011). In a summary of studies of trends in childhood overweight and obesity Wang and Lobstein (2006) concluded that North America, Europe and parts of the Western Pacific have the highest prevalence of overweight children. The authors estimated that by 2010, 38% of European school-aged children would be overweight (IOTF criteria) and approximately 10% of these would be obese.

In order to explain the increasing prevalence of obesity, the external determinants of energy balance have been in focus, e.g. the mechanization and automation which have dramatically reduced the amount of energy we need to spend on basic activities, in addition to technological developments causing increased screen-time. In a recent review of the relative contribution of energy intake and energy expenditure to childhood obesity, however, the

authors conclude that there is no consensus on the main driver of secular trends of weight gain among children (Bleich, Ku, & Wang, 2011). Nevertheless, the increasing prevalence indicates that a great number of children are in need of obesity treatment. Developments of efficient treatment programs are therefore warranted. The current thesis contributes to this by examining changes in body fat, energy intake and physical activity in children participating in a randomized controlled trial of a family-based intervention.

1.3. Causes of obesity

Gaining weight is a simple process: it merely involves taking in more energy than is expended. The core question is why some children find themselves in a state of positive energy balance, whereas others do not (Wardle, 2005). In spite of extensive research, the mechanisms by which people gain excessive weight and body fat are still only partially understood (Caballero, 2007).

1.3.1. The energy balance

Energy balance is the state in which total energy intake equals total energy needs. All the energy needed by the body comes from carbohydrates, protein and fat,- named macronutrients because they are required in relatively large amounts in the diet (Carr, 2003). Unlike protein and carbohydrates, fat can be stored in the body in relatively large amounts (Ogden, Yanovski, Carroll, & Flegal, 2007). Therefore, if energy intake is greater than energy expended, weight will increase. The different macronutrients differ in energy content, fat containing the most calories (1 g = 9 kcal), carbohydrate and protein the least (1 g = 4 kcal). According to Norwegian recommendations (Norwegian Directory of Health, 2005) the energy contribution of fat should not exceed 25-35% of daily energy intake, carbohydrate should account for about 50-60% and, protein 10-20%. Added sugar should not exceed 10% of daily energy intake. A national survey of the dietary status of 1824 Norwegian 9- and 13-year olds, showed that fat contributed to 32% of the total energy intake, carbohydrate to 55%, protein to 14.5%. Added sugar accounted for 17.5%, far above the national recommendations (Overby, Lillegaard, Johansson, & Andersen, 2004). It is reasonable to assume that the diet of children with obesity differs from that of normal-weight children, but a review concluded that there is

no clear relationship between dietary intake and body fatness (Rodriguez & Moreno, 2006). The reliability of these data is questionable, however, owing to the difficulty in obtaining objective measures of dietary intake. In addition, most of these studies are based on self-reported height and weight. Therefore, research applying a more objective methodology in the study of the relationship between obesity and dietary intake is needed. In the current thesis, objective measures of body-fat and one of the most reliable methods of dietary assessment available are applied when the relationship between dietary intake and changes in obesity is examined. In addition, the dietary composition of treatment seeking children with obesity is described as well as whether the participants meet the national recommendations for dietary intake.

Metabolism refers to the range of biochemical processes involved in the transformation of nutrients into internal energy. Metabolic rate is the total energy expenditure per minute and can be divided into the resting metabolic rate (RMR), the thermic effect of food (TEF) and physical activity (Stroebe, 2008). The RMR is the energy expended by an individual who is awake but resting, not actively dieting and in a comfortable temperature. We use most of our energy simply keeping our body functioning; the liver, the kidneys, the brain and the heart being organs with especially high metabolic activity (Schutz & Jèquier, 2004). The increase in energy expenditure after a meal, the TEF, is mainly owed to the energy costs of nutrient absorption, processing and storage. Physical activity, the third component, describes any bodily movement produced by skeletal muscles that increases energy expenditure and is the most variable component of daily energy expenditure (Plasqui & Westerterp, 2007). There is a significant negative relationship between physical activity and obesity in children and higher levels of habitual activity are protective against obesity (Jimenez-Pavon, Kelly, & Reilly, 2010; Reichert, Menezes, Wells, Dumith, & Hallal, 2009). In a comparison of overweight and obesity prevalence in school-aged children from 34 countries the authors found that within most countries physical activity levels were lower and television viewing times were higher in overweight than normal-weight youth (Janssen, 2005). Physical activity, being the only "energy out" factor we can possibly affect, is therefore of great importance in the study of obesity, with regard to both prevention and treatment.

In summary, obesity is closely related to the energy balance, but less is known with regard to the relative contribution of "energy in" and "energy out". The current thesis adds to this knowledge gap by exploring the relative importance of energy intake and physical activity in explaining change of body fat during obesity treatment.

1.3.2. Genetics

Energy intake and energy expenditure, the ability to store excess fat and to lose fat, are all processes that appear to have genetic determinants (Barsh, 2000). Obesity can be assessed as a quantitative phenotype by genes, the environment, and gene-environment interactions (Eisenmann, 2006). It is well-known that obesity runs in families. A meta-analysis of twin- and adoption studies showed that genetic factors had a strong effect on the variation of BMI at all ages (Silventoinen, Rokholm, Kaprio, & Sorensen, 2010). Genome-wide association studies (GWAS) have identified 32 obesity-linked loci, most notably in the genes FTO and TMEM18 and downstream of the gene MC4R, and suggest a number of others (Speliotes et al., 2010). Even though obesity is highly heritable 75 , these loci collectively explain less than 2% of the heritability of obesity. Therefore, it is likely that interactions between genes and environments play a substantial role in the etiology of obesity (Andreasen & Andersen, 2009). The susceptibility of obesity is partly determined by genetic factors, but an "obesity-promoting environment" is necessary for its phenotype expression (Loos & Rankinein, 2005). Adoption studies support the role of family environment, finding correlations between adoptive parents and children`s relative weight. The correlations were substantially stronger between children and their biological parents, however (Silventoinen, et al., 2010). Nevertheless, since genetic change is slow, the increase in prevalence of pediatric obesity must be owed to the environmental change or the interplay between our genes and the environment (Eisenmann, 2006).

In summary, both genetic and environmental factors promote a positive energy balance causing obesity, and the route between genes and obesity goes through behavior. Studies show, for example, that eating behavior style affects the association between obesity and the obesogenic environment (Wardle, 2005). Family lifestyle and food habits affect the development of food-preferences which may affect body weight (Maffeis, 2000). It has also been shown that children with obesity work relatively less hard for physical activity reinforcers (Epstein, Smith, Vara, & Rodefer, 1991). Even though genetics are of great importance in the development of obesity in children, for the time being, behavior is the only factor we can affect in order to reduce obesity. Regardless of a child`s genetic disposition to obesity, the only way to treat obesity is through diet and physical activity. We therefore need to know how to affect such health behavior and how this behavior is related to obesity. The current thesis examines parental health cognitions as predictors of change in body fat, in

addition to exploring the relative importance of dietary intake and physical activity in the change of body fat during treatment.

1.3.3. Psychological theories

The increase in obesity is made worse by the fact that people seem unable to lose substantial amounts of weight or avoid regaining weight after weight loss (Stroebe, 2008). A number of psychological theories have been developed to explain why self-regulation of weight is so difficult (Stroebe, 2008).

1.3.3.1. Psychosomatic theory

The psychosomatic concept of obesity, published in 1957 (Kaplan & Kaplan), claims that obesity is the result of overeating. Kaplan and Kaplan suggested a number of hypotheses based on learning theory to explain why some people overeat (Stroebe, 2008). According to the theory, appetite can become classically conditioned to non-nutritional factors (e.g. dinnertime) or result from instrumental conditioning. For example, individuals who have learned that eating reduces fear or anxiety will be motivated to eat whenever they experience such negative emotions, even though they do not feel hunger (Kaplan & Kaplan, 1957). The differential sensitivity hypothesis offered by Bruch (1961, 1964) offers another explanation. Bruch claimed that patients with obesity were unable to differentiate sensations of hunger from other bodily arousals. She explained this inability as the failure of parents to teach their children to recognize hunger signals and to differentiate between such signals and other bodily sensations, e.g. when food is used to reward the child or is used as an expression of love, the child does not learn to differentiate bodily signals (Bruch, 1961, 1964). In summary, the psychosomatic theory of obesity posits that eating may reduce anxiety, and that individuals with obesity overeat in order to reduce discomfort (Canetti, Bachar, & Berry, 2002). There are two mechanisms through which anxiety could result in overeating within psychosomatic theory, however (Stroebe, 2008). First, according to Kaplan and Kaplan (1957) overeating may have become a learned response to anxiety that serves to reduce anxiety; second, according to Bruch (Bruch, 1961, 1964), anxiety can stimulate eating in individuals who have failed to learn to distinguish hunger cues from cues that signal emotional states. Consistently with psychosomatic theory, some experimental studies show

that obese subjects` food intake is not guided by internal signals, but the findings are inconsistent (Stroebe, 2008). Research further suggests that anxiety facilitates eating in individuals with obesity (Pine, 1985; Slochower, 1983) as posited by psychosomatic theory, at least in situations where food stimuli are salient (Stroebe, 2008). Emotional eating seems to be particularly prevalent in subjects seeking treatment for obesity (Ganley, 1989).

1.3.3.2. Externality theory

In an attempt to describe why individuals with obesity overeat in a food-rich environment, Schachter et al. (1968) claimed that their eating is triggered by food-relevant cues (e.g. palatability, salience, time of day, etc.) in comparison with those of normal-weight who eat in response to internal hunger signals (Burton, Smit, & Lightowler, 2007). This assumption was tested in a series of studies and, on the basis of this research, Stroebe (2008) observes that the core assumption of the externality theory, namely that external cues have a greater impact on food intake of individuals who are overweight or obese compared with normal-weight people, has been supported. It has even been shown that obese children were hyper-responsive to food stimuli compared with those of normal-weight, and that brain activations in response to food stimuli in obese children failed to diminish significantly after eating (Bruce et al., 2010). Schachter also suggested that the greater sensitivity to food cues was a manifestation of a more generalized sensitivity to external cues, but this assumption has not received empirical (Stroebe, 2008).

1.3.3.3. Restraint theory

Restraint theory (Herman & Mack, 1975) was originally conceived as an extension of externality theory and aimed at explaining why obese individuals` food intake is triggered by external rather than internal cues. Restraint theory suggests that food deprivation rather than obesity, as suggested by externality theory, determines an individual`s overresponsiveness to external food cues (Stroebe, 2008). Eating restraint refers to the intentional effort to restrict one`s food intake to control one`s body weight and restrained eaters constantly worry about what they eat and chronically restrict their food intake in order to avoid becoming obese (Canetti, et al., 2002). This assumption indicates that dietary restraint is a better predictor of externally-triggered eating than obesity. Herman and Polivy (1980) postulated a "disinhibition

hypothesis" that self-control of restrained eaters may be temporarily released by disrupting events or "disinhibitors", e.g. an emotional experience, which results in overeating (Canetti, et al., 2002). This hypothesis has been empirically confirmed (Ruderman, 1986). The assumption that differences in level of restraint underlie differences between obese and normal-weight people's eating patterns, has not been supported, however (Ruderman, 1986).

1.3.3.4. The behavioral susceptibility model of obesity

In summary, psychological theories of obesity assume that normal-weight individuals eat when they are hungry and stop when they feel full, but individuals with obesity are less able to recognize these bodily cues. It has been found that early self-regulation difficulties are a risk factor for the development of obesity (Francis & Susman, 2009) and low inhibitory control is associated with high body weight (Pauli-Pott, Albayrak, Hebebrand, & Pott, 2010). Individuals respond differently to the "obesogenic environment," and low responsiveness to internal satiety signals and high responsiveness to external cues may be one plausible mechanism (Carnell & Wardle, 2008). Carnell and Wardle (2008) conceptualize how multiple eating- and behavior related factors can interact to impact on eating, activity behavior and weight in the behavioral susceptibility model of obesity, a modernized expanded version of Schacter`s externality theory. As suggested by the model (see Figure 1.), an individual`s weight status is determined by complex interactions between biological and environmental factors.
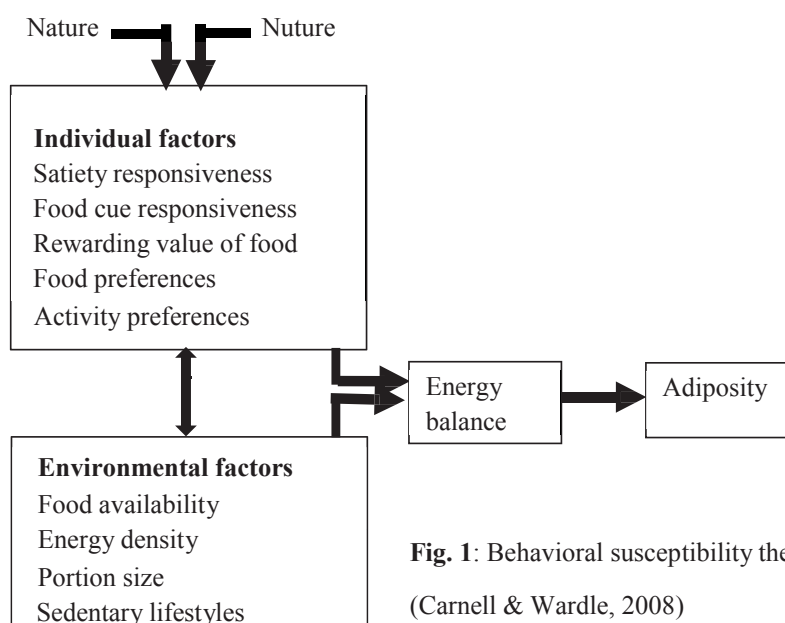
Fig. 1: Behavioral susceptibility theory of obesity (Carnell & Wardle, 2008)

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The treatment program examined in the current thesis focuses on the environmental factors of this model, - i.e. portion sizes, the availability of food, energy density and sedentary lifestyles. These are factors mainly regulated by parents/primary caregivers. As suggested by the model, changing these factors will affect the individual factors. In general, children develop in transaction with their primary care-givers (Sameroff, 2000, 2010). Through repeated interaction over time where caregivers help regulate children's behavior and emotions, the child becomes increasingly self-regulated. In regard to treatment of obesity we may therefore assume that if parents are able to regulate and thus reduce portion sizes, for example, the child will gradually be better able to self-regulate intake. In the current thesis we study predictors of parent`s ability to perform such behavior as to reduce portion sizes and the availability of food and thereby offer the external regulation needed in order for the child to develop better self-regulation skills.

1.4. Definitions and diagnosis

Obesity is an excess of body fat which increases the risk of mortality and morbidity (Reilly, 2005). The clinical problems associated with obesity are produced by enlarged fat cells, either because of the weight or the mass of the extra fat, or because of the increased secretion of fatty acids and numerous peptides from enlarged fat cells (Bray, 2004). The consequences of these two mechanisms are other diseases, such as diabetes mellitus, heart disease and some forms of cancer (Bray, 2004). Even though no single body fat value can clearly distinguish health from disease or risk of disease (Barlow, 2007), body fat ≥ 25 in boys and 30 in girls has been associated with an abnormal lipid profile, and thereby an increased risk of cardiovascular disease (Williams et al., 1992). In addition to gender differences in the development of adiposity (McCarthy, Cole, Fry, Jebb, & Prentice, 2006), the proportions of the various components of body composition vary during growth (Pietrobelli, Boner, & Tato, 2005). Body fat reference curves have therefore been published (McCarthy, et al., 2006). Body fat can be measured by different techniques, but dual energy X-ray absorptiometry (DXA), which is applied in the current thesis, is considered the most accurate and reliable measurement of body composition in children (Helba & Binkovitz, 2009). Body fat distribution, being an important determinant of obesity-related negative health effects, underlines the importance of using DXA or related techniques in detecting health risks associated with obesity (Helba & Binkovitz, 2009). DXA has been shown to have the capacity

for clinical application including prediction of metabolic abnormalities associated with excess percentage of body fat (Sopher et al., 2004).

Even though obesity is defined as excess body fat, the current definition of obesity is based on excess body weight (Okorodudu et al., 2010). This is partly because body fat is traditionally considered difficult to measure and because it has not been considered a useful predictor of clinical outcome (Ogden, et al., 2007; Wells & Fewtrell, 2008). Body Mass Index (BMI), a measure of body weight adjusted for height (kg/m²), is the most widely used tool for measuring overweight and obesity and has been shown to be highly correlated with body-fat in the general population (Krebs et al., 2007; Pietrobelli et al., 1998). For adults BMI $\geq$ 25 is defined as overweight, BMI $\geq$ 30 represents obesity and BMI $\geq$ 40 represents severe obesity. These definitions are related to functional outcomes of mortality and morbidity (Ogden, et al., 2007). BMI does not however explicitly monitor the core symptom, namely excess body fat, and is therefore only an indicative measure of obesity. In addition, there has proved to be wide variability in the relative level of fat for a given BMI value (Wells et al., 2006). A newly published meta-analysis of nearly 32 000 adults shows that BMI cut off values failed to identify half of those with excess percentage body fat (Okorodudu, et al., 2010). The low sensitivity of BMI questions the use of BMI as a measure of obesity in clinical practice. In addition, BMI as a relative measure of obesity makes it difficult to study changes over time and differences between cultures. Further, because weight and height distribution changes with age, the use of BMI as an indicator of relative weight in childhood is problematic (Poskitt, 2000). As a result, a statistical definition of overweight based on the 85th and 95th percentiles of gender-specific BMI-for-age is often used (Ogden, et al., 2007). The use of two cut-off points captures varying risk levels and minimizes both overdiagnosis and underdiagnosis (Barlow, 2007). It has been recommended that BMI≥95th percentile should be defined as "obesity," since at this cut-off body fat levels are likely to be high, whereas BMI≥85th percentile should be defined as "overweight" (Barlow, 2007).

In addition to the use of percentiles, BMI standard deviation scores (BMI SDS/BMI z-score) are also widely used to account for the fact that BMI changes with age and differs between the sexes (Reilly, 2005). BMI SDS is the difference between the patient`s BMI and the age- and sex-specific mean BMI divided by the BMI standard deviation of the reference group (Sklar et al., 2000). Therefore, in the diagnosis of obesity based on BMI SDS, the type of reference data used plays a major role. Sensitivity (low false-negative rate: the diagnosis of excessively fat children as non-obese) and specificity (low-false-positive rate: the incorrect

diagnosis of lean children as obese) are important aspects to consider (Reilly, 2005).
Reference data are usually based on representative data from a given country (Ogden, et al., 2007), but international reference data also exist. The most widely used international reference data are the sex-specified cut-off values published by Cole et al. (2000). These data are based on six nationally representative data sets and are often referred to as the International Obesity Task Force (IOTF) cut-off values. They represent cut-off points chosen as the percentiles that match the adult cut off values of BMI of 25 and 30 (Ogden, et al., 2007). There are disagreements, however, with regard to whether national or international reference data should be used (Reilly, 2005). In two reviews of evidence for and against the use of national vs. international reference data, Reilly (2002, 2010) argues that national reference data are superior to the IOTF approach, with significantly higher sensitivity. Sensitivity is determined by testing BMI`s ability to correctly identify children with high body fat percentage (Reilly, Dorosty, Emmett, & Alspac Study Team, 2000), suggesting measures of body fat to represent the "gold standard". In a comparison of different measures of adiposity change in growing children, Cole et al. (2005) claim that BMI z-score is a good choice when adiposity is measured over time, but is far from ideal since the variability becomes progressively smaller the fatter the child. Therefore, even though most guidelines recommend the use of BMI for age with national reference data to define pediatric obesity (Barlow, 2007; National Institute for Health and Clinical Excellence, 2006; Reilly, 2010), the ideal monitoring tool should directly assess adiposity (McCarthy, et al., 2006). In accordance with this, body fat is used as the main outcome of the current thesis, in addition to BMI SDS.

One argument for using direct measures of body fat is because the definition of obesity is closely related to disease or risk of disease. Although excess weight itself can exert adverse effects on some health outcomes, the health risk of obesity is the result of excess abdominal fat, particularly visceral fat (Wells & Fewtrell, 2008). In addition, BMI does not distinguish between increased mass in the form of fat, lean tissue or bone, and hence can lead to misclassification (McCarthy, et al., 2006). In the evaluation of treatment efficacy, BMI cannot discriminate the relative changes in fat and lean mass. Physical activity is an important component of pediatric obesity treatment, so increase in lean mass and loss of fat stores can be expected, which could constitute weight maintenance (Wells & Fewtrell, 2006). To account for this, we use percentage body fat as an outcome in the current studies. In addition, there is lack of evidence associating pediatric body composition with clinical outcome and studies exploiting the capacity of body composition techniques to improve clinical

management are called for (Wells & Fewtrell, 2008). In the present work, we therefore examine the relationship between changes in energy intake, physical activity and body fat.

1.5. Consequences of obesity in children

1.5.1. Medical consequences

Pediatric obesity has both short- and long-term consequences. In a review of health consequences of obesity, Reilly et al examined 34 studies of the association between obesity and cardiovascular risk factors measured in childhood (Reilly et al., 2003). The authors conclude that there is a consistent association between obesity and most of the major cardiovascular risk factors, such as high blood pressure, dyslipidemia, abnormalities in the left ventricular mass and/or function, abnormalities in endothelial function and hyperinsulinemia and/or insulin resistance, as seen in adults (Reilly, et al., 2003). A more recent review, however, found little evidence to suggest that childhood obesity is an independent risk factor for cardiovascular disease (Lloyd, Langley-Evans, & McMullen, 2010). Instead, the relationships observed seem to be dependent on the tracking of BMI from childhood to adulthood (Lloyd, et al., 2010), one of the most important long-term consequences of obesity in childhood. The persistence of obesity from childhood to adulthood is more pronounced when the child has at least one obese parent, if the child`s obesity is severe (defined as BMI>95th compared with BMI>85th) and present at older ages (Reilly, et al., 2003). In a recent review all included studies consistently report an increased risk of overweight and obese youth becoming overweight adults, even though predictive values varied considerably (Singh, Mulder, Twisk, van Mechelen, & Chinapaw, 2008).

1.5.2. Psychosocial consequences

For most children, the psychosocial consequences of obesity are more pronounced than the medical consequences. The social stigma associated with obesity can be pervasive and may lead to serious emotional and social problems (Puhl & Latner, 2007). Several reviews find a relationship between obesity and low self-esteem, but the association is modest when community samples are studied (French, Story, & Perry, 1995; Wardle & Cooke, 2005). In a recent review of studies using multi-component assessments of self-esteem in obese youth,

however, there is strong evidence for obesity being associated with reduced self-esteem (Griffiths, Parsons, & Hill, 2010). Of the sub-domains assessed, athletic/physical competence and physical appearance showed the strongest relationship. The latter review was restricted to studies using an agreed definition of obesity and validated multi-dimensional measures of self-esteem, possibly explaining why the findings differ from earlier reviews. It could be, however, that impaired self-esteem found with regard to athletic/physical competence and physical appearance is more related to an impaired body-image than impaired self-esteem in general. Negative feelings towards one's body may cause negative feelings towards one's self, resulting in impaired self-esteem (E. T. Higgins, 1987). Pesa et al (2000) found that low self-esteem in adolescent girls was no longer significant after body-image was controlled for. Another study found that among girls with low-moderate body esteem, heavier girls had higher self-esteem than (relatively) lower weight girls (Erickson, Hahn-Smith, & Smith, 2009). The cross-sectional design of these studies, however, does not allow us to draw conclusions regarding the causality of the relationship between body image and general self-esteem. Nevertheless, there are consistent findings of a relationship between BMI and body-dissatisfaction in children; the higher the BMI, the lower the body-image (Ricciardelli & McCabe, 2001).

Several stigma-related variables may mediate the relationship between obesity and self-esteem and between obesity and body-dissatisfaction. Weight-based teasing from peers and concern about weight and shape has been shown to explain both relationships (K. K. Davison & Birch, 2002; Eisenberg, Neumark-Sztainer, & Story, 2003; Lunner et al., 2000; Shroff & Thompson, 2004). Lowered self-esteem has also been found in children who believe they are responsible for their overweight as compared with those who attribute their overweight to an external cause (Pierce & Wardle, 1997). The experience of weight stigma is particularly sensitive in the adolescent years since the formations of social relationships are especially salient during this period (Puhl & Latner, 2007). Studies show that obese youth are more at risk of being bullied than their normal-weight peers (Janssen, Craig, Boyce, & Pickett, 2004), are less likely to spend time with friends (Falkner et al., 2001) and more likely to be socially isolated and to be peripheral to social network (Strauss & Pollack, 2003). This social marginalization may aggravate social and emotional consequences (Strauss & Pollack, 2003). There have been several studies examining the prevalence of mental health problems in children and adolescents with obesity. Summarizing ten years of research, Zametkin et al. (2004) conclude that there is no clear indication of higher rates of psychopathology in the

general population of obese children. Therefore, in spite of adverse social and interpersonal consequences of obesity, most obese children are neither depressed nor have lowered self-esteem (Wardle & Cooke, 2005). It is important to point out however, that there are differences between community samples of children and those seeking treatment for obesity. Clinical samples of children with obesity have lower self-esteem (Braet, Mervielde, & Vandereycken, 1997; Pierce & Wardle, 1997) and more psychological problems (Britz et al., 2000; Erermis et al., 2004; Vila, 2004) compared with obese or normal-weight community controls. The most prevalent problems are social- and behavioral problems (Epstein, 1996), anxiety (Vila, 2004) and depression (Erermis, et al., 2004).

Obesity in children has also been shown to be associated with increased risk of disordered eating behavior (Goldschmidt, Aspen, Sinton, Tanofsky-Kraff, & Wilfley, 2008). In reviewing the current state of the literature, Goldschmidt et al (Goldschmidt, et al., 2008) conclude that overweight youth are significantly more likely than normal weight controls to report binge-eating, with a prevalence number up to 30%. Adolescents with obesity have also been found to be at risk of suicidal behaviors (Puhl & Latner, 2007). In a study of 9943 adolescents, Falkner et al (Falkner, et al., 2001) found obese girls to be 1.7 times more likely to report suicide attempts in the previous year, than their normal-weight peers. Other studies confirm the association between obesity in youth and suicidal thoughts and attempts (Swahn et al., 2009; van Wijnen, Boluijt, Hoeven-Mulder, Bemelmans, & Wendel-Vos, 2010). In a study by Dave et al. (2009), however, actual weight did not have an independent effect on suicidal behaviors, but the perception of being overweight had a strong impact on suicidal behaviors for girls. This is supported by a population study of Dutch adolescents where feeling overweight, rather than being overweight was associated with less favorable psychological well-being (Jansen, van de Looij-Jansen, de Wilde, & Brug, 2008).

1.5.3. Quality of life

In addition to addressing medical and psychosocial consequences of obesity it is also important to question how obesity impacts the child`s quality of life (QoL). In the current work and in line with most definitions, QoL is identified as a multi-dimensional concept, incorporating the child and his/hers caregivers evaluation of his/her life regarding physical and cognitive functioning, psychological well-being and social interaction (Koot & Wallander, 2001). As it is a hypothetical construct no universal definition of QoL exists

(Wallander, 2001), but there is an important distinction between health-related QoL and overall QoL (Koot, 2001). The former advocates a medical and health care perspective on QoL, but the latter also includes non-medical aspects of a person's life, such as jobs, family and friends (Koot, 2001). Another important aspect of the concept of QoL is that it includes both objective and subjective evaluations. This adds valuable information when we try to understand how obesity affects children. An obese child may be completely healthy with no psychosocial co-morbidities, but still feel that being obese impairs his/her quality of life. When QoL is measured in children and adolescents both self-report and proxy report should be applied (Wallander, 2001). In the current work both self-reported and parent-reported QoL are measured. Low agreement between informants appears to be the rule (Koot, 2001), possibly due to the different perspectives of children and their parents.

It is generally agreed that children and adolescents with obesity have impaired QoL compared with normal-weight controls (Griffiths, et al., 2010; A. R. Hughes, Farewell, Harris, & Reilly, 2007; Schwimmer, 2003) and there seems to be a linear relationship between QoL and BMI (Tsiros et al., 2009). Physical functioning and physical health seem to be the sub-domains mostly affected by obesity (Griffiths, et al., 2010). Obesity also impacts on social acceptance and functioning, but the impact on scholastic/cognitive functioning is less clear (Griffiths, et al., 2010).

In summary, childhood obesity has medical and psychosocial consequences, both in the short- and the long term. There are great differences between subgroups of children with obesity, however. Clinical samples of obese children have more psychological problems and impaired QoL compared with population based samples of obese and normal-weight controls, possibly due to the different characteristics of those who seek treatment and those who do not (Wardle & Cooke, 2005). In order to identify those at particular risk of psychosocial problems we need to know how obesity is related to such problems, and how these problems are related to each other. To meet the need for such knowledge, the current work explores the relationship between QoL and psychopathology in treatment-seeking children with obesity.

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1.6.   Treatment of obesity in children

1.6.1.   General findings

Intervention studies in pediatric obesity have improved in quality and quantity over the past several years (Whitlock, O'Connor, Williams, Beil, & Lutz, 2010) and several reviews and meta-analysis have been published (K. A. Kitzmann et al., 2010; Luttikhuis et al., 2009; McGovern et al., 2008; McLean, Griffin, Toney, & Hardeman, 2003; Wilfley, 2007; Young, Northern, Lister, Drummond, & O'Brien, 2007). It is generally agreed that family-based behavioral interventions have at least a short-term effect in reducing overweight in children and lead to increased psychological well-being (Blaine, Rodman, & Newman, 2007; Griffiths, et al., 2010). Family-based interventions focus on changing the behavior of multiple family members, not only the obese child (Epstein, Valoski, Wing, & McCurley, 1994), recognizing that obesity develops and is maintained in a family context (Golan & Weizman, 2001). Luttikhuis et al (2009) concluded in their Cochrane review that combined behavioral lifestyle interventions, namely the use of behavioral components to facilitate modifications in diet and physical activity, produce a significant and clinically meaningful reduction in overweight compared with standard care or self-help. Cognitive and behavioral management techniques such as problem-solving, goal-setting and limiting exposure to unhealthy food are used in order to enhance the families' ability to succeed in changing life-style. The behavioral therapy included in most interventions is aimed at changing thinking patterns and actions in relation to dietary intake and eating, physical activity and sedentary behaviors in addition to the family`s food and physical environment (Luttikhuis, et al., 2009). It has been found that the greater the number of techniques taught to both parents and children, the better the treatment effect (McLean, et al., 2003). In addition, moderate - to high-intensity interventions have significantly greater effect on weight-outcomes than low-intensity interventions (Whitlock, et al., 2010) and programs with more components are more efficacious than those using fewer components (Seo & Sa, 2010).

1.6.2.   Treatment goals, treatment effect and clinical significance

Treatment guidelines define the primary goal of obesity treatment to be improved long-term physical health through permanent healthy lifestyle habits (Barlow, 2007). No consensus exist on how much height for weight change should be the goal in pediatric obesity treatment

(Epstein, Paluch, Roemmich, & Beecher, 2007). The Barlow et al (Barlow, 2007) guidelines recommend weight-maintenance in overweight children aged six to eleven with comorbidities, whereas weight-reduction is advocated for obese children. Both international and national guidelines advise care providers to help families make small, gradual changes that can be maintained in the long term (Barlow, 2007; Norwegian Directory of Health, 2010). The expert committee recommendations state that the general goal for all ages is for BMI to deflect downward until the 85th percentile (Spear et al., 2007). Knowing that some children are healthy with BMI values between the 85th and 95th percentiles, however, the authors state that clinical judgment plays a critical role in weight recommendations. Further, obesity interventions may vary in effect owing to differences in the age of the child, in metabolism, in nutritional needs, in physical maturation and in psycho-social development throughout childhood (Luttikhuis, et al., 2009).

There is a lack of long term data on the effectiveness of treatment programs for children with obesity, but those few long-term studies conducted show satisfactory maintenance of treatment effects, with mean reduction ranging from a decrease of 8 to 20 percent overweight (Braet & Van Winckel, 2000; Epstein, McCurley, Wing, & Valoski, 1990; Epstein, Valoski, Wing, & McCurley, 1990; Golan & Crow, 2004). Epstein et al (2007) point to the fact that the 95th percentile is equivalent to about 2.0 SD and a change of 1.0 SD could therefore move a child with a BMI SDS of 3.0 to below the 95th percentile. The authors argue, however, that there are likely to be health advantages even if the child remains well above the 95th percentile. It has been shown that improvements in body composition and cardio-metabolic risk can be seen with BMI z-score reductions >0.25 in obese children aged nine to twelve, whereas greater benefits accrue from >0.5 unit reductions (Ford, Hunt, Cooper, & Shield, 2010). Others have found that there are no threshold levels for the reduction in BMI z-score required to decrease metabolic risk in obese children (Reinehr, Kleber, & Toschke, 2009). As many obesity treatment programs targeting lifestyle changes are of short duration, there may be minimal evidence of adiposity reduction during this period (K. A. Kitzmann, et al., 2010). Use of conventional or adult-oriented outcomes is thus inappropriate. Luttikhuis et al (2009) declared a need for defining short- and long-term outcomes for children at various weight levels. Changes in weight-related behaviors such as eating and activity habits (K. A. Kitzmann, et al., 2010) and improved psychosocial outcomes (Barlow, 2007) may be more noticeable in the short term. These measures are likely to be more meaningful, until the children's growth and development stabilize (Luttikhuis, et al., 2009). Studies on multi-

componential child obesity treatment focusing solely on adiposity outcomes may thus underestimate the breadth of these interventions' effectiveness.

1.6.3. Diet and physical activity

Reducing overweight is closely dependent on total caloric intake since a negative caloric balance is essential to promote weight-loss (Ness-Abramof & Apovian, 2006). In the guidelines from the American Academy of Pediatrics it is recommended that weight-reducing diets contain "less energy than required to maintain weight but not less than 1200 kilocalories a day" (Spear, et al., 2007). The goal of the nutritional part of pediatric obesity interventions is to induce incremental dietary changes that can be successfully incorporated into a global lifestyle change during childhood and maintained into adulthood (Fitch & Bock, 2009). The emphasis is placed on guiding healthy food choices and appropriate portion sizes rather than achieving a certain caloric goal (Fitch & Bock, 2009).

An inverse relationship between dairy intake of sugar-sweetened beverages , meal frequency (Toschke, Thorsteinsdottir, Von Kries, & G.M.E. Study Group, 2009) and overweight and obesity has been observed, and should therefore constitute an important part of the diet component of any obesity intervention. In a study of 6-9 year olds, food-based recommendations found to be most effective for reducing energy and fat intake included; changing to reduced fat milk, reducing intake of cereal-based and snack foods and replacing juice or soft drinks with water (Gehling, Magarey, & Daniels, 2005). In a multicenter randomized study of obesity treatment in children and adolescents, all groups significantly decreased total quantity of food and kilo joule (KJ) after six and twelve months, with no differences between the groups (Burrows, Warren, Baur, & Collins, 2008). In a review examining the effectiveness of dietetic interventions in pediatric obesity treatment, however, the authors conclude that the dietary intervention or participant food intake is rarely described (Collins, Warren, Neve, McCoy, & Stokes, 2006). To address the mentioned knowledge gaps, the current thesis aimed at giving detailed descriptions of the intervention and to explore dietary changes during treatment.

It is commonly agreed that reduced physical activity and increased sedentary behavior (TV-viewing, computer games, etc.) are implicated in the etiology of childhood obesity (Reilly & Dorosty, 1999; Reilly & McDowell, 2003). Several studies have shown a strong

negative relationship between physical activity and obesity in children (Ness et al., 2007) and higher levels of habitual physical activity are protective against obesity in children and adolescents (Jimenez-Pavon, et al., 2010). Physical activity increases the amount of oxidized fat, indicating that more fat is consumed by the body, which helps control fat mass (Maffeis & Castellani, 2007). In addition to reducing adiposity, physical activity improves metabolic disorders and helps keep weight stable (Maffeis, 2008). Engaging in higher-intensity physical activity is associated with lower waist circumference and less visceral fat in youth (Kim & Lee, 2009). An extra fifteen minutes of physical activity a day at the age of 12 was associated with less fat at the age of 14 in a prospective birth cohort study (Riddoch et al., 2009). Reduction in physical activity promotes fat gain (Maffeis, 2008). In their review of randomized trials, McGovern et al. (2008) reported that trials that measured the effect of physical activity on adiposity found a moderate treatment effect and trials measuring the effect on BMI found no significant effect. Reducing access to sedentary activities has shown to be more effective than reinforcing active behavior choices for weight loss in obese children (Epstein, Coleman, & Myers, 1996; Robinson, 2001).

In the current thesis we explore whether changes in physical activity predict changes in body fat during treatment. As already shown, diet and physical activity are important ingredients of pediatric obesity treatment, but less is known with regard to their relative importance. The current thesis therefore aimed at examining their relative contribution to explaining changes in body fat during treatment.

1.6.4. Parental involvement

Diet and physical activity are important ingredients in interventions aimed at reducing obesity in children, but in order for treatment to succeed, parents have to be involved. Children`s eating is modified by exposure to and accessibility of foods, by parents modeling behavior and their child-feeding practices (L. L. Birch & Fisher, 1998). Parents are also important health-promoters with regard to physical activity (Beets, Cardinal, & Alderman, 2010; Edwardson & Gorely, 2010). When reviewing combined lifestyle interventions, McGovern et al (2008) found that the greatest treatment effect was associated with parental involvement, i.e. when the parents were targeted individually or with the child. This finding is supported by an earlier review showing that parental involvement is associated with weight-loss in children (McLean, et al., 2003). Golan et al (Golan, 2006; Golan & Crow, 2004) even showed that

children who actively participate in psycho-behavioral education sessions, with or without their parents, had less weight reduction and fewer behavioral changes compared with children who did not attend these session. This finding contradicts that of Epstein et al (Epstein, Myers, Raynor, & Saelens, 1998; Epstein, Valoski, et al., 1990) who found treatment programs targeting both parents and children as superior. Golan et al. (Golan, 2006) argue that the different findings may be because in their design parents and children were seen together, whereas in the Epstein design children and parents participated in separate groups. The involvement of parents in treatment of obesity in children is not straightforward. In a meta-analysis of family-based behavioral weight loss treatments for children, the authors conclude that even though the meta-analysis suggests that including parents in outpatient weight-loss interventions enhances outcome, it does not reveal which of the many possible aspects of parental influence were modified in the intervention in order to produce weight-loss (Young, et al., 2007). In a more recent meta-analysis, Kitzmann et al. (2010) found that youth in programs with high parental involvement had outcomes about ¾ standard deviation better than controls and about ¼ standard deviation better than youth in programs with low parental involvement. It has also been shown that programs that included parent training in general behavior management and educated parents about nutrition and food preparation had significantly larger effect sizes than programs that did not include such components (K. A. Kitzmann, et al., 2010). It is reasonable to assume though, that the level of parental involvement will change owing to age and development (Luttikhuis, et al., 2009). It has been shown, for example, that adolescents achieved greater weight loss when treated alone (Tanofsky-Kraff et al., 2007). Therefore, even though management of obesity should be addressed from the perspective of the whole family (Dennis & Goldberg, 1996), there is still a need for studies which try to answer the question of how and to what extent to involve parents in treatment of obese children at different ages (K. M. Kitzmann & Beech, 2006). Many pediatric obesity intervention studies have been criticized for methodological flaws such as limitations in recruitment methods, small sample sizes, lack of randomization details, high attrition-rates, short-term follow-up (<12 months), no intention-to-treat analysis and many were highly resource-intensive, limiting their potential use in clinical care (Collins, et al., 2006; Kavey, 2010; Luttikhuis, et al., 2009). Considering the fact that family-based obesity treatment is costly for the health care system and demanding for the afflicted families, there is an urgent need to increase our knowledge of how to deliver this treatment to achieve persistent effects. It is therefore reasonable to ask what kind of parental involvement is sufficient to produce change. In the current thesis we therefore examine whether a self-help

group of parents differ from a therapist-led group of parents in improving adiposity and dietary intake in children with obesity.

1.6.5. Predictors of treatment success

In the development of more effective treatment programs and tailored interventions, the search for predictors of treatment is important. If we know what baseline characteristics predict treatment success we can address these variables during treatment in order to enhance treatment efficacy. Several studies show that the child`s initial weight (Braet, 2006; Epstein, et al., 1994; Madsen et al., 2009; Moens, Braet, & Van Winckel, 2010) and age (Moens, et al., 2010; Reinehr, Kleber, Lass, & Toschke, 2010) are significant predictors of outcome. In a comparison of the efficacy of older versus contemporary treatment programs, Epstein et al (Epstein, et al., 2007) found age and gender to be predictors of z-BMI up to 24 months, with younger children and girls showing greater change. Psychological predictors of outcome have also been examined. Moens et al (2010) found the child`s self-worth to predicted outcome in an eight-year follow up study. Further, eating pathology has shown to affect treatment effect negatively (Goossens, Braet, Van Vlierberghe, & Mels, 2009; Wildes et al., 2010). In a study by Braet (2006), though, global self-worth and psychopathology did not predict weight loss. The authors of a review of psychosocial pre-treatment predictors of weight control argue that the evidence is too inconsistent to conclude that such variables (e.g. eating self-efficacy, self-esteem, body image) predict treatment outcome (Teixeira, Going, Sardinha, & Lohman, 2005). They also found that eating-pathology and depression assessed before treatment did not predict outcome after treatment.

In addition to psychosocial predictors of treatment outcome, the extensive role of parents in pediatric obesity treatment makes the study of parental predictors important. What parental characteristics are predictive of treatment success? Parent's` age and BMI have been shown to predict outcome, in addition to family structure (Marild, Dahlgren, & Hochberg, 2009). Further, maternal psychopathology has been found to be a major negative determinant of children`s outcome (Moens, et al., 2010). Few studies, however, have examined broader parental characteristics and their relationship to children`s outcome (Moens, et al., 2010). As they are the agents of change in pediatric obesity interventions, it is of special importance to know what characterizes those parents who are able to make the necessary lifestyle changes and what obstacles parents face in changing the family's lifestyle. Since family-based

interventions of obesity are informed by conceptual models that take into account the fact that pediatric illness is influenced by multiple contexts of development (K. M. Kitzmann & Beech, 2006), the family system perspective should be applied in the search for potential predictors of outcome. In addition, since treatment is aimed at changing the family's health behavior, health behavior models constitute an important theoretical framework.

1.7. Theoretical background

1.7.1. The family systems perspective

The social-ecological model developed by Bronfenbrenner (Bronfenbrenner, 1979) and adapted by Kazak (1989) and Wood's bio-behavioral family model (K. M. Kitzmann & Beech, 2006) are examples of family systems perspectives on pediatric illness. Such models propose that a problem in any member of a family has an effect on all other members (Kazak, 1989). The term "social ecology" is defined as the study of the relation between the developing human being and the settings and contexts in which the person is actively involved (Kazak, 1989). The social-ecological model propose that the child is at the center of a series of levels, which represent settings that have bidirectional influences on the child (Kazak, 1989). In the case of pediatric obesity, such a model would suggest that a child's diet and eating behavior as well as her/his physical activity would be a product of the child's dispositions and developmental level, interaction with his/her parents and friends, as well as being related to larger systems such as the politics of food-advertising. Figure 2 presents a model of the development of childhood obesity based on the results of research assessing predictors of childhood overweight in combination with ecological systems theory (K. Davison & Birch, 2001).
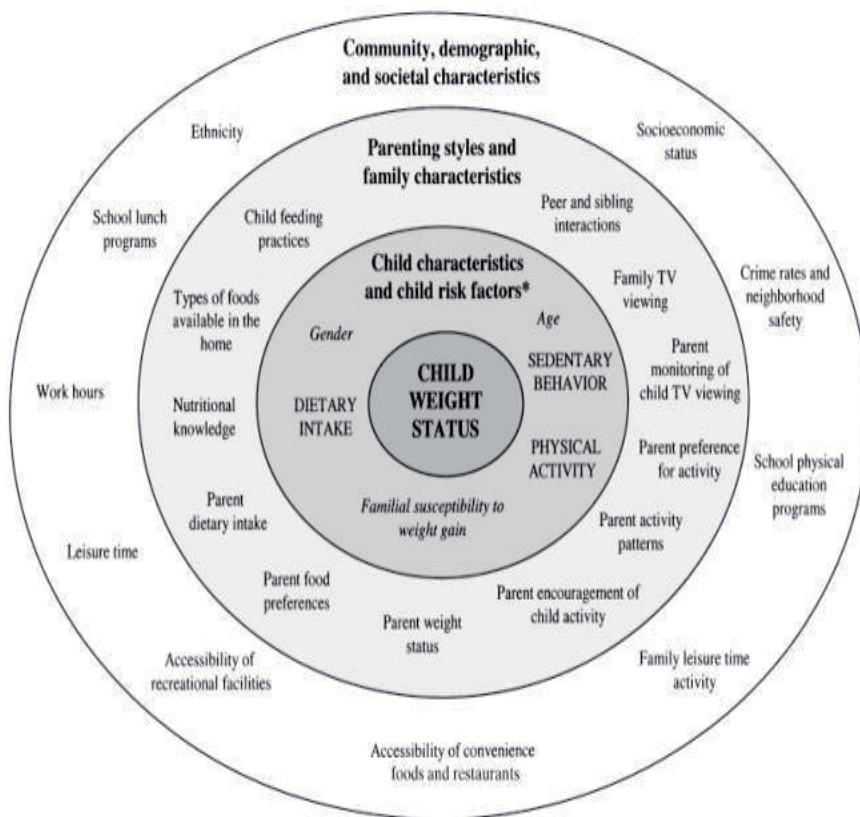
Fig. 2: Ecological model of predictors of childhood overweight (K. Davison & Birch, 2001) (p.171).

Note: *=Child risk factors (shown in upper case lettering) refer to child behaviours associated with the development of overweight. Characteristics of the child (shown in italic lettering) interact with child risk factors and contextual factors to influence the development of overweight (i.e. moderator variables). The development of child risk factors is shaped by parenting styles and family characteristics, such as parents' dietary intake and activity patterns, nutritional knowledge, child feeding practices, peer and sibling interactions. Characteristics of the school environment, and community, demographic, and larger environmental factors, such as parent work-related demands (i.e. work hours and leisure time), ethnic background and the availability and accessibility of recreational facilities, influence child adiposity status as a result of their influence on parenting practices and children's daily eating and activity behaviours (K. Davison & Birch, 2001, p. 171).

Although the socio-ecological model is used for an understanding of the development of obesity in children, it can also be applied to treatment of obesity. Treatment of obesity focuses mainly on child- and parent variables, more specifically on changing their diet and physical activity behavior. Since predictors associated with development of obesity are not equal to those predicting changes in diet- and physical activity during treatment, additional variables must be added. Factors predicting health behavior change can be found within the health behavior models.

1.7.2. Health behavior models

Health behavior is typically defined as behavior undertaken by individuals to enhance or maintain their health (Stroebe, 2000). Several models have been developed in an attempt to describe why individuals do or do not engage in particular health behaviors and how they go about changing such behavior, suggesting behavioral principles that are common across health behaviors (Noar, Chabot, & Zimmerman, 2008). The models are used both as a framework for designing interventions and for understanding how interventions work to promote change in diet and physical activity behaviors (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003). In order to test whether changes in theoretical constructs are responsible for changes in the outcome variable, mediator analysis may be applied (Lubans, Foster, & Biddle, 2008). A mediator is an intervening causal variable necessary to complete the pathway from an intervention to the targeted behavioral outcome (Bauman, Sallis, Dzewaltowski, & Owen, 2002), e.g. self-efficacy as a mediating variable in the cause-effect sequence between the intervention and weight-loss. Applying the mediating variable framework reveals that the effectiveness of interventions is limited by two factors: the ability of the mediating variables to predict behavior, and the ability of the interventions to affect change in the mediating variables (Baranowski, Cullen, & Baranowski, 1999).

1.7.2.1.The Social Cognitive Theory

The Social Cognitive Theory (SCT) (Bandura, 1977, 1991, 1998, 2001), a comprehensive human behavior theory, is the most frequently used paradigm in weight management interventions (Palmeira et al., 2007). SCT is based on the reciprocal determinism between behavior, environment, and person, with their constant interactions constituting the basis for

human action (Bandura, 1998). The theory specifies a set of determinants and the mechanisms though which they work in order to affect health behavior (Bandura, 2004).The model predicts that belief in one`s efficacy to exercise control is a common pathway through which psychosocial influences affect behavioral change (Bandura, 2004). Self-efficacy refers to the individuals belief in his or her ability to perform and succeed in specific situations or activities, the individuals confidence that he/she is able to change his/her behavior (Bandura, 1977, 1986). People with greater levels of self-efficacy will be more likely to engage in a specific behavior (e.g. exercising, eating fruit and vegetables), persist until they manage it, and maintain the behavior (Baranowski, et al., 2003). The construct of self-efficacy has been among the most analyzed psychosocial constructs in both nutrition and physical activity studies, in addition to the concept of perceived barriers and benefits (Palmeira, et al., 2007). According to Bandura (Bandura, 1982) self-efficacy expectations develop and are modifiable through four sources of experiential information; performance accomplishments, vicarious learning or modelling; verbal persuasion or encouragement from others to engage in a specific behavior; and degree of emotional arousal (diminishing negative affect such as anxiety). In obesity treatment for example, setting realistic goals when aiming at changing health behavior (e.g. increased intake of fruit can increase the individuals' sense of self-efficacy through performance accomplishments and thereby increase the likelihood of changing health behavior. In several adult studies, positive associations between self-efficacy and weight-loss were evident during the intervention phase (Dennis & Goldberg, 1996). Typically, self-efficacy increases over the course of obesity treatment, but the prediction of weight loss seem to vary depending on gender and the definition of self-efficacy used. Even though self-efficacy has been found to significantly predict weight loss in adults (Bas & Donmez, 2009), the findings are inconsistent (Teixeira, et al., 2005).

1.7.2.2. The Theory of Planned Behavior

The Theory of Planned Behavior (TPB) is the health behavior model most extensively used in research. According to TPB, perceived subjective norms, together with attitudes, and perceived behavioral control, predict behavioral intensions, which in turn influence behavior (Ajzen, 1991). The relative influence of attitudes, subjective norms, and perceived behavioral control in the prediction of intention is expected to vary across behaviors and intentions. When the behavior or situation affords the person complete control over behavioral

performances, intentions alone should be sufficient to predict behavior (Ajzen, 1991). Perceived behavioral control refers to the individual`s perception of the ease or difficulty of performing the behavior of interest (Ajzen, 1991), and closely resembles the construct of self-efficacy. Perceived behavioral control is believed to moderate the relationship between intention and behavior, i.e. intention will convert to behavior when perceived behavioral control is high (Baranowski, et al., 2003). For example, if two people have equally strong intentions to start dieting, and both try to do so, the person who is confident that s/he can master the dieting is more likely to persevere than the person who doubts his/her ability (Ajzen, 1991). In general, TPB has been shown to account for about 27% and 39% of the variance in behavior and intention, respectively (Armitage & Conner, 2001). TPB has also been shown to significantly predict weight-loss in adults (Schifter & Ajzen, 1985). To the best of our knowledge, the TPB has not been applied in pediatric treatment studies. TPB constructs, however, have been examined in population studies of children. Such studies have found that parents' attitudes towards mealtimes and nutrition influence children's health (Gable & Lutz, 2000, 2001) and that negative parental attitudes toward children`s television viewing correlated positively with the degree to which parents regulated their children`s TV-viewing (Christopher, Fabes, & Wilson, 1989). In a study of parents as health promoters (providing healthy foods and limiting unhealthy foods), the TPB demonstrated its predictive utility with attitudes, subjective norms and perceived behavioral control predicting behavioral intentions, and behavioral intentions predicting parents` tracking behavior of their children`s food intake (Andrews, Silk, & Eneli, 2010).

1.7.2.3. The Health Belief Model

The Health Belief Model (HBM), first developed by social psychologists in the US Public Health Service, states that the likelihood that a person will engage in a given health behavior is a function of the extent to which the person believes that he/she is personally susceptible to the particular illness and his/her perceptions of the severity of the consequences of contracting the disease (Rosenstock, Strecher, & Becker, 1988; Stroebe, 2000). Whether the person will engage in a particular health behavior will further depend on whether he/she perceives that the benefits of the behavior outweigh the barriers. In addition, a cue to action has been suggested as necessary to trigger appropriate health behavior (Rosenstock, et al., 1988), such as an environmental (e.g. media campaign, a friends` disease) or bodily event (e.g. a bodily

symptom), that triggers perceptions of susceptibility (Baranowski, et al., 2003). According to the HBM there are many reasons why people do not change health behavior in spite of the risk of disease. First, people show a tendency to underestimate their own health risks compared with those of others. Second, they are unlikely to engage in health-protective behavior if they doubt their effectiveness or if they feel the efforts is too great (Stroebe, 2000). The relation between the variables of the HBM has never been formalized or explicitly spelled out and a number of important determinants of health behavior are not included, such as potentially positive aspects of health behavior, the concept of self-efficacy and perceived behavioral control (Stroebe, 2000). A review of studies based on the HBM supports the model (Janz & Becker, 1984), but a meta-analysis shows that only 10% of the variance in health behavior could be accounted for by any one dimension of the model (Harrison, Mullen, & Green, 1992).

1.7.2.4. Health behavior models and the treatment of obesity

In summary, the health behavior models are all founded on the common metatheory that psychosocial factors are important contributors to human health (Bandura, 2004). There is a considerable overlap between the models and the key health cognitions they identify (Conner, 2010), e.g. the SCT construct of self-efficacy partly addresses the confidence a person has in being able to overcome the HBM barriers to performing a behavior (Baranowski et al, 1999). This suggests some advantages of combining distinct constructs from each theory (Baranowski et al, 1999). Based on such an assumption the current thesis applied the SCT construct of self-efficacy, the TPB constructs of attitudes and subjective norms, and the HBM construct of perceived barrier, all which are constructs examined in studies on how parents' health cognitions affect the promotion of physical activity and healthy eating in their children (Adkins, Sherwood, Story, & Davis, 2004; Dwyer, Needham, Simpson, & Heeney, 2008; Smith et al., 2010). The self-efficacy construct is applied because of its extensive use in health behavior change research and in adult obesity interventions in particular. Further, it is reasonable to assume that the strong cultural norms related to being thin and healthy and the concurrent stigmatization of obesity also affect parents of obese children. Their attitudes and subjective norms are therefore important when parental health cognitions as predictors of change in body fat during treatment are explored, and hence were applied in the current study. Parents promoting healthy eating in their child face few physical barriers in contemporary

society. Even though there may be physical obstacles in the case of physical activity, such as access to recreational areas and the safety of neighborhoods with respect to walking and biking, they are still considered minor in contemporary Norway. Other perceived barriers could include factors such as financial costs, physical barriers, personality, and emotional characteristics (Rosenstock, et al., 1988). Even so, as a clinician, I have often found that parents face emotional barriers when changing health behavior, e.g. feeling bad when limiting availability or amount of food, and that these barriers surpass the material or informational barriers. The "barriers" construct applied in the present thesis therefore captures the emotional aspects rather than practical or physical aspects, and these are therefore termed perceived emotional barriers.

Most research based on health behavior models studies one behavior at a time (Baranowski, et al., 2003), even though multiple unhealthy behaviors often co-occur (Prochaska, Spring, & Nigg, 2008). Success in changing one or more health behavior may increase the person's self-efficacy to improve risk behaviors that he/she is less motivated to change (Prochaska, et al., 2008). This is especially important with regard to the treatment of obesity where multiple behaviors are targeted. No theory of behavior change, however, directly addresses the issue of how to intervene in more than one behavior simultaneously (Prochaska, et al., 2008).

In evaluating the usefulness of health behavior models in weight control, Baranowski et al (2003) point to the fact that the models do not specify at what ages they can be applied. The models are strongly based on the individual and do not take into account that children are under the strong influence of their parents. The competing influences of parents, peers, and personal control have not been elucidated (Baranowski, et al., 2003) and the question of how the models can be applied when parents are the agent of change is unclear. It is in fact a general concern that the models do not account for environmental influences (Kremers, 2010). Regarding food consumption, for example, children are dependent on their parents for food availability. Studies show that availability is one of the most important predictors of children's fruit and vegetable consumption (Baranowski et al., 1993). Thus, children`s health cognitions may be of less importance in predicting children's food-consumption than environmental factors (Baranowski et al, 1999). In the current treatment program availability of healthy food and unavailability of unhealthy food was addressed. Whether parents are able to make healthy food available and limit unhealthy food, however, will, according to the health behavior models, partly depend on their health cognitions. Therefore, when we apply

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health behavior models in the study of obesity in children, parents` health cognitions are of utmost importance and probably more important than the children`s own health cognitions. Since the health behavior models do not explicitly address parents as agents of change, however, such knowledge has to be found elsewhere. The current intervention takes advantage of theory, experience and research conducted on the "The Incredible Years" parent program.

1.7.3. "The incredible years"

"The incredible years" are research-based effective programs for reducing children's aggression and behavioral problems and increasing social competence at home and at school (Webster-Straton, 2011; Webster-Stratton & Reid, 2010). The group-based parent programs are intended to promote parent competences and strengthen families through emphasizing parenting skills known to promote children's social competence and reduce behavioral problems (how to play with children, helping children learn, effective praise and use of incentives, effective limit-setting and strategies to handle misbehavior). The program also aims at enhancing parent interpersonal skills such as effective communication skills, anger management, problem-solving between adults, and ways to give and get support (Larsson et al., 2009; Webster-Straton, 2011). The efficacy of the program has been shown in several studies, resulting in the program being widely used (Brestan & Eyberg, 1998; Webster-Stratton & Reid, 2010; Webster-Stratton, Reid, & Hammond, 2004). A randomized controlled trial of the parent- and child training program conducted in a sample of 127 Norwegian children aged four to eight showed among several outcomes that parental use of positive strategies increased after treatment (Larsson, et al., 2009). Even though treatment of conduct problems differs from treatment of obesity to a great extent, they are both aimed at changing parental behavior in order to manage a set of behaviors in the child. Praise, support, limit setting, and structuring are among the parenting skills that are considered perhaps equally important in managing eating/physical activity as in managing oppositional behavior problems. In addition, interventions including a parent training component have been shown to increase treatment efficacy in children with obesity (K. A. Kitzmann, et al., 2010). The parent intervention developed for the current study was therefore based on research on and clinical experience in conducting the "The incredible years" program.

1.8. Summary

Obesity is defined as excessive body fat and the number of children with obesity is increasing. Obesity is caused by both genetic and environmental factors and is associated with medical and psychosocial consequences. Research has shown that treatment-seeking children with obesity report more psychological problems and impaired QoL than normal-weight children. These findings have mainly been explained by stigma-related factors (e.g. teasing), since social stigma associated with obesity can be pervasive and may lead to serious emotional and social problems (Puhl & Latner, 2007). However, few studies have used mediation models in order to answer *why* clinical samples of obese children show impaired psychosocial functioning. Correlation analyses are important as a first step in examining a relationship between certain variables, but are not sufficient in examining the nature of relationships. We need to go beyond simply describing what kind of problems obese children experience and start looking for how these problems interact and relate to each other. For example, if we know why obese children report impaired QoL we can address these factors during treatment in order to increase the QoL reported. In other words, such knowledge is important in order to address psychosocial problems in a more sophisticated manner in more tailored treatment programs.

Research has shown that healthy eating, increased physical activity and parental involvement are important components of pediatric obesity treatment, but we know less about how these components interact. If we detect the mechanisms of change and reveal which components can explain the reduced obesity obtained, we can "do more of what works best," and thereby increase treatment efficacy. In order to increase efficacy, we also need to know which factors predict treatment success. Since treatment of obesity is about changing health behavior, predictor variables should be adopted from behavioral change theories. Health cognitions constitute the most important part of such theories and have been shown to predict physical activity and healthy eating in both population and intervention studies. Owing to the extensive role of parents in the treatment of pediatric obesity, parental health cognitions as predictors of outcome need to be examined.

In addition to the need to examine parental predictors of treatment success, the most effective way to involve parents in obesity interventions remains unclear (Golan, Kaufman, & Shahar, 2006; Reinehr, 2011). Randomized trials exploring different parental interventions are needed. Considering the fact that family-based obesity treatment is costly for the health care

system and demanding for the afflicted families, there is an urgent need to increase our knowledge of how to deliver effective as well as cost-effective treatment which achieves persistent effects.

2.0.   AIMS OF THE THESIS

The overall aim of the current thesis was to examine psychosocial functioning and changes in adiposity, diet and physical activity in children with obesity participating in a randomized, family-based outpatient intervention conducted at St Olav`s University Hospital, Norway, from 2005 to 2010.

The aim of Study I was to measure psychopathology and QoL in treatment-seeking children with obesity compared with a matched community sample. In addition, we tested the hypothesis that psychopathology mediates the relationship between QoL and obesity. The main purpose of Study II was to examine whether parents' self-efficacy, perceived emotional barriers, subjective norms, and attitudes could predict change in their children's total body fat at six months and two-year follow-up after treatment. Study III aimed to examine how changes in physical activity and diet predicted changes in body fat during treatment. In Study IV we compared the efficiency of therapist-led vs. self-help groups of parents in treatment of pediatric obesity, in addition to describing dietary changes during treatment. In summary, the following research questions were asked:

1. Do treatment-seeking children with obesity have more psychological problems and impaired QoL compared to a matched community sample?
2. Does psychopathology mediate the relationship between obesity and QoL?
3. Are changes in children`s body fat during treatment predicted by parental health cognitions?
4. Are diet and activity equally important in reducing body fat during treatment?
5. Are parental self-help groups and therapist-led groups equally efficient in reducing body fat in children treated for obesity?

3.0. METHODS

3.1. Participants

Participants of Study I were 185 treatment-seeking children with obesity (93 girls, 92 boys) and a matched sample of 799 community children (367 girls, 432 boys). The age range of the clinical sample was seven to eighteen years, with a mean age 11.5 ($SD = 2.6$); mean weight 98.7 kg ($SD = 51.4$), mean BMI 30.7 ($SD = 5.3$), and mean BMI SDS 3.03 ($SD = 0.5$). All but eight of the subjects of the clinical sample were ethnic Norwegians (Caucasian); four of these were of African origin and four were of Latin-American origin. The community sample consisted of children aged eight to sixteen years with a mean age of 12.1 ($SD = 2.3$).

Participants of Study II, III and IV numbered 99 children (48 girls, 51 boys) with a mean age of 10.3 ($SD=1.7$) and a mean BMI SDS of 2.99 ($SD=0.46$). All but two of the children were ethnic Norwegians (Caucasian): one child was of African origin and the other of Latin-American origin. Measured height and weight records for the children's parents showed that their fathers (N=54) had a mean BMI of 29.9 (SD=3.6) and their mothers (N=91) a mean BMI of 31.9 (SD=7.3) at baseline. Baseline characteristics of participants of Study II, III and IV are presented in Table 1.

Table 1

Characteristics of the participants of Study II, III and IV at baseline

(N=99)	
Mean (SD)	
Age	10.3 (1.7)
Weight (kg)	62.7 (16.3)
Height (cm)	146.8 (11.3)
BMI	28.60 (4.1)
BMI SDS	2.99 (0.5)
Body fat (%)	40.55 (4.1)
Mothers BMI (N=91)	31.86 (7.3)
Fathers BMI (N=48)	29.88 (3.6)
Parents`occupation [*]:	
Unskilled workers (%)	5.2
Farmers/fishermen (%)	3.1
Skilled workers (%)	47.4
Lower professionals (%)	22.7
Higher professionals (%)	11.3
Leaders (%)	10.3
The child`s caregiving situation:	
Living with both parents (%)	60.2
Living with a single parent (%)	16.3
Single parent and her/his new partner (%)	16.3
Equal time with each parent (%)	5.1
Foster parents (%)	2.0

[*]Classification of parents' occupation is based on the International Standard of Classification of Occupations (ISCO-88) (International Labour Office, 1990).
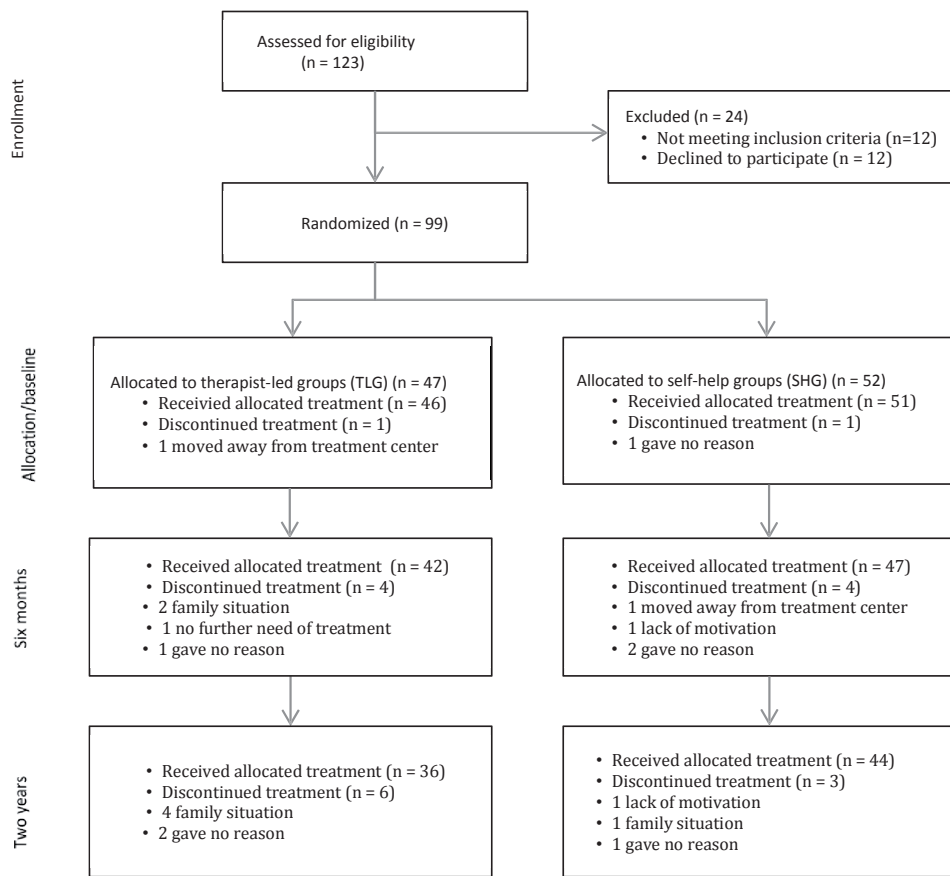
3.2. Procedure

In Study I, children and adolescents who were referred by their general practitioner for outpatient obesity treatment at St. Olav`s University Hospital, the general hospital in

Trondheim, Norway, between August 2003 and February 2008 were assessed for eligibility. The inclusion criteria were ages between seven and eighteen and BMI $\geq$ 2 Standard Deviation Score (BMI SDS) (Cole, et al., 2000; Cole, Freeman, & Preece, 1995, 1998). Children lacking the ability to participate in group treatment were excluded (pervasive developmental disorders, mental retardation). Of 250 patients attending, 25 patients did not meet the inclusion criteria and 40 patients did not want to participate in the study, yielding a sample of 185 subjects (93 girls, 92 boys). No alternative treatment program was available. The community sample of Study I consisted of children attending schools in the hospital's catchment area. Sixty-one age cohorts (that is all pupils at the same grade at one specific school) were randomly selected from all fourth, sixth, eight and tenth age cohorts. In total, 1,997 children (990 girls, 1,007 boys) participated in the survey, yielding a response rate of 71.2 % of eligible children. Exclusion criteria were insufficient competence in the Norwegian language (N= 51) and/or having a developmental level corresponding to more than two years below the relevant grade (N=47) (Jozefiak, 2009). Children with overweight or obesity were not excluded from the community sample, because the aim of Study I was to compare treatment-seeking obese children with the general population of children, not normal-weight children exclusively. Data were collected in the school setting by a research assistant at the same period of time as the data collection of the clinical sample. More details on the community sample are described elsewhere (Jozefiak, Larsson, Wichstrom, Mattejat, & Ravens-Sieberer, 2008). Each child in the clinical sample was randomly matched by sex and age group (8–9; 10–11; 12–13; 14–15 and 16–18) to five children from the community sample. Not all age-cohorts contained enough controls and in those cases all children in the control cohort were used.

Participants of Study II, III and IV were children referred for obesity treatment at St. Olav`s University Hospital between April 2005 and February 2008. They were consecutively recruited after meeting four inclusion criteria: age between seven and twelve; BMI $\geq$ 2 SDS (Cole, et al., 2000; Cole, et al., 1995, 1998); participation of at least one parent; and ability to participate in a group setting. Eighty percent of those who met the inclusion criteria joined the treatment program, resulting in a study population of 99 children (48 girls and 51 boys). The remaining 20% did not want to participate in the treatment, and no alternative intervention was offered. After a medical examination it was established that there was no organic cause for any subject`s obesity, and none of the subjects received any medication that might have interfered with growth or weight control.

Stratified by the age, sex and BMI of their child, participating parents were randomly allocated to one of two intervention groups (ratio 1:1) by use of a computer-generated list of random numbers; a therapist-led group (TLG) led by two trained therapists, or a self-help group (SHG) (Figure 3).

Fig. 3: Procedure and drop-out

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All children participated in children's groups and all families attended individual counselling. As can be seen in Figure 4, all groups met every second week for ten sessions during the first six-month treatment period (phase 1).

Phase 1:
Six months

Phase 2:
Eighteen months

Therapist-led groups 2 meetings/month (Total: 10 meetings)	**Self-help groups** 2 meetings/month (Total: 10 meetings)	**Therapist-led groups** 1 meeting every 3rd month (Total: 5 meetings)	**Self-help groups** 1 meeting every 3rd month (Total: 5 meetings)

Children's groups 2 meetings/month (Total: 10 meetings)	**Children's groups** 1 meeting every 3rd month (Total: 5 meetings)

Individual family counseling 1 meeting/month (Total: 6 meetings)	**Individual family counseling** 1 meeting every 6th month (Total: 3 meetings)

Fig. 4: Overview of interventions during the study period

Over the remaining 18 months of the two-year intervention program (phase 2), the groups met five times at the hospital. Each group session lasted two hours, including breaks, and each individual family counseling session lasted 30 minutes. Data were collected in a hospital setting by the members of the treatment staff, before onset of treatment, after six months, and after two years of treatment. Body fat was measured by trained personnel not involved in the treatment.

As can be seen in Figure 3, there was a total drop out of 10% at six months, and 19% at two years of treatment, with no difference in drop out between the two groups. Reasons given for the drop-outs were inability to continue to participate in the treatment program because of a family situation; a lack of motivation for treatment; no further need of treatment and inability to continue to participate in the treatment program because the family moved away.

3.3. Treatment program

For both intervention groups weight regulation was sought through increasing the families' daily level of physical activity, reducing their sedentary behavior and establishing healthy dietary habits with proper nutrition for the entire family. Based on international and national recommendations (Barlow, 2007; Helsedirektoratet, 2011), the intervention focused on regular mealtimes, increased intake of fruits and vegetables, less sugar and fat, more fiber-dense food, at least one hour of moderate physical activity per day and reduced sedentary behavior. Daily physical activity involved walking instead of riding in a car, taking the stairs rather than using an elevator, playing outside, cycling and general exercising.

3.3.1. Therapist-led groups

The aim of the therapist-led intervention group was to strengthen the parents' competence and the skills required to accomplish the lifestyle changes necessary in order to reduce their child`s obesity. Parents were allocated to groups of four to six parental couples of children of similar age and BMI. Both parents were requested to attend if possible. In cases where the parents no longer lived together, one of the parents attended with their new partner if appropriate. This new partner attended as a substitute for or in addition to the other parent, depending on the familial situation and the level of co-operation between the parents. Two therapists were present in the group treatment and a detailed treatment manual was devised (Steinsbekk & Wichstrøm, 2005). The structure of the treatment provided was adapted from the parent-program of "The Incredible Years", a research-based program for reducing children's aggression and behavioral problems and increasing social competence (Webster-Stratton & Reid, 2010; Webster-Stratton, et al., 2004). The Child and Adolescent Psychiatric Clinic at St. Olav's University Hospital in Trondheim is one of the sites where the program has been tested, and the clinic thus has extensive experience in conducting these types of interventions. Similarly to the Webster-Stratton program our manual used the group format, and role play for training in parenting skills, in addition to home assignments and group feedback to the parents. Pairs of therapists met regularly with taped therapy sessions in order to receive supervision from a trained and experienced Webster Stratton instructor and supervisor.

Ten sessions was conducted with the following content: (1) expectancies and goal setting; (2) communication about obesity, diet and physical activity; (3) daily physical

activity; (4) everyday meals and nutrition; (5) mastery and motivation; (6) guidance and limit setting; (7) who should join the team? the role of siblings and the social network; (8) parents' history of diet and physical activity; (9) self-concept and body image; (10) vacations and parties. Behavioral change techniques, such as monitoring, goal-setting, modeling, self-talk and reward, were applied. A series of written material was developed for the parents as part of the manual, such as "fridge-notes", home activity sheets, goal attainment sheets, etc.

The content of the treatment manual was based on results and clinical experience from a pilot study conducted at the Department for Children and Adolescents, in collaboration with the Department of Child- and Adolescent Psychiatry, both at St. Olav's University Hospital, Trondheim, Norway. Twenty-five children with obesity (aged seven to fifteen) participated in the treatment pilot conducted from 2003 to 2005. The aim was to reduce obesity among the children by means of increasing daily physical activity, limiting time spent on sedentary activities and promoting healthy eating. Treatment was conducted in age-segregated child groups, individual counseling, and parent groups. The session themes of the treatment program of Study II, III and IV were based on the results of and experience with the parent groups of the pilot.

3.3.2. Self-help groups

Self-help is based on the principle of mutual help and the work is based on the participants own experiences and knowledge (The Directorate for Health and Social Affairs, 2004). The self-help group of the current study may be categorized as initiated self-help (Høgsbro, 1992) since a professional initiated and organized the groups and attended the two first meetings as well as the last one. The role of the professional was to organize the group and facilitate group rules governing group behaviors to be formed. The sharing of experiences, feelings, and thoughts concerning being a parent of an overweight child, the management of obesity and changing lifestyle was encouraged.

3.3.3. Children's groups

All children participated in age segregated treatment groups of six to eight children. The groups were led by a clinical dietitian and a physiotherapist and the aim was to promote positive experiences from physical activity and healthy eating. The aim was accomplished

through participation in different activities such as climbing, ball-games and swimming as well as education and tasks related to healthy eating. In order to increase physical activity and as suggested by Trost et al (Trost, Kerr, Ward, & Pate, 2001), the intervention aimed at boosting self-efficacy perceptions regarding physical activity. Coping, mastery and having a good time were therefore emphasized. In the group sessions, bodily reaction to physical activity were also addressed (e.g. how does it feel to get sweat? why does the heart beat so fast? is it dangerous?). In some of the sessions the participants spent time cooking and tasting different kinds of foods, learning about nutritional needs, and were taught basic dietary skills. In addition, the psychosocial consequences of being overweight were addressed in a session led by a psychologist. No manual was developed for this one session, but the aim was to share experiences, thoughts and feelings related to being obese, e.g. experiences of teasing and bullying, difficulties and strategies in making the necessary lifestyle changes etc.

3.3.4. Family counseling sessions

In addition to the group settings each family met monthly with a physiotherapist and a clinical dietician for an individual consultation. The aim was to evaluate the family's progress, to settle rewards for achieved goals and to define new goals.

3.4. Measures

3.4.1. Anthropometric and body composition

Anthropometry was measured with the children wearing light clothing and no shoes. Weight was obtained by a digital scale (Seca 930, Vogel & Halke, Hamburg) and height was measured to the nearest 0.1 cm by stadiometer (Hyssna Limfog AB, Sweden). BMI was calculated in kg/m^2 and BMI SDS was computed with Nova Nordisk Nordinet® 3.1.2. Due to lack of Norwegian norms at the initialization of the current treatment study, British reference values were applied (Cole, et al., 1995, 1998). Dual Energy X-ray Absorptiometry (DXA, Discovery QDR), considered to be one of the most accurate methods of measuring body composition (Helba & Binkovitz, 2009), was used to estimate total body fat (%). DXA is the most widely used and validated tool for assessing body composition. As an index of fatness percentage fat is often used, i.e. fat mass divided by weight (Wells, 2001).

3.4.2. Psychological measures

3.4.2.1. Quality of Life (QoL)

QoL was measured with the Norwegian version of the Kinderlebensqualität Fragebogen (Questionnaire for Measuring Health-related Quality of Life in Children and Adolescents, revised version (KINDL-R) (Bullinger, von Mackensen, & Kirchberger, 1994; Helseth & Jozefiak, 2004), a well-established QoL instrument used in several clinical and community studies. The KINDL-R consists of six subscales: "Physical well-being," "Emotional well-being," "Self-esteem," "Family," "Friends," and "School." Each item addresses experiences over the past week and is rated on a five-point scale from 1 = "Never" to 5 = "Always" . Mean scores are calculated for each of the subscales, then combined to produce a total score. The subscale- and total score are linearly transformed to a 0-100 scale; the higher the score, the better the QoL. Both the self-report questionnaire for children and the parent form were used.

Psychometric testing of the KINDL-R revealed good scale utilization and scale fit as well as moderate internal consistency (Bullinger, Brutt, Erhart, & Ravens-Sieberer, 2008). A Norwegian normative study also confirmed the internal consistency and test–retest reliability (Jozefiak, et al., 2008) . In the present study, the internal consistency of the KINDL-R total score self-report form was alpha = .80 for the clinical sample and alpha = .86 for the community sample. For the parent report, the internal consistency was alpha = .84 for the clinical sample and alpha = .88 for the community sample.

3.4.2.2. Psychopathology

The Norwegian versions of the Child Behavior Checklist (CBCL) and the Youth Self-Report Form (YSR) were used to measure psychopathology, a well-established quantitative multi-informant approach (Achenbach, 1991; Nøvik, 1999). This approach also identifies syndromes e.g. "Anxious/depressed" and clinical cut-off values and generates suggestions for DSM-IV diagnoses, but it is based on empirical syndrome scales that quantify a certain amount and intensity of internalizing, externalizing or total emotional and behavioral problems (Achenbach & Rescorla, 2001). Parents are asked to report on their children's emotional and behavioral problems over the preceding six months, in the same way as the children report on their own emotional and behavioral problems in the self-report form. Each

item is rated on a scale of one to two 0 = "Not true," 1 = "Somewhat or Sometimes True," 2 = "Very True or Often True". In the present study, we used the Total Problem scale 118 items), the Internalizing Problem scale (31 items), comprising the Anxious/Depressed, Withdrawn/Depressed and Somatic Complaints subscales, the Externalizing Problem scale (32 items), comprising the Rule-Breaking Behavior and Aggressive Behavior subscales, and the remaining eight syndrome scales: Attention Problem (9 items), Thought Problem (12 items) and Social Problem (11 items). Participants older than 11 completed the YSR. The Norwegian versions of the CBCL and YSR have shown satisfactory validity and reliability (Heyerdahl, Kvernmo, & Wichstrom, 2004; Nøvik, 1999, 2000).

3.4.2.3. Parental health cognitions

Since no parent questionnaire exist that measures health cognitions related to the dietary and physical activity behavior typically promoted in obesity interventions, the Parental Health Cognitions Inventory was developed for Study II to measure parental health cognitions in regard to changes in children's diet and physical activity behavior. The questionnaire is based on the health behavior models SCT, TPB and HBM and measures parent`s self-efficacy (SCT), attitudes (TPB), subjective norms (TPB) and perceived barriers (HBM). Both self-efficacy $\alpha=.62$ and perceived emotional barriers $\alpha=.57$ were assessed by four items. The TPB constructs attitudes $\alpha=.68$ and subjective norms $\alpha=.80$ were assessed by a set of 11 items. The items were rated on a four-point Likert scale 1="Totally agree," 2="Partly agree," 3="Disagree," 4="Totally disagree". Treatment of obesity implies changing different health behaviors; all health cognition scales therefore include both diet and physical activity-related items. Higher scores represent higher self-efficacy, attitudes (the higher the score, the stronger the attitude related to the health behavior in question) and strongly perceived subjective norms the higher the score, the more important are others' opinions on the health behavior in question) and less perceived emotional barriers.

3.4.3. Diet

A four-day estimated food record, consisting of three consecutive weekdays and one weekend-day, was used to estimate the child's dietary intake. Children and parents were instructed to register everything the child ate and drank during the four-day period. Recording

food intake both at each meal and in between meals was emphasized in the written material distributed along with the food record forms. To improve the participants' accuracy in reporting portion sizes, an evaluated booklet with a photograph series of 13 food items of known portion weights was distributed to the families (Lillegaard, Overby, & Andersen, 2005). This method has been approved for accurately estimating dietary intake in a paediatric population, and it is less burdensome for the participants than a weighed food record (J. A. Higgins et al., 2009). In addition to comparing foods with photographs, foods could be weighed or reported in household measures (e.g. deciliters of milk) or as units (e.g. number of apples). To make the food record as precise as possible, a clinical dietician reviewed the food record together with the family.

To calculate the daily energy and macronutrient intake the reported food intakes from the food records were entered into "Mat på Data" version 5.1, a Web-based dietary analysis program based on the Norwegian Food Composition Table 2006 (MVT-06) (Food Safety Authority, the Directorate for Health, & the Department of Nutrition at the University of Oslo, 2006). To evaluate the effect of the intervention on dietary habits, changes in energy and macronutrient intake over time were analyzed, and the children's intake compared with national dietary recommendations (Norwegian Directory of Health, 2005), protein (10-20 percent of energy intake (E%)); fat (25-35 E%); saturated fatty acids (SFA)($\leq$10 E%); monounsaturated fatty acids (MUFAs) (10-15 E%); polyunsaturated fatty acids (PUFAs) (5-10 E%); carbohydrates (50-60 E%); added sugar ($\leq$10 E%); and dietary fibre (2-3g/MJ). To control for age effects, intake of macronutrients was expressed as E% and fibre as nutrient density (g/MJ). Energy intake was computed per kilogram of body weight and as ratio of energy intake to estimated basal metabolic rate (EI/BMR). The BMR was estimated from weight and height by means of age- and sex-dependent Schofield-equations (Schofield, 1985), considered as an accurate method for estimating the BMR of obese children (Firouzbakhsh et al., 1993; Rodriguez, Moreno, Sarria, Fleta, & Bueno, 2002). To identify dietary underreporting, age- and sex-dependent cut-offs for the EI/BMR ratios were used to find implausible food records (Sichert-Hellert, Kersting, & Schoch, 1998).

3.4.4. Physical activity

Physical activity was measured with an Actigraph GT1M accelerometer (ActiGraph LLC, Pensacola, FL, U.S.). The Actigraph (formerly CSA/MTI) is a small device (5.3 x 5.1 x 2.2

cm) placed on a standard belt which is worn around the waist. Children were instructed to wear the monitor for seven consecutive days, except when they were sleeping, swimming and showering or bathing. Activity data were recorded in 1 min. epochs and processed with accelerometer analysis software (MAHUffe) (MRC Epidemiology Unit, 2010). In the current study, analyses were carried out for general physical activity (GPA), reported in mean counts min^{-1}. GPA appears to be a robust parameter that is not affected by epoch length, and can be compared between studies (Dencker & Andersen, 2008). In order not to misinterpret lack of use of the accelerometer with inactivity, only data from children who had registered activity data for at least 480 minutes a day, for at least three days, were included in the study. These criteria are comparable with those used in other studies (Riddoch et al., 2004).

3.5. Statistics

3.5.1. Study I

To compare differences in means between the clinical and the community sample included in Study I, independent *t*-tests were conducted in SPSS 15.0. Structural equation modeling (SEM) was applied to explore the relationship between QoL and psychopathology and to test the theoretical distinction between these two concepts. SEM is a comprehensive method for the quantification and testing of theories and typically contains latent variables, i.e. theoretical or hypothetical constructs or variables that are not observable (Raykov & Marcoulides, 2006). QoL and psychopathology were treated as latent constructs in the current study. SEM can be used to test the interrelationship between such constructs as well as their relationship to the measures assessing them. Confirmatory factor analysis (CFA) is one type of structural equation model (Raykov & Marcoulides, 2006), conducted in the current study to test the hypothesis that QoL and psychopathology are distinct constructs as measured by KINDL-R and CBCL/YSR. Thus, the six KINDL-R subscales and the eight CBCL/YSR Syndrome Scales were used in the analysis, representing the two factors QoL and psychopathology. In the CFA no directional relationship between the constructs were assumed, only that they were potentially correlated with each other (Raykov & Marcoulides, 2006).

In order to test whether the relationship between impaired QoL and obesity is mediated by psychopathology, path-analysis was conducted. Path-analysis, being another type of structural equation model, focuses on observable variables (Raykov & Marcoulides, 2006)

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and allows the simultaneous modeling of several related regression relationships (L. K. Muthèn & Muthèn, 1998-2010). For continuous dependent variables, such as body fat (%) in the current study, linear regression models are used (L. K. Muthèn & Muthèn, 1998-2010).

The SEM analysis of Study I was conducted in Mplus Version 5.1 (L. K. Muthèn & Muthèn, 1998-2010) and a robust maximum likelihood estimator was used. In any structural equation model, the unknown parameters are estimated in such a way that the model becomes capable of "imitating" the analyzed covariance matrix (Raykov & Marcoulides, 2006). The robust maximum likelihood estimator is based on corrected statistics obtainable with the maximum likelihood method and is robust for mild deviations from normality (Raykov & Marcoulides, 2006). In Study I, both parent-reported and self-reported total QoL scores of the clinical sample at baseline were normally distributed. The parent-reported (CBCL) total problem score also had a normal distribution according to the Kolmogrov-Smirnov test (Field, 2005), but the self-reported (YSR) total problem score was significantly non-normal ($D(34) = 0.16, p < .05$).

Full information maximum likelihood was applied to handle missing data in Study I. Mplus does not impute values for those that are missing, but uses all data that are available to estimate the model. Each parameter is estimated directly without prior completion of the missing data values for each individual (L. K. Muthèn & Muthèn, 1998-2010). Different estimation methods are also used to evaluate the goodness of fit of structural equation models, i.e. the extent to which the reproduced covariance matrix differs from the observed covariance matrix (Raykov & Marcoulides, 2006). In the current study, the following indicators were used to assess the goodness of fit of the models: the chi-square test (χ^2), the comparative fit index (CFI) the Tucker-Lewis index (TLI) and the root mean square error of approximation (RMSEA). With respect to CFI and TFI values above 0.95 are considered indications of good fit whereas values below 0.06 are considered indices of good fit with respect to the RMSEA (Yu, 2002).

3.5.2. Study II

In Study II, repeated measures, using SPSS 17.0, were applied to analyze changes in the outcome measures from baseline to six months of treatment and end of treatment (two years). SEM was used to test whether the selected health cognition variables could predict changes in

body fat (%) and was conducted in Mplus Version 5.1 (L. K. Muthèn & Muthèn, 1998-2010). The SEM model consisted of a measurement model, which is a confirmatory factor analysis (CFA) for the health cognition variables, and a path model that predicts total body fat (%) at the two follow-ups and controls for initial body fat. In the CFA the health cognition variables were thus latent continuous constructs. One major characteristic of SEM is that it explicitly takes into account measurement errors (Raykov & Marcoulides, 2006). The estimates were thus free of measurement error and the path coefficients were therefore not hampered by the moderate reliability of the health cognition constructs. The individual observed items from which these latent variables were construed were treated as ordered categorical variables. A weighted least square parameter estimator (WLSMV), which is robust to non-normality, was therefore used (L. K. Muthèn & Muthèn, 1998-2010). Full information maximum likelihood was applied to handle missing data. The comparative fit index (CFI: values approximating 0.95), the Non-normed Fit index (NNFI: values approximating 0.95), and the root mean square error of approximation (RMSEA: values approximating 0.05) were used to evaluate the overall goodness-of-fit (Raykov & Marcoulides, 2006).

3.5.3. Study III

Repeated measures (general linear models), using PASW 17.0, were applied to analyze changes in total body fat, energy intake and physical activity from baseline to six months and at the end of two years of treatment. Growth modeling, a technique for modeling within-person change across repeated measures and between-person differences in those changes (Grimm & Ram, 2009), was used to capture individual differences in change during treatment. Growth modeling, which may be accommodated within an SEM approach, focuses on growth and/or decline in longitudinal data (Raykov & Marcoulides, 2006). Even though the traditional analysis of variance and covariance represents a powerful methodology for measuring change, the assumption of sphericity, i.e. implying the same patterns of correlation for repeated measures can be problematic (Tabachnick & Fidell, 2007). In addition, in the study of predictors of change, as in the current study, the ANCOVA assumptions concerning the use of perfectly measured covariates and regression homogeneity may be questionable (Huitema, 1980; Raykov & Marcoulides, 2006). Structural equation modeling methodology thus represents a highly useful alternative framework (Raykov & Marcoulides, 2006). As recommended by Mùthen (B. Muthèn, 2002), growth modeling in a latent variable framework

was used in the current study, making it possible to carry out analysis of multiple processes, e.g. allowing growth factors to be regressed on each other. The advantages of growth modeling in latent variable framework is the flexible curve shape (i.e. both linear and quadratic), the individually-varying times of observation and the regressions among random effects (i.e. slopes (s) and intercepts (i) can be treated as both dependent variables and predictors) among others (B Muthen & Muthen, 2010).

In order to enable growth analysis using only two observation points, residuals were fixed to zero in the current analysis. Thus, growth factors were treated as observed variables. Growth analysis yields two factors. The first is the intercept, which was defined in the present study as the growth starting-point. Because we used only two measurement points in the growth analysis, the intercept is identical to the baseline value. The second factor is the slope, which represents the change from baseline to six months in the current study. Growth factors were calculated with Bayesian estimation (B. Muthen & Asparouhov, 2010b). In maximum likelihood analysis parameters are viewed as constants and estimates are found by maximizing a likelihood computed for the data (B. Muthèn, 2010). In Bayesian analysis, on the other hand, parameters are viewed as variables and prior distributions for parameters are combined with the data likelihood to form posterior distributions for the parameter estimates (B. Muthèn, 2010). In Mplus diffuse priors are used as the default. The posterior provides an estimate in the form of a mean, median, or mode of the posterior distribution. The advantage of Bayesian estimation in the present case was that parameter estimates were not required to have a normal distribution (B. Muthèn, 2010). In addition missing data could be handled using a multiple imputation approach.

In Study III, structural equation modeling (SEM) was used to examine both the relationship between the growth factors and the relationship between the growth factors and total body fat at the end of treatment. In our model, we hypothesized that, on biological grounds, changes in energy intake and energy expenditure (i.e. activity level), cause changes in body fat during the treatment period, and not vice versa. All intercepts were allowed to correlate, whereas all slopes were regressed on all intercepts. Finally, body fat at two years was regressed on all intercepts and slopes. Both growth modeling and SEM were conducted with Mplus Version 6.0 (L. K. Muthèn & Muthèn, 1998-2010). Posterior Predictive Model Checking (PPMC) was used to evaluate the goodness of fit of the overall model. PPCM is based on the rationale that if a model fits the data, then the observed data should look like replicated data generated from the posterior distribution of the model parameters (Zhu, 2009). Differences between the observed and generated data in discrepancy measures incorporated in

PPMC are evaluated by the Posterior Predictive P-value (PPP) (Zhu, 2009). PPP values near 0.5 indicate that a realized discrepancy measure value looks similar to the posterior predictive values, indicating the goodness of fit of the model, whereas PPP values near 0 or 1 indicate misfit (Zhu, 2009). The confidence interval at 95% was used to evaluate statistical significance. To test the statistical significance of mediation, Sobel's test was used (Sobel, 1982).

3.5.4. Study IV

Independent samples t-tests using PASW 17.0 were applied to determine differences between the intervention groups at baseline, six months and two years. One-sample t-tests were applied to determine accordance of dietary intake with national recommendations. Paired-sample t-tests were applied to determine change in outcomes from baseline to six months and two years of treatment. Differences between groups for the mean change in outcomes from baseline to six months and two years were analysed with two-sample t-tests. The analyses were performed on an intention-to-treat basis for each outcome measure and involved all participants who attended assessments, regardless of whether they completed the treatment (Hollis & Campbell, 1999). This indicates that even children not attending a single session were included, as far as they were present at one or several points of measurement. There is no consensus about how to handle missing data in-intention-to treat analysis (Hollis & Campbell, 1999), but in the current study missing data were not estimated but subjected to a listwise deletion procedure. A confidence interval of 95% was used to evaluate significance.

3.6. Ethics

Written informed consent was obtained from all parents and the study was approved by the Regional Ethical Committee for Medical Research.

4.0. RESULTS

4.1. Study I

In Study I QoL and psychopathology were examined in a sample of 185 treatment-seeking children (93 girls, 92 boys) with obesity and a matched sample of 799 community children (367 girls, 432 boys). The results showed that parental reports of the children`s QoL were significantly lower in children with obesity compared with their matched controls. Parent-reported QoL was impaired on five of the six QoL dimensions and on the total QoL, the "school" dimension was the only non-significant dimension when we compared the two samples. There was no difference in self-reported QoL between the two samples, however, except on one subscale "Friends". With regard to psychopathology, children with obesity scored significantly higher than the community sample on the CBCL (parent-report) Total Problem Scale, Internalizing Scale and Externalizing Scale, indicating more emotional and behavioral problems. For the YSR (self-report) scores, there were significant differences between the two samples on the Total Problem Scale and the Internalizing Problem Scale, but not on the Externalizing Problem Scale.

The current study also statistically tested the theoretical distinction between QoL and psychopathology, using both parent-reported and self-reported data. A CFA analysis conducted to test the hypothesis that QoL and psychopathology are two separate constructs showed that a two-factor model consisting of one psychopathology factor and one QoL factor was superior to a one-factor (psychopathology and QoL combined) solution, with the model-fit bordering on acceptable values when the subscales compromising the internalizing and externalizing broadband constructs were allowed to correlate. Specifying further factors did not increase the fit. Since critics have claimed that measuring QoL using well-being scales results in the relationship between QoL and psychopathology becoming tautological, the CFA analysis were repeated without the KINDL-R emotional and physical well-being scales being included. The results of these analyses did not, however, differ from the previous results.

In addition to testing the distinction between QoL and psychopathology, Study I also aimed to explore increased psychopathology as a potential mediator of impaired QoL in children with obesity. In this SEM analysis, QoL, measured by the six KINDL-R subscale scores, was regressed on obesity and psychopathology, the latter measured by the eight CBCL/YSR Syndrome Scale Scores. With regard to self-reported data, there was no

significant relationship between obesity and QOL, and thus no relationship to be mediated by psychopathology. The results of the parent-reported data, on the other hand, revealed that the indirect effect of obesity on QoL was higher than the direct effect of obesity on QoL, indicating that psychopathology accounted for more than all of the effect of obesity on QoL. When the SEM analysis was repeated without the KINDL-R Emotional and Physical well-being measures included, the estimates were practically identical to the previous results. The largest differences in estimates between the results with and without the well-being measures included did not exceed 0.02, and never approached significance.

4.2.   Study II

Study II tested the hypothesis that parental self-efficacy, perceived emotional barriers, attitudes, and subjective norms could predict change in body fat in children treated for obesity. Body fat was measured in 99 children (48 girls, 51 boys) with obesity at baseline, after six month and after two years of treatment. Parental health cognitions (self-efficacy, perceived emotional barriers, subjective norms, attitudes) were examined by questionnaires completed by the parents. There was a significant decrease in the children's BMI SDS and body fat at both six month and two year follow-up. The correlation between total body fat (%) from baseline to six month follow up was r=.86 (p<.001), and from baseline to 24 months it was r=.63 (p< .001).

The CFA analysis of the health cognition variables showed that all factor loadings between each indicator and latent variable were statistically significant (ranging from .46 to .88), and with fit-indices bordering on acceptable values (CFI=.94, NNFI=.94, RMSEA=.07). The "Self-efficacy" construct was significantly correlated to "Barriers" r=.54, p< .001) and "Attitude" r=.73, p< .001 , but not to "Subjective norm" r=.07, p=.56 . "Barriers" was further significantly related to "Attitude" r=.66, p< .001) and "Subjective norm" r=.38, p< .001. The correlation between "Subjective norm" and "Attitude" was r=.05 p=.73.

In order to test whether the health cognition variables could predict change in total body fat during treatment, body fat was regressed on the four health cognition variables in a forward step-wise inclusion procedure, adjusted for initial values of total body fat. In this forward procedure, the health cognition constructs entered the model according to their ability to predict total body fat without taking into account the other health cognition constructs. In

the initial analysis where the health cognitions constructs were tested one at a time, perceived emotional barriers were the only significant predictor of body fat at six month follow-up. At two year follow up, perceived emotional barriers were the strongest predictor, but subjective norms also turned out to be a significant predictor of body fat. Therefore, on the basis of this initial analysis, perceived emotional barriers entered the model first. In the stepwise procedure, the inclusion of additional health cognition variables did not improve the model. The results thus revealed that perceived emotional barriers were a significant predictor of change in total body fat at both six month and two year follow-up when the initial body fat was controlled for. The findings are strengthened by the fact that there was no significant relationship between emotional barriers and body fat at baseline. Self-efficacy, subjective norms, and attitudes did not improve the amount of variance explained in the overall model. The SEM model displayed acceptable fit indices (CFI=.97, NNFI=0.96, RMSEA=0.06) but the model could not be improved to increase the fit in any theoretically meaningful way.

4.3. Study III

Changes in body fat, energy intake and physical activity were examined in 99 children (48 girls, 51 boys) with obesity participating in a two year outpatient treatment of obesity. There was a significant decrease in total body fat, energy intake and physical activity, both at six months and at the end of two years of treatment. The results of the SEM analysis showed that the slope of body fat, viz. change in body fat was significantly predicted by the slope of energy intake, but not by the slope of physical activity. This result indicates that the decrease in body fat observed after six months of treatment could be explained by changes in energy intake, but not by changes in physical activity over the same period. In addition, body fat at baseline was significantly correlated with energy intake at baseline (r=.37, CI= 0.17 to 0.53, p<0.001). Physical activity, on the other hand, was unrelated to body fat at baseline (r=.13, CI=-.08 to .30, p=0.16).

When analyzing the two year follow-up data we found that although the change in energy intake observed from baseline to six months (i.e. the slope of energy intake) did not directly predict the body fat measured at the two year follow-up, there was a strong indirect effect, mediated by the decreased body fat observed from baseline to six months (the slope of body fat) (indirect beta: 0.68 x 0.74=0.50, p<0.001). These results suggest that the dietary changes made in the first six months of treatment had a sustained effect on body fat at two years. Furthermore, there was a negative relationship between energy intake at baseline and

body fat measured at the two year follow-up. In addition, energy intake at two years was strongly predicted by baseline energy intake levels.

With respect to physical activity, in contrast, there was neither a direct nor an indirect effect of the growth factors on body fat at the end of treatment, i.e. changes in physical activity were neither directly nor indirectly related to body fat at end of treatment. The results did show, however, that the slope of physical activity significantly predicted comparatively higher levels of physical activity at two years of treatment. Overall, our model fitted well with the data (PPP = 0.46, PPC = -19.42 to 33.50).

4.4.   Study IV

Study IV was conducted to compare the efficiency of therapist-led groups versus self-help groups for parents in the treatment of obesity in children. Changes in the children's BMI z-score, body fat and diet were used as outcome measures. There were no significant differences between the two groups at baseline, regarding child and parent anthropometry, child age, gender, energy intake and BMR. Further, there were no differences between the participants who handed in food record forms at six months and two years, and those who did not. Children with parents in both the therapist-led and the self-help groups had mean E% of SFA above the recommended amount ≤10 E at baseline, whereas mean E% of protein, fat, MUFA, PUFA, carbohydrates and added sugar, and g/MJ intake of fibre were in accordance with Norwegian recommendations (Norwegian Directory of Health, 2005).

The results further showed that there were no significant differences between the two treatment groups regarding change in body fat, BMI z-scores or dietary intake from baseline to six months and two years. In both intervention groups, body fat, BMI z-scores and energy intake significantly decreased from baseline to six months and from baseline to two years, but no significant changes were found from six months to two years. The dietary macronutrient composition changed with E% of added sugar decreasing from baseline to six months in the TLG, and E% of SFA decreasing from baseline to six months in the SHG, but these changes were not sustained after two years. In both groups, the reported E% of SFA was above Norwegian recommendations at all assessment points, whereas E% of the remaining macronutrients was in line with Norwegian recommendations at all times. The mean daily intake in grams of SFA and carbohydrates significantly decreased from baseline to six months

in the TLG; however, only the decrease in carbohydrates was sustained after two years. The mean daily grams of protein, fat and SFA significantly decreased from baseline to six months in the SHG, whereas the mean daily grams of fat, PUFA and carbohydrates decreased significantly from baseline to two years.

In summary, the key study finding was that no significant differences were detected between the therapist-led and self-help groups at any time, but both groups achieved a significant but modest reduction in total body fat and BMI z-score after six months, which was sustained after two years of treatment. In addition, both groups achieved a significant reduction in energy intake from baseline to six months which was sustained at two years, without compromising the macronutrient composition of the diet.

5.0. DISCUSSION

5.1. Psychosocial consequences of obesity

5.1.1. Quality of life and psychopathology

Study I showed that treatment-seeking children with obesity have impaired parent-reported QoL and more psychological problems than community children. This finding is in accordance with earlier research (Griffiths, et al., 2010; McElroy et al., 2004; Tsiros, et al., 2009; Zametkin, et al., 2004). Regarding psychopathology, both parent- and self-reports revealed children with obesity had higher scores than their matched controls, but there was no difference in self-reported QoL between the two samples, except on one subscale "Friends".

In contrast to the current results, several studies report both self-reported and parent-reported QoL to be impaired in children with obesity compared with normal-weight children (Griffiths, et al., 2010; Pinhas-Hamiel et al., 2006; Riazi, Shakoor, Dundas, Eiser, & McKenzie, 2010; Schwimmer, 2003). The discrepancy between the current findings and earlier results, however, may be because of the instruments used. In the studies referred to above, PedsQL[TM] (Varni, Seid, & Kurtin, 2001) is used to measure QoL. In a study using KINDL-R, however, self-reported QoL was not impaired in treatment-seeking children with obesity compared with a community sample of children, except for the "Friends" subscale (Wille et al., 2009), exactly the same results as in the current study. PedsQL[TM] and KINDL-

R are both generic QoL instruments, consisting of 23 and 24 items, respectively, encompassing physical-, emotional-, social- and school functioning subscales (Ravens-Sieberer, 2001; Varni, Limbers, Bryant, & Wilson, 2010). The KINDL-R consists of an additional two subscales, namely "Family" and "Self-esteem". Unfortunately, no study exists on the relationship between these two QoL measures, although they have both been found to be suitable instruments (Bullinger, et al., 2008; de Wit, Delemarre-Van De Waal, Pouwer, Gemke, & Snoek, 2007; Janssens, Gorter, Ketelaar, Kramer, & Holtslag, 2008; Jozefiak, et al., 2008). Altogether, PedsQL^{TM} and KINDL-R seem to be comparable instruments. In PedsQL^{TM}, however, eight items are used to measure physical functioning, but in KINDL-R, only four items are used to assess this subscale. It is therefore possible that PedsQL^{TM} is better able to capture impaired physical functioning. Since studies show that physical functioning is one of the QoL subdomains most often impaired in children with obesity (Griffiths, et al., 2010), this may partly explain the different findings of studies using PedsQL^{TM} compared with those applying KINDL-R. Nevertheless, this assumption needs to be tested, in addition to the need for a more thorough comparison between these two QoL measures.

Further, most studies use normal-weights as a comparison group when studying QoL in children with obesity (Griffiths, et al., 2010). Since weight and height were not obtained in the community sample of the current study, the matched controls may include some overweight participants, thereby decreasing the differences between the clinical sample and their matched controls. Even though the lack of height and weight measures of the matched controls is a limitation of Study I it is not, however likely that the results are affected by this limitation. In the light of the prevalence of obesity in Norwegian children (Andersen, 2005; Juliusson, et al., 2010; Juliusson, et al., 2007), 20 people in the community sample were estimated to be obese. If these were excluded from the community sample, the KINDL-R total QoL score would be 0.001 SD higher. Thus the results would have been identical if compared with a normal-weight sample.

Finding parent-reported but not self-reported QoL to be impaired in children with obesity is in accordance with a review showing that parents of obese youths tend to report QoL as worse than do the children themselves (Tsiros, et al., 2009). The discrepancy between parents` and children`s account of QoL is also seen in children with acute lymphoblastic leukemia (Savage, Riordan, & Hughes, 2009) and asthma (Petsios et al., 2011). The use of both parent- and self-report has been emphasized in the QoL literature, however, because QoL measures subjective well-being and the perspectives of parents and children may differ

without one perspective being more correct than the other (Wallander, Schmitt, & Koot, 2001). In general, parents perceive an illness to have more negative consequences than do the children themselves (Eiser & Morse, 2001). Further, the degree to which a parent feels responsible for his or her child's condition may affect the ratings (Spieth, 2001). Obesity being a condition related to life-style, it is reasonable to assume that parents often feel responsible for their child's overweight. Finding only parent-reported and not self-reported QoL to differ from that of community children is probably because of each individual's beliefs about the child's health and well-being (Upton, Lawford, & Eiser, 2008).

5.1.2. The association between obesity, QoL and psychological problems

If indeed there is a causal relationship between obesity and psychosocial impairments, this relationship needs to be explained in order to guide prevention and treatment efforts. Children with obesity experience stigmatization, i.e. negative weight-related attitudes and beliefs that are manifested by stereotypes, bias, rejection and prejudice towards them simply because they are obese (Puhl & Latner, 2007). Such weight stigma can include verbal teasing, physical bullying and social rejection. There seems to be an association between psychosocial consequences of obesity and stigmatization since studies show that psychosocial outcomes often disappear after controlling for stigmatizing experiences (Puhl & Latner, 2007). In a qualitative study low self-confidence, isolation, and peer anxiety were all identified as resulting from victimization and were all barriers to developing peer relationships (Griffiths & Page, 2008). Weight-based teasing has also been shown to be associated with disordered eating and binge-eating (Haines, Neumark-Sztainer, Eisenberg, & Hannan, 2006; Neumark-Sztainer et al., 2010; Neumark-Sztainer et al., 2002), as well as depression and anxiety (Libbey, Story, Neumark-Sztainer, & Boutelle, 2008). Research also suggests that obesity may increase vulnerability to adverse physiological reactions to psychosocial stressors, i.e. the health consequences associated with obesity may therefore partly result from the effects of discrimination (Puhl & Latner, 2007).

   In summary, these studies indicate that the psychosocial consequences of obesity can partly be explained by the stigmatization children with obesity face. Stigmatization, however, does not universally lead to low self-esteem and mental health problems (Corrigan & Watson, 2002; Funderburk, McCormick, & Austin, 2007). It is reasonable to assume that the relationship between stigmatization and psychosocial consequences is moderated by several factors. Studies of stigmatized children show that those who internalize negative societal attitudes about a group to which they belong are more likely subsequently to have lower self-

esteem, a reduced sense of self-efficacy, and higher rates of various mental and physical health problems (Bos & Van Balen, 2008; Gershon, Tschann, & Jemerin, 1999; Kidd, 2007; Latner, Stunkard, & Wilson, 2005). Those who correctly attribute adversity and poor outcomes to the prejudicial attitudes and unfair treatment of others are better able to maintain self-esteem (Bos & Van Balen, 2008; Lysaker, Roe, & Yanos, 2007).

Other factors may also affect the relationship between obesity and psychological problems. According to psychological theories of obesity lack of self-regulation is the main driver of the development of obesity (Stroebe, 2008). One may question whether this dysfunctional regulation is related to eating behavior exclusively, or to a more general regulation difficulty. It has been shown that toddler self-regulation skills predict risk of obesity (Graziano, Calkins, & Keane, 2010). In the study of Graziano et al (2010), emotion regulation was the primary self-regulation skill involved in predicting normative changes in BMI. Since emotional dysregulation has been shown to predict childhood psychopathology (Keenan, 2000), such a finding may indicate that the relationship between psychopathology and obesity is related to difficulties in emotional regulation, causing both overeating and psychological problems. If so, there is not necessarily a causal link between obesity and psychopathology. Perhaps dysregulation represents a third factor explaining the relationship between obesity and psychological problems. The association between obesity and psychopathology is complex, however, and much work remains to be done before we can know whether this assumption is true.

5.1.3. Psychopathology as a mediator of the relationship between obesity and QoL

Study I tested the assumption that psychopathology and QoL are two distinct concepts and that increased psychopathology mediates the relationship between obesity and impaired QoL. The results supported the theoretical distinction between QoL and psychopathology, and the distinction confirmed by both parent-reported and self-reported data, further validates the hypothesis of QoL and psychopathology being separate constructs. Since mean QoL total score differences between the clinical sample and the community sample were evident only for parent-reported QoL, self-reported data were not used in the mediator analysis. The results confirmed the hypothesis of psychopathology being a mediator of the relationship between obesity and parent-reported QoL.

To the best of our knowledge, Study I was the first study to examine psychopathology as a mediator of the relationship between obesity and QoL, but studies of children with

psychiatric disorders have found QoL to be related to psychopathology (Bastiaansen, Koot, Bongers, Varni, & Verhulst, 2004; Sawyer et al., 2002). Further, the association between psychopathology and QoL in children with obesity has been established through the aforementioned research, showing that treatment-seeking children with obesity have both impaired QoL and more psychological problems compared to community children.

It could be claimed that psychopathology affect the relationship between obesity and QoL simply because psychopathology and QoL are overlapping concepts. As the present study has shown, however, they are distinctly different phenomena. Further empirical support for such a distinction is found in a study showing that children in outpatient psychiatric care improve their QoL despite no changes in psychopathology (Bastiaansen, Koot, & Ferdinand, 2005). Jozefiak et al (2010) found that QoL was able to distinguish between children referred for outpatient psychiatric treatment and those not referred despite their having equal levels of parent-reported emotional and behavioral problems. It has been concluded that it is not the psychiatric diagnosis per se but the subjective meaning that has the greatest impact on an individual`s assessment of QoL (Schubert, Herle, & Wurst, 2003).

QoL addresses the individual's perceptions and experiences. Our perceptions are influenced by our inner states and emotions. It is therefore reasonable to assume that the negative emotions caused by having psychological problems will affect the child's QoL. Further, since QoL encompasses the child's functionality and well-being, the reduced functionality caused by psychopathology will affect the QoL reported. There are, however, multiple pathways between the child's weight status, psychological problems and QoL. The cross-sectional design of the present study does not allow for conclusions regarding causality. The current findings show, however, that the relation between obesity and QoL cannot be fully understood without taking psychopathology into consideration as a mediating factor. Yet if so, then why do we not find QoL to be impaired in children with obesity when they report more psychological problems than the matched controls? Does the relationship between QoL and psychopathology differ depending on whether self- or proxy reports are used? The Pearson correlations between self-reported QoL and self-reported psychopathology in the clinical and community sample were $r = -.53$ (p<0.01) and $r = -.65$ (p<0.01), respectively. Parent-reported QoL and psychopathology, showed comparable correlations of $r = -.59$ (p<0.01) for the matched controls and $r = -.55$ (p<0.01) in the clinical sample. These analyses indicate that the relationship between QoL and psychopathology does not differ between parent-reported and self-reported data and therefore cannot explain why obese children report

more psychological problems, but not more impaired QoL than community children. This is supported by a study of Janicke et al (2007), finding childhood depression to be related to both self-reported and parent-reported QoL.

5.1.4. Clinical implications

The results of the current thesis indicate that the impaired parent-reported QoL found in treatment-seeking children with obesity could be explained by elevated levels of psychopathology, suggesting that it is not the obesity *per se*, that causes the lowered QoL. If indeed these statistical relationships reflect a causal chain, these findings suggest that if we succeed in treating the psychological problems reported by treatment-seeking children with obesity, QoL may increase regardless of whether the treatment is successful or not in terms of reduced obesity. This assumption is supported by the finding that improvements in QoL reported after obesity treatment do not depend on weight loss (Griffiths, et al., 2010), and there is no significant correlation between decreases in body fat percentage and QoL scores (Yackobovitch-Gavan, Nagelberg, Demol, Phillip, & Shalitin, 2008). Whether the increased QoL often reported after obesity treatment is caused by lowering of psychological problems remains to be tested, however. In children with psychiatric problems, though, reducing psychiatric symptoms has been shown to improve QoL (Bastiaansen, et al., 2005). In summary, these findings support the hypothesized clinical implications of the current finding, suggesting that QOL can improve during treatment if psychological problems are addressed and regardless of weight-loss obtained. Future studies should test this hypothesis.

5.2. Parental health cognitions and the treatment of obesity

The crucial role of parents in treatment of obesity in children makes it salient to explore parental predictors of treatment. If we identify predictors of treatment success we can address these factors in particular and thereby increase treatment efficacy. In a review of pre-treatment factors affecting outcome in lifestyle interventions the authors conclude that parent's age, BMI and family structure are significant predictors of outcome Marild, et al., 2009). Other studies have found parental psychopathology to affect outcome negatively (Moens, et al., 2010; Pott, Frohlich, Albayrak, Hebebrand, & Pauli-Pott, 2010). Exploring parental health cognitions as predictors of change in body fat during treatment of obesity add to this knowledge.

5.2.1. Perceived emotional barriers as predictor of change in body-fat

The aim of the present study was to examine whether parents' self-efficacy, perceived emotional barriers, subjective norms, and attitudes could predict change in their children's total body fat at six months and two year follow-up after a family-based treatment of obesity. Parental perceived emotional barriers were a significant predictor of body fat at both follow-ups, even when the initial body fat was taken into account. The findings are strengthened by the fact that there was no significant relationship between emotional barriers and body fat at baseline. Self-efficacy, subjective norms, and attitudes did not improve the amount of variance explained in the overall model. When tested one at a time, subjective norms turned out to be the only significant predictor in addition to perceived emotional barriers at two year follow-up. At six month follow-up, perceived emotional barriers were the only significant predictor of those examined.

5.2.2. Why are perceived emotional barriers the only significant predictor?

An important question raised by the current findings is why perceived emotional barriers are the only significant predictor of changes in body fat. There may be both methodological and theoretical answers to this question. The methodological aspects are discussed under the section of methodological strengths and limitations (5.6.3.2.). With regard to a more substantial reason why barriers were the only significant predictor of those examined, we should question whether we were true to the health behavior models applied in the study. According to the SCT, the TPB and the HBM health cognitions or beliefs predict the health behavior in question. In Study II we hypothesized that parents' attitudes, subjective norms, self-efficacy and barriers regarding changes in diet and physical activity behavior could predict changes in children's body fat. We thus explicitly assumed that parental health cognitions affected diet- and activity behavior, which in turn affected children's body fat. In that sense, we were not true to the models. According to the health belief models we should have measured whether these cognitions predicted changes in diet- and activity behavior. It is possible that measuring parental behavior rather than changes in children's body fat would have increased the likelihood of attitudes, self-efficacy and subjective norms becoming significant predictors of change in the current study. It could also be that the families succeed in changing health behavior, but perhaps the changes were not sufficient to affect body fat, thereby explaining why these health cognitions do not turn out to be significant predictors. On the other hand, the results of Study III showed that the children's dietary intake changed and that these changes could explain the reduced obesity obtained during treatment.

The health behavior models try to explain why individuals engage in health behavior and how they go about changing such behavior. In Study II we examined how parental health cognitions affected changes in their children. There may of course be other factors that influence one`s own health behavior compared with factors affecting behavior directed toward one`s children. Baranowski et al (2003) also point out that research has not specified at what ages these models apply. The models are also highly individual and do not take into account the competing influences of parents and peers (Baranowski, et al., 2003). It is therefore reasonable to question whether health behavior models can be applied in examining parental predictors of change in children's health. Population studies, however, have that found parents' attitudes towards mealtimes and nutrition influence children's health (Gable & Lutz, 2000, 2001) and that negative parental attitudes toward children`s television viewing correlated positively with the degree to which parents regulated their children`s TV-viewing (Christopher, et al., 1989).

In line with the results of Study II, based on a review of 47 studies, Janz & Becker (1984) concluded that perceived barriers were the most powerful health belief dimension across various study designs and behavior of adults. Overall though, findings are inconsistent with regard to the predictive power of attitudes, subjective norms and self-efficacy (Armitage & Conner, 2001; Baranowski, et al., 2003; Palmeira, et al., 2007). In order to explain this, Baranowski et al. (2003) point out that personal characteristics are not sufficient for behavioral change. Owing to the influence of environmental factors on eating and activity behavior (Edmonds, Baranowski, Baranowski, Cullen, & Myres, 2001; Giles-Corti & Donovan, 2002) it is unlikely that interventions focused on changing the characteristics of individuals alone will result in substantial changes in diet or physical activity, and thereby reduce adiposity (Baranowski, et al., 2003).

5.2.3. Perceived emotional barriers as a concept

Even though the concept of perceived barriers includes a wide range of disparate items from financial costs and physical barriers to personality and emotional characteristics (Rosenstock, et al., 1988), most studies examine physical or practical barriers to promoting healthy eating and physical activity in children (Dwyer, et al., 2008; Slater et al., 2010; Smith, et al., 2010). Since the concept of perceived emotional barriers has rarely been examined in child studies it is reasonable to ask whether we can be sure we have actually measured such barriers. Using a non-validated questionnaire makes it salient to ask such a question. In the Parental health cognitions questionnaire developed for the current study, the barrier items are related to the

parents` feeling of guilt, having bad conscious or feeling pity for the child if limiting the child`s intake of sweets or reducing sedentary behavior. Are such feelings in line with the typical definition of "barriers"? A barrier describes a person's perception of both the difficulties in performing the specific behavior of interest and the negative outcomes that may result from performing that behavior (Baranowski, et al., 2003). We may argue that the feelings of guilt and bad conscious are both perceptions of difficulty and negative outcomes. Feeling pity for the child may hinder parents in conducting the behavior (e.g. saying no to sweets), but conducting the behavior (limiting sweets) may also cause the parent to feel guilty afterwards. On the other hand, we have not explicitly operationalized the concept of perceived emotional barriers in Study II and thus cannot be totally sure that we really are measuring such a concept.

Perceived emotional barriers may also be related to other factors, such as parenting style and skills. Authoritative parenting style has been shown to be protective against the development of overweight (Berge, Wall, Loth, & Neumark-Sztainer, 2010; Berge, Wall, Neumark-Sztainer, Larson, & Story, 2010) and permissive parenting style is related to lower monitoring of children's unhealthy food intake (Blissett & Haycraft, 2008). A permissive parenting style was associated with less reduction of obesogenic load at home and less weight loss in a family- based treatment of obesity in children (Golan, 2006). Permissive parenting is characterized by low expectations for self-control and discipline in a setting of high sensitivity and warmth (Rhee, Lumeng, Appugliese, Kaciroti, & Bradley, 2006). Although this is not tested in the current study, it is reasonable to assume that permissive parents will perceive more emotional barriers in limiting unhealthy eating and activity behavior. Future studies should examine the relationship between emotional barriers, parenting style and the treatment of obesity in children.

5.2.4. Why do emotional barriers predict change in body fat?

It is reasonable to assume that those parents who perceive several emotional barriers will have more difficulties in carrying out the necessary health behavior changes. Their emotional barriers, feeling pity for the child or having a bad conscious, are probably deterrents to limiting their child's intake of unhealthy food or reducing sedentary behavior. Consequently, they are less able to reduce the child's overweight. Child resistance has been shown to be the most common factor reported when parents are asked what difficulties they face in achieving a healthy diet (Slater, et al., 2010). It is reasonable to assume that the emotional barriers perceived will add to this, i.e. the child`s resistance is harder to manage if the parent feel

guilty about reducing the child`s food intake or limiting their access to sweets. Children`s resistance may further be related to children`s temperament. Possibly parents of temperamentally difficult children perceive more emotional barriers than parents of children with a more easygoing temperament. These assumptions need to be tested, but studies have shown temperament to be associated with overweight in children (Agras & Mascola, 2005; Wu, Dixon, Dalton, Tudiver, & Liu, 2011).

According to the Theory of Planned Behavior, perceived behavioral control denotes a subjective degree of control over performance of the behavior in question and is related to health behavioral change (Ajzen, 2002). The concept of perceived control is in several ways similar to the concept of perceived barriers; in simple terms, the more barriers perceived by a person, the less control that person will perceive in performance of a behavior. Uzark et al (1988) found that weight-loss in obese adolescents was significantly related to personal control over weight. The study also showed that the adolescents who felt less personal control over their weight had parents who perceived more barriers related to management of the child's weight problem. Uzark et al. (1988) measured barriers as the degree of difficulty a parent felt in helping the adolescent lose weight. Thus, perceived barriers might not only affect parents' ability to carry out lifestyle changes, but perhaps also affect the child's own ability to change health behavior, thereby further decreasing the chance to succeed in reducing obesity.

5.2.5. Clinical implications

The results of Study II indicate that treatment of obesity in children would be more efficient if parents perceived fewer emotional barriers with regard to health behavior change. The findings may therefore have important clinical implications for increasing treatment efficacy by targeting parents` perceived emotional barriers. Addressing parents` emotional barriers at the onset of and during treatment could include discussing thoughts and feelings related to their perceived barriers, e.g., source of parental guilt about setting limits on food intake and reducing sedentary behavior, how parents handle feeling sorry for their child when he/she is not allowed to eat the same amount of sweets as other children, etc. It is reasonable to assume that by addressing such thoughts and feelings the parents will feel more confident and less emotionally ambivalent about making the necessary health behavior changes. Working through ambivalence is an important principle of Motivational Interviewing (MI), an evidence based tool facilitating behavior change (Rollnick, Miller, & Butler, 2008). An expert

committee suggested the use of MI as a counseling technique in the prevention and treatment of obesity in children (Barlow, 2007). There are few studies examining the effectiveness of MI in the treatment of obesity in children, but one study shows that the use of MI skills is associated with increased exercise, reduced weight and less TV/computer screen time in adolescent patients (Pollak et al., 2009). With regard to the use of MI in counseling parents of obese children, studies are in progress (Taylor et al., 2010).

5.3.   Energy intake and physical activity in the treatment of obesity

In addition to exploring pre-treatment factors predicting outcome in pediatric obesity interventions, we need to identify those components of treatment of greatest importance in reducing obesity. With such knowledge, we can design interventions maximizing those aspects of treatment shown to affect outcome the most.

5.3.1.   The relative importance of energy intake and physical activity

In Study III we found that body fat, energy intake and physical activity significantly decreased during treatment. Changes in energy intake predicted body fat at six months and indirectly predicted body fat after two years treatment. Changes in physical activity affected body fat neither during nor at the end of treatment.

The decrease in adiposity and energy intake from baseline to the end of treatment is comparable with that of other studies (Burrows, et al., 2008; Reinehr et al., 2010). In accordance with the current results, Bean et al (2011) found energy intake to decrease in participants of a six months multidisciplinary obesity program. Contrary to the current results though, a study of Scottish children participating in an individualized behavioral obesity treatment program found physical activity measured by accelerometer to increase during treatment (A. Hughes, 2008). Deforche et al (2004) reported that adolescentss` self-reported changes in physical activity increased during treatment, but decreased to pretreatment levels six months after treatment. In a review of the impact of obesity treatment interventions on children's physical activity, Cliff et al (2010) concluded that most studies are of low quality with small samples. Contrary to the current results, however, most studies reported an increase in at least one physical outcome at post-test or follow-up.

In order to test the effectiveness of different components of treatment, several randomized trials have examined single treatment elements and combinations of such

elements. Earlier research shows that diet-only or diet plus exercise interventions are more effective than exercise only interventions (Collins et al., 2011; Shalitin et al., 2009). Even studies that have targeted screen time and television viewing find that the effect on weight is due to reduced energy intake and not to increase in physical activity: When children spend less time on sedentary activities they also eat less (Epstein et al., 2008). Meta-analyses suggest that interventions that include a dietary treatment achieve relative weight loss (Collins, et al.,2006), thus suggesting that dietary interventions affect dietary changes which in turn affect adiposity. Such assumptions, however, have rarely been tested statistically.

Although pediatric obesity interventions have been shown to affect energy intake and physical activity, the current study expands this knowledge by statistically testing whether changes in energy intake or physical activity were actually responsible for changes in body fat. In addition to the direct effect of changes in energy intake on body fat at six months, there was a strong indirect effect of altered energy intake on body fat at the two year follow-up, which was mediated by changes in body fat from baseline to six months. This indicates that the dietary changes made in the first six months of treatment had a sustained effect on body fat at two years. Thus, even though the direct effect of the changes is only short-term, they are influential in sustaining a decrease, or at least in reducing a potential increase in body fat at the two-year follow-up. It is therefore reasonable to assume that children who are able to change their diet significantly during the first phase of treatment will have the largest body fat decreases, and even though the children`s energy intake does not decrease any further, the effect of the changes will be sustained. This assumption is supported by research showing initial weight-loss to predict treatment outcome (Braet, 2006). As our results show, there is no significant relationship between changes in energy intake from baseline to six-months and energy intake at the end of treatment. In addition, our findings suggest that those children who reduce their energy intake the most during the first 6-months of treatment are not necessarily those who have the relatively lowest energy intake at the end of treatment.

In accordance with the current results, adult obesity studies report that most weight loss occurred as a result of decreased energy intake (National Institutes of Health, 2000). Increasing physical activity did not result in significant weight loss over a six-month period. Further, pediatric obesity intervention studies have found that trials measuring the effect of physical activity on adiposity report a moderate treatment effect (McGovern, et al., 2008).

It is difficult, though, to compare the current findings with earlier research, since prior research did not explicitly examine whether diet and exercise can explain the reduced obesity obtained. In order to do so, mediation analysis must be applied. A study of a school-based obesity prevention program based on the TPB, found that the effect of the implemented intervention on BMI was mediated by the changes in fruit, fat and oil intakes, but physical activity was not a significant mediator (Angelopoulos, Milionis, Grammatikaki, Moschonis, & Manios, 2009). In accordance with the current findings, no association was found between change in time devoted to moderate vigorous physical activity (MVPA) and change in BMI. To the best of our knowledge, the current study is the first to apply mediation analysis in order to examine the relative contribution of diet and physical activity components in a family-based outpatient treatment of obesity in children. Wilfley et al (2007) call for future research identifying moderators and mediators of pediatric obesity interventions.

5.3.2. Why is physical activity unrelated to body-fat?

As the results of Study III show, changes in physical activity were unrelated to body fat at baseline, during treatment and at end of treatment. Contrary to the aims of the intervention, physical activity was reduced from the start to the end of treatment. One obvious conclusion of this finding is that the intervention did not succeed in increasing the children's level of physical activity. The aim of increasing daily life activity and self-efficacy related to activity was not sufficient to enhance physical activity. One may assume that it is necessary to include structured exercise in order to increase the mean level of activity. In the study by Hughes et al. (2008), however, children were found to increase their level of physical activity even though exercise was not included as part of the intervention. In a review of the impact of child obesity interventions on physical activity, the authors concluded that two of three high-quality studies indicated that the use of behavioral change techniques in a multidisciplinary program do enhance free-living activity (Cliff, et al., 2010). This is in contrast to the current results.

Children with obesity have been shown to be less physically active than normal-weight children (Lazaar et al., 2007; Riddoch et al., 2009), but the participants of the current study showed activity levels at the start of treatment comparable with those of Norwegian children in the general population (Helsedirektoratet, 2008). Obviously, it is more difficult to increase the level of physical activity in children who are already physically active, possibly explaining why the participants did not become more active. The decrease in the mean level

of physical activity during the two year intervention may also be related to a general decline in physical activity during the adolescent years (Armstrong & Welsman, 2006). Physical activity appears to decline even more rapidly in obese than nonobese adolescents (Kimm et al., 2002). Another possible explanation for the decline in the mean level of physical activity is seasonal differences in physical activity. Riddoch et al. (2007) found a summer-winter difference of 108 counts/min in 11-year old children. In Study III, pre-treatment data were collected from April to May, and six months data was collected from October to November. There is also a decrease in activity from baseline to two years, however, even though both baseline and 2 years data were collected in the spring.

Nevertheless, the fact that there was a decrease at the group level is immaterial to explanation of individual differences. The lack of association between changes in physical activity and later adiposity imply that those who became more physically active did not become less obese than those who reduced their physical activity. The variability in mean scores and in changes indicates that there were indeed children who increased their physical activity, at least compared with the others, even though the intervention was not successful in altering the mean level of physical activity. One would thus still expect those children who did increase their physical activity to attain comparatively reduced body fat.

One possible explanation for the lacking effect may be that the changes made in energy expenditure were not large enough to translate into detectable changes in energy reserve, i.e. body fat, given the current sample size. Provided that the current results are accurate, another explanation could be that those who are more physically active compensated for the increased activity by increasing their energy intake. Such an assumption is supported by adult weight-loss studies (Turner, Markovitch, Betts, & Thompson, 2010). Further, the main aim of the physical activity component of the current intervention was to increase daily life physical activity, and supervised exercise was not included as part of the treatment. It has been shown that in order for physical activity to affect body fat in overweight individuals, it has to be of high-intensity (Ness, et al., 2007).

5.3.3. Clinical implications

The results of Study III showed that with regard to reducing obesity, a particular focus on energy intake rather than expenditure is warranted. Spear et al. (2007) show that, although the

evidence is limited, increased physical activity alone does not improve children's weight status substantially, but the promotion of routine physical activity may help to prevent the development of overweight and obesity in the first place and reduce cardiovascular disease risk factors. In a review of the relative contribution of energy intake and energy expenditure to explain the increasing prevalence of obesity in children the authors conclude, however, that there is no consensus on the main driver of these trends (Bleich, et al., 2011). With regard to treatment on the other hand, Katz (2011) argues that "*the case for prioritizing attention to calories in over calories out is even stronger than the available scientific literature suggests. It is a case well made by an application of sense, and some very simple math*" p. 35 . For example, if a child bikes moderately fast one hour a day, resulting in a total of 300 kcal burned in an hour, 60 of these would have been burned at rest,- implying a net "energy benefit" of 240 kcal. One large soda provides 310 kcal and a small serving of French fries is 230 kcal. (Katz, 2011, p.35). This example shows that the calories burned in an hour of biking could be restored in minutes. In addition, the possibility of making sedentary children start biking an hour a day is small. If we fail to improve the quality and quantity of children`s diets, we will not succeed in reducing obesity (Katz, 2011).

The current study found moderate, but sustained improvements in adiposity and dietary intake from six months to two years of treatment, 18 months after the intensive part of the intervention, possibly implying that the families acquired important changes in eating habits. These altered eating habits may contribute to a reduced risk of perhaps the most serious consequence of childhood obesity: the condition tracking into adult life. Physical activity also tracks from adolescence to adulthood (Telama et al., 2005), however, thereby influencing long-term health. Physical activity is further associated with broad physiological and psychosocial health benefits (Strong et al., 2005), so the promotion of physical activity is of great importance regardless of the moderate effect in obesity interventions. Brambilla et al. (2011) have claimed that it is important to view diet and physical activity components as complementary but different targets in daily clinical practice, such as body weight control for diet and metabolic health for physical activity.

In summary, knowledge with regard to the relative contribution of different components of obesity treatment in children is scarce. The current study finding is therefore important, but in need of replication. In addition to multi-arm intervention studies, future studies should apply mediation models in order to find the most curative elements of treatment.

5.4. Parental involvement in the treatment of obesity

Even though studies have shown that parents are important health promoters and that parental involvement is crucial in the treatment of obesity in children, we need to know more about what kind of parental involvement is necessary in order to reduce obesity (Golley, Hendrie, Slater, & Corsini, 2011). Owing to the costs of treatment, with regard to both financial and human resources, we need to search for the most cost-effective intervention.

5.4.1. Parental self-help groups versus therapist-led groups

The objective of Study IV was to compare the long-term (two years) efficiency of therapist-led groups (TLG) of parents and parental self-help groups (SHG), assessed by changes in children`s adiposity and dietary intake. To our knowledge, the current study is the first to compare the long-term changes in adiposity and dietary intake accompanying different ways of involving parents in family-based obesity treatment of children. Evaluating change in dietary intake in addition to adiposity broadens the narrow view often presented of family-based obesity treatment effectiveness. The key study finding was that no significant differences were detected for change in adiposity and dietary intake between children of parents in the TLG and SHG. In both groups, the children achieved a significant, but modest reduction in body fat and BMI z-scores after six months, which persisted throughout two years of treatment. Also, both groups achieved a significant reduction in energy intake from baseline to six months, which was sustained after two years, without compromising the macronutrient composition of the diet.

Only a couple of studies have examined parental self-help in pediatric obesity interventions. In one study an intensive individualized school-based weight loss program resulted in significantly greater BMI z score reductions compared with self-help (Johnston et al., 2007). The self-help intervention included the use of *Trim Kids* (Sothern, von Almen, & Schumacher, 2001), a weight management book, in addition to a parent-led program consisting of 12 weekly sessions followed by maintenance activities for improving diet and level of physical fitness of children. The participants of the trainer-led intervention met for 12 weeks of daily sessions followed by 12 weeks of biweekly sessions in addition to monthly therapist-led parental meetings. Nova et al (2001) compared dietary intervention with self-help and found the first to be significantly more efficient than the second. The participants of the self-help intervention were given general health and obesity information leaflets. In a study of obesity treatment for adults a structured commercial weight loss program provided

modest weight loss but more than self-help over a two-year period (Heshka et al., 2003). A randomized trial of treatment of binge-eating disorder in adults found significant differences between the self-help group and therapist-led groups at the end of treatment, but no between-group difference at follow-up (Peterson, Mitchell, Crow, Crosby, & Wonderlich, 2009; Peterson et al., 2001). In summary, the lack of between group differences found in the current study differs from earlier studies of self-help in obesity treatment. Comparisons are difficult, though, due to large differences in content, intensity and duration of treatment.

In accordance with the current findings, a recent meta-analysis found similar reductions in adiposity after child obesity treatment conducted under a wide range of conditions (K. A. Kitzmann, et al., 2010). Golley et al (2007) even found wait list controls to reduced their BMI z score by 5% at 12-month follow-up, which closely resembled the 6% and 9% BMI z-score reductions of the two intervention groups. The wait list group received the same general healthy lifestyle pamphlet as the other groups and was contacted by telephone three or four times for five minutes as a retention strategy. These findings indicate that when certain main components are present, interventions may be efficient in the short-term, regardless of how treatment is delivered.

5.4.2. Why are there no between-group differences?

The lack of between-group differences in the current study may be owed to several reasons. One possible reason is that the TLG intervention was inefficient. As already shown, however, the reduction in adiposity obtained during treatment is comparable with that of other studies. Contrary to what was expected though, the TLG intervention was not more efficient than the SHG intervention. In light of research showing the importance of behavioral interventions in treatment of obesity in children (Luttikhuis, et al., 2009), one of the main differences between the two parent interventions was the application of behavioral techniques in the TLG`s. It may as well be though, that the type and amount of such techniques were insufficient to make a difference. Inclusion of prompt barrier identification, restructuring the home environment, prompting self-monitoring and specific goal-setting behavior change techniques are associated with intervention effectiveness (Golley, et al., 2011). Most treatment programs teach and encourage the use of many behavioral strategies to help children change their diet and/or physical activity levels, but few studies report on whether participants use these strategies and whether their level of use is associated with observed changes in weight (Spear,

et al., 2007). Thus, it is difficult to determine the relative efficacy of the different behavioral strategies and the amount needed to produce a significant effect. Generally though, it is about controlling the environment, monitoring behavior, setting goals, and rewarding successful changes in behavior (Dietz & Robinson, 2005), strategies explicitly applied in the TLG intervention of the current study. Even though all group sessions were videotaped and fidelity to the manual was addressed in the counseling of the therapists, the material have not been thoroughly analysed and coded in order to check fidelity. Since the type and number of behavioral techniques taught in the sessions are not explicitly examined, we cannot conclude that the two parental group interventions really differed with regard to the use of behavioral techniques, even though they were supposed to. Analyzing the taped material of the self-help group sessions would also have been useful in order to draw conclusions with regard to the similarities and differences between the two groups. Ideally, we should also have videotaped and analysed the individual consultations, since behavioral techniques were probably applied in these sessions as well, i.e. monitoring and goal-setting changes in physical activity and diet.

In addition to the use of behavioral techniques, general parenting skills were also addressed in the TLG`s since research has shown parent skill training to increase efficacy of pediatric obesity interventions (Golley, et al., 2007; Magarey et al., 2011). A meta-analysis found parent training in general behavior management to be associated with significantly better outcomes in family-based interventions (K. A. Kitzmann, et al., 2010). The treatment manual of the TLGs was based on the parent program "The Incredible Years," where parenting skills are a main component. In the current intervention, the aim was to teach general parenting skills with a focus on behaviors relevant to childhood obesity. The manual presented themes to discuss and parenting principles to address in the sessions, i.e. reinforcing positive behavior, communication and cooperation etc. On the other hand, the treatment manual did not explicitly state which parenting skills to address in which sessions and how to address them. It may therefore be, that the parent skills training component was too small or too inconsistently focused to make a difference.

Another possible explanation for the lack of between-group differences is that the detection of obesity through recruitment and baseline assessment is sufficient to cause reduced obesity, by making families aware of the child's obesity and motivating them to change behavior (A. R. Hughes et al., 2008). Parents` readiness to change has been suggested as a key predictor of treatment success (Barlow, 2007). Because parents enrolling in the current trial were probably ready to make lifestyle changes, regardless of group allocation,

this may have caused the similar improvement seen in both intervention groups. Further, it is possible that the SHG`s have been just as efficient as the TLG`s with regard to motivation and change, i.e. parents motivating and consulting each other as to what lifestyle changes would be effective and how to make these changes. Overall, social support intervention has been shown to work in a range of conditions (Hogan, Linden, & Najarian, 2002) and self-help confers a number of psychological benefits, such as self-reliance and an increased sense of empowerment (Latner, Stunkard, Wilson, & Jackson, 2006). Study II showed that perceived emotional barriers were the only parental health cognition variable predicting changes in body fat during treatment. Possibly such barriers were addressed just as much in the SHG`s as in the TLG`s. At least the opportunities to discuss and receive support to handle perceived emotional barriers may have been equal in both conditions. In addition, information and advice may have been exchanged between parents in the two intervention groups.

In addition to the above mentioned explanations, the main reason why the two interventions appear to be equally efficient might be because of the design of the study which is discussed under the "Methodological strengths and limitations" section (5.6.1.).

5.4.3. Clinical implications

Although the current study was designed to test the assumption that therapist-led groups of parents are more efficient in treating obesity in children than self-help groups of parents, the findings do not allow a conclusion to be drawn regarding this research question. The results do indicate though, that parental self-help groups may be a cost-effective intervention in the treatment of pediatric obesity. There is little doubt that cost-effectiveness will become an increasingly important consideration in future health decisions. As the two intervention groups in the current study were equally efficient, a logical inference is that the least expensive intervention is the more cost-effective. The potential resource saving of self-help groups, instead of therapist-led groups, has important health cost implications. Self-help groups might be the solution to the scarcity of health professionals in primary and community health care. Further, self-help groups have been proposed as an important treatment modality for the provision of continuing care, due to the need for long-term obesity treatment as well as the cost of such care (Latner, Wilson, Stunkard, & Jackson, 2002). Future studies should examine the efficacy of parental self-help groups in the treatment of obesity in children. The findings of Study IV are in great need of replication.

5.5. Are the changes obtained during treatment clinical significant?

First of all, the overall efficiency of the current intervention cannot be determined owing to the lack of a control group. As findings from several studies indicate that adiposity continues to increase in obese children not receiving treatment (Golley, et al., 2007; Wright, Emmett, Ness, Reilly, & Sherriff, 2010), it is reasonable to assume that both intervention groups would have been successful compared with a non-intervention control group. A meta-analysis comparing wait list controls and participants of lifestyle interventions found that intervention groups showed greater improvement than about 78% of those in the control group at the end of treatment and 73% at follow up (Wilfley, 2007). Further, as health consequences of child obesity and the importance of early intervention are well recognized, there are ethical issues associated with having a long-term non-intervention group in child obesity studies (Warren et al., 2007).

5.5.1. Changes in BMI SDS compared with other studies

The current study found an overall mean BMI SDS change of 0.2 from baseline to six months and 0.15 from baseline to 24 months. As an example, one boy aged 8 years and 9 months at start of treatment (height=149,7 cm; weight=56 kg; BMI=25; BMI SDS=2,47) showed a decrease in BMI SDS of 0.23 at 6 months (height=154,2 cm; weight=57,4 kg; BMI=24,1; BMI SDS=2,24). At two years follow up his BMI SDS had increased (height=162,5 cm; weight=68,9 kg; BMI=26,1; BMI SDS=2,31), but still there was a decrease of 0.16 from baseline.

Compared with those behavioral studies included in the metaanalysis in Luttikhuis et al.`s review (2009), for those under 12 years of age, Golan et al. (2006) report a mean BMI SDS change of 0.1 from baseline to the end of treatment (18 months); Golley et al. (2007) report a mean BMI SDS differences from baseline to six months ranging from 0.15 to 0.24 depending on the type of intervention, and corresponding numbers for 12 months are 0.15 to 0.24; Hughes et al. (2008) found a median change in BMI z-score of 0.1 from baseline to six months and 0.07 from baseline to 12 months; and Kalavainen et al (2007) report a mean BMI SDS change in the group treatment of 0.3 from baseline to six months and 0.2 at 12 month follow-up, compared with 0.2 and 0.1.for the routine treatment group. There is a lack of studies with follow-up beyond one year (Collins, et al., 2011), but Kalavainen et al. (2011) found BMI SDS to decrease by 0.2 from baseline to two year follow-up, compared to the 0.15 decrease of the current study.

5.5.2. Changes in body-fat compared with other studies

Few studies report changes in body fat during treatment. One high-intensity family-based one-year program including exercise, dietary and behavior modification reported a body fat reduction of 4% points at 12 months (Savoye et al., 2007) compared with 2.0 % points after two years in the current study. In the study by Savoye et al.(2007), baseline body fat was 47% compared with 40% in the current study. The higher the baseline values, the more likely individuals are to lose weight (Moens, et al., 2010). Results from two cohorts of children aged eight to 18 participating in an established residential weight management intervention camp show mean body fat reduction ranging from 2.6% points to 4.0% points assessed at baseline and end of intervention (L. A. Birch, 2011). Reinehr et al (2010) report a change in body fat based on bioimpedance analysis of 2.7% points from baseline to six months after an outpatient lifestyle intervention, comparable with the 2.2% points reduction obtained at six-months follow-up in the current study. In summary, the changes in BMI SDS and body fat of the current study are in accordance with those found in similar studies even though such comparisons are limited by differences in intervention duration and intensity.

5.5.3. Clinical significance of changes in BMI SDS and body fat

In addition to comparing the current results with earlier findings it is reasonable to ask whether the changes in BMI SDS and body fat found are clinically significant. There has been no theoretical or experimental work indicating how much weight for height change should be the goal in pediatric treatment programs (Epstein, et al., 2007). Some may argue that the clinical significance of the adiposity reduction found in the present study is limited, as a recent study (Ford, et al., 2010) suggests a reduction in BMI z-score of at least 0.25 is required to improve adiposity and metabolic health in obese adolescents. Kirk et al (2005), however, reported that a BMI z-score reduction of 0.15 was associated with clinically important improvements in the obesity-related medical complications of dyslipidemia and hyperinsulinemia. In a study of obese prepubertal children, moderate weight reduction was associated with a decrease in tumoral necrosis factor-α, increased leptin and decreased T-adiponectin (Martos-Moreno, Barrios, Martinez, Hawkins, & Argente, 2010). Others have shown that there are no threshold levels for the reduction in BMI z-score that is required to reduce metabolic risk in obese children (Reinehr, et al., 2009). In adults, small changes in weight have been shown to result in a 58% risk reduction in diabetes (Diabetes Prevention Program Research Group, 2002) and a 5-10% weight-loss was associated with a 35% reduced risk of metabolic disorders (Goldstein, 1992).

In summary, it is reasonable to assume that the reduced adiposity obtained during the current intervention is of clinical significance. Reduced obesity is not sufficient to evaluate treatment, however. Improved QOL, reduction of psychological problems and well-regulated eating behavior have also been shown to be positive outcomes of pediatric obesity interventions (Braet & Van Winckel, 2000; Griffiths, et al., 2010; Tsiros, et al., 2009). Such improvements are of special importance when long-term effects of treatment are taken into consideration. Several authors have stated that it is important to focus on changes in behavior, rather than changes in weight (Lowry, 2007; Nowicka & Flodmark, 2006). Based on such an assumption, an important question in regard to the clinical significance of the current intervention is therefore: did the children change their health behavior during treatment?

5.5.4. Changes in health behavior

The decrease in energy intake during treatment found in Study IV may indicate that the children's dietary habits changed significantly. Finding the decrease in energy intake from baseline to six months is sustained at two year follow-up strengthens this result. Apart from the excess in SFA intake, the macronutrient composition of the diet was in accordance with national recommendations (Norwegian Directory of Health, 2005) at all times. This indicates that except for a reduction in the intake of SFA, changes in the dietary composition of the participants were not required. There was in fact an improvement in the quality of dietary fat from baseline to six months, as E% of SFA decreased, but this was not sustained at two years. This finding may indicate a necessity to emphasize dietary choices regarding the quality of fat more clearly during the intervention. Changes in dietary intake in the present study are in accordance with similar findings from the few child obesity interventions reporting this outcome (Alexy et al., 2006; Burrows, et al., 2008; Waling, Lind, Hernell, & Larsson, 2010). Altogether, the results suggest that the children changed their diet in a healthy way. As Study III showed, the reduced adiposity obtained was explained by changes in energy intake during treatment, further suggesting that the dietary changes were of clinical significance. The health behavior changes related to diet are in contrast to the mean decrease in physical activity during treatment. This finding has already been discussed in earlier sections of the current thesis.

5.5.5. Summary

In summary, the current study of a family-based outpatient treatment of obesity in children found moderate but significant reductions in BMI SDS and body fat at both six months and two year follow-up. Since the changes are comparable with earlier findings and are associated with health benefits, it is reasonable to conclude that they are of clinical significance. The changes in physical activity, on the other hand, are not. Showing that the reduced body fat obtained at six months is sustained at two years further strengthens the clinical significance of the results given that metaanalyses indicate that weight commonly begins to rebound by the 12-month follow-up (Collins, et al., 2006; Luttikhuis, et al., 2009). The decrease in body-fat and BMI SDS obtained during treatment is rather moderate, however, despite a quite extensive intervention program. Building on the current results, future studies should aim to identify the most curative elements of treatment and the most cost-effective parental intervention in order to increase treatment efficacy.

5.6. Methodological strengths and limitations

5.6.1. Study design

The current thesis is based on a randomized controlled trial comparing two different parent-group interventions. As already mentioned, the lack of between-group differences may be due to the study design, specifically the similarity between the two arms of the study. Since all children participated in children`s groups, and all families received the same number of individual consultations, the two arms of the study only differed with regard to the parent group allocation. The difference between the two parent groups was the structured skills-training component and the use of behavior modification techniques applied in the TLGs, in addition to the groups being led by a therapist. It may be, however, that some of these techniques were applied in the individual consultations as well, thus minimizing the difference between the two interventions groups. Obviously, we could have developed a manual to insure that the clinical dietitian and physiotherapist did not apply such techniques. However, the main aim of the individual consultations was to discuss potential changes in activity and diet, to set and evaluate goals. If the sessions were conducted according to a treatment manual where the use of behavioral techniques was not allowed, it would have been difficult to fulfill the aim of the consultations.

A recent review shows that energy intake/density and food choices are likely to be targeted in effective prevention interventions (Golley, et al., 2011). Even though generalizing from prevention to intervention may be questionable it is fair to point out that energy intake and food choices were addressed by the clinical dietitian in the individual sessions of the current treatment program. This indicates that all children, regardless of parental intervention group received this component of treatment, thereby decreasing the difference between the two intervention groups. If the two different parent groups were the only intervention, we would be better able to answer whether a parental self-help group is a sufficient condition to reduce obesity in children.

Further, in order to account for several common treatment components of the two arms of the study, we could have included one study arm without any group intervention at all. The number of subjects referred for treatment, however, limits the number of groups it is possible to include in the study. Another possible improvement in the design of the study would be the comparison of skills-training groups with self-help groups, not including children's groups or individual consultations at all. In summary, the study was not well designed to answer the question of whether parental SHGs are just as efficient as TLGs in reducing children's body fat during treatment. It seems that some common factors of obesity treatment (e.g. readiness to change, receiving help, etc.) explain so much of the variance that the additional components added in the TLG intervention did not make any difference. At least we did not have the statistical power to detect such a difference.

5.6.2. Sample

In addition to examining the design of the study as one reason for the lack of between-group differences, it is reasonable to ask whether the hypothesis was rejected due to other methodological limitations of the study. As stated by Kelly et al (2010), the size of the sample should be based on how many patients are required to answer the research questions of the study. They add that it is only worthwhile detecting a difference between treatment groups if the size of the difference is large enough to be clinically relevant (Kelly, et al., 2010). The current thesis of course raised several research questions. As already pointed out, the design of the study was not well suited to answer whether the two intervention groups were equally efficient in reducing the children's adiposity owing to the factual small mean difference between the groups, which was smaller than expected when we designed the study. Power calculations (G*Power) (Faul, Erdfelder, Lang, & Buchner, 2007) showed that given a

group difference of mean BMI SDS = 0.25 (SD = 0.5) and using a one-tailed test with a power of 0.75, we would need 44 remaining participants in each group after drop out (one in every eight children estimated to drop out). In contrast, given the observed BMI SDS group difference after two years of treatment, a power of 0.75 and a significance level of 0.05, we would in fact need 3691 participants in each of the two intervention arms. Power analysis (G*Power) based on the mean difference in body fat % between the groups shows that we would require a total of 8303 participants. Obviously, such sample sizes are neither possible to obtain nor clinically significant to detect.

5.6.3. Measures

5.6.3.1. Body fat

Obesity is due to excessive body fat, and the use of body fat as an outcome measure is therefore an advantage of the current study. Using body fat rather than BMI as an outcome measure is especially important in addressing both physical activity and diet, because of the possibility that a rise in lean mass will mask a decrease in body fat (Sacher et al., 2010). DXA is widely used and has the benefit of accurately quantifying body fat (Helba & Binkovitz, 2009). In a comparison of an old and a new version of the DXA software (Hologic Discovery), however, Shypailo et al. (2008) conclude that DXA has not yet achieved sufficient reliability to be considered a "gold standard" for the assessment of body composition in pediatric studies . In addition, an evaluation of DXA against the four-component model of body composition in obese children and adolescents aged five to 21 shows that DXA (Lunar Prodigy) significantly overestimated fat mass (Wells et al., 2010). The four-compartment model (4-CM) is a reference method combining measurements of total body water, body density, and total body bone mineral to estimate a fourth component, namely body fat % (Sopher, et al., 2004). Although DXA cannot be considered the "gold standard" it is the most accurate measure available. In addition, the focus of the current thesis is changes in body fat during treatment, so a possible overestimation of body fat will at worst represent a systematic error. Since the same type of DXA was used when we gathered data at all three measurement times, the results, i.e. change in body fat, will not be affected by a possible overestimation.

5.6.3.2. Parental health cognitions

The Parental Health Cognitions Inventory was developed for the current study to measure parental health cognitions with regard to changes in children's diet and physical activity behavior. Ideally, the instrument should have been properly psychometrically tested before being applied in Study II, but this was not possible for practical reasons. The fairly low internal consistency of the questionnaire represents a limitation of the current thesis. One possible explanation for this lack of consistency, however, is the fact that the measure included both diet and physical activity items for each of the health cognition variables explored, thus measuring cognitions concerning a relatively wide set of health behaviors. Since different health behaviors such as dieting and physical activity have been shown to be only weakly correlated (Kremers, De Bruijn, Schaalma, & Brug, 2004), it could be assumed that if only diet-related items had been included in the questionnaire, the internal consistency would have improved. Although different health behaviors are weakly correlated, however, energy balance-related behaviors (EBRBs) have been shown to co-occur or cluster (Kremers, et al., 2004), indicating that the combination of behaviors is more prevalent than expected on the basis of the prevalence of the separate behavior. Hence it is important to include both activity and diet-related items when measuring behavior change, as is done in the current study.

Further, the low alpha obtained may indicate that the health cognition constructs measured are comprehensive and not narrowly defined. Additionally, it is difficult to obtain high alpha-values when using only four to six items, as is the case in the current study, because Cronbach's alpha increases as the number of items on a scale increases (Holt, Clark, & Kreuter, 2001). It should also be noted that the moderate reliability might not have affected the findings since the health cognition constructs were treated as latent constructs and thus were free of measurement error. In addition, the results of the CFA show that the measures had satisfactory factorial validity.

Nevertheless, the current findings must be interpreted within the context of the low internal consistency found and the lack of proper psychometrical testing of the Parental Health Cognitions Inventory.

5.6.3.3. Diet

The dietary assessment in the current study was based on a four-day dietary food record. Even though dietary intake cannot be estimated without error, the use of prospective methods of assessment has the advantage of not relying on memory (Collins, Watson, & Burrows, 2010), thereby increasing accuracy. Nevertheless, validation studies of energy intake data indicate that much of the dietary data from children and adolescents is prone to reporting error, mostly through under-reporting (Lioret et al., 2011; Livingstone, Robson, & Wallace, 2004). In addition, higher weight individuals tend to under-report energy intake to a greater degree (Fisher, Johnson, Lindquist, Birch, & Goran, 2000). Since reporting accuracy seems to vary as a function of children's relative weight and body composition, it may be that the most obese children of the current study under-reported the most, thus representing a random bias (Collins, et al., 2010). Such bias affects the macronutrient composition of the reported diet (Pryer, Vrijheid, Nichols, Kiggins, & Elliott, 1997). To identify underreporting, age- and sex-dependent cut-offs for the EI/BMR ratio was used (Schofield, 1985; Sichert-Hellert, et al., 1998). Further, in order to increase the accuracy of the reported portion sizes, an evaluated photographic booklet was used in the current study (Lillegaard, et al., 2005).

In the current study parents received the dietary record forms by post and it was not specified whether the parents or the child should be responsible for the food intake registration. Thus, we cannot be sure whether the child or the parent completed the records. Further, since the children aged two years between the first to the last registration, it might well be that parents` registered food intake at baseline, whereas the child was responsible for registration at the end of treatment. This may represent a random error. It is highly recommended that researchers clearly indicate who is the source of dietary intake reporting as it remains unclear whether children`s or parents` report are more valid (Collins, et al., 2010). Studies show that parental reports of children's intake are accurate for times when parents are present to observe the child's intake (Baranowski, Sprague, Baranowski, & Harrison, 1991; Klesges, Hanson, Eck, & Durff, 1988; Linneman et al., 2004), but parents are not always reliable reporters of their child's out-of home food intake (Baranowski, et al., 1991).

5.6.3.4. Physical activity

The main aim of including a physical activity component in treatment of obesity is to increase energy expenditure in order to reduce adiposity. It is a question of energy in and energy out. Thus, it is reasonable to ask how well counts per minute, the outcome variable of activity of the current study, are related to energy expenditure. Physical activity is defined as bodily movements, produced by skeletal muscles and resulting in energy expenditure (Plasqui & Westerterp, 2007). Total counts per minute as a measure of children`s level of physical activity have shown good validity and reliability (Trost, 2001) and the criteria for inclusion and analysis methods applied in the current study were based on reliability studies (Ekelund et al., 2001; Mattocks et al., 2008; Trost, Pate, Freedson, Sallis, & Taylor, 2000). Doubly Labely Water (DLW) is the only method available for accurate measurement of total energy expenditure under free-living conditions and is thus considered to be the gold standard (Plasqui & Westerterp, 2007). In a review evaluating accelerometers against DLW the authors conclude that the Actigraph, the accelerometer used in the current study, correlates reasonably with DLW-derived energy expenditure (Plasqui & Westerterp, 2007).

The extent to which body movement leads to energy expenditure, however, is dependent on body size and body composition (Plasqui & Westerterp, 2007); it takes more energy to move a large body than a smaller body. In the current sample of treatment-seeking children with obesity, the degree of obesity differs, and thus for the most obese children a given number of counts per minute will represent more energy spent than for less obese children. Various methods can be applied to correct energy expenditure for body size and composition (Plasqui & Westerterp, 2007), but none of these were used in the current study.

An additional limitation is that the accelerometer has been shown to underestimate physical activity in children (Riddoch, et al., 2004). The accelerometer cannot be used for swimming or other under-water activities and is unable to pick up cycling activities (Kristensen et al., 2008). Nor are activities performed by the upper-body registered (e.g. throwing a ball). These limitations indicate that children who have increased their swimming and cycling activities have not had their activity registered properly, possibly underestimating the amount of activity registered in the current study. In addition, we have experienced that children with obesity often prefer swimming or cycling rather than walking, running and ball-games, due to the "costs" of moving a large body. Even so, we expect that these activities together account for only a minor fraction of total physical activity in children, let alone

change in physical activity, and therefore are not a major source of error. Another possible bias is that larger persons move with a lower frequency of steps compared with smaller people walking at the same speed (Anderssen, Kolle, Steene-Johannessen, Ommundsen, & Andersen, 2008). This may have contributed to a possible underestimation of the level of physical activity found in the current study, since the children aged two years from baseline to the end of treatment. Actigraph accelerometry output, however, shows little age- or size-related systematic variation for the same behavioral input across a wide age/size range (Reilly et al., 2008).

On the other hand, there is a possibility that wearing an accelerometer causes children to be more active than they normally are, thus overestimating activity. As already discussed and contrary to earlier findings, the obese children of the current study show the same level of physical activity at baseline as normal-weight children. Perhaps the possible effect of wearing an accelerometer is greatest at the first time of monitoring, thus contributing to the decline in the mean level of physical activity from pre-treatment to post-treatment found in the current study. A change in normal activity levels because of the participants' knowledge that their activity levels are being monitored (Welk, Corbin, & Dale, 2000) is potentially greater, however, when the children are able to check their score themselves throughout the course of the day (Rowlands & Eston, 2007). The accelerometer used in the current study did not allow for such self-monitoring.

Another possible bias is the validity of the accelerometer measurements. In order to have valid registration the accelerometer must be used according to the instructions, i.e. the whole day for seven consecutive days. Relatively few children had valid activity registrations at all three times of measurement, but 72.5% of those who completed the two year treatment program had at least one valid measure in addition to the baseline measure. There were no significant differences with regard to gender, age or BMI SDS between those children with a valid registration at baseline exclusively and those with at least one valid registration in addition to the one at baseline. Since missing data were estimated (Maximum Likelihood), the relatively few numbers of valid registrations have been accounted for in the analysis of physical activity in Study III. The main advantage of this estimation technique is the use of all available data.

5.7. Statistics

5.7.1. The measurement model of Study I

In Study I, a CFA was conducted to explore the hypothesis that QoL and psychopathology are two distinct constructs. In a brief commentary on this study, Gandhi (2010) states that the "*the overall impression exists that the model may not fit the data particularly well*" p.617 . We agree with Gandhi in that the model does not fit data very well, and as we stated in the paper; the fit-values are bordering on acceptable values. Due to limited space, it was not possible to present alternative models in the paper. However, the presence of alternative models with better fit values has been examined. First, the sample was randomly split in two with the prospect of establishing an alternate solution with exploratory factor analyses which could be replicated with confirmatory factor analyses in the other part of the sample. The model fits of 1 to 4-factor alternate solutions are presented in Table 2.

Table 2

Model fits for Exploratory Factor-analysis of Psychopathology and QoL as latent factors

Model alteration	χ^2	df	CFI	TLI	RMSEA	CI
Parent-report						
1 factor	1418.74*	77	.696	.641	.112	.180-.197
2 factors	248.06*	64	.958	.941	.077	.067-.087
3 factors	175.24*	52	.972	.951	.069	.058-.081
4 factors	134.307*	41	.979	.953	.068	.055-.081
Self-report						
1 factor	1629.77*	77	.603	.531	.203	.194-.211
2 factors	335.28*	64	.931	.901	.093	.083-.103
3 factors	166.26*	52	.971	.949	.067	.056-.078
4 factors	85.213*	41	.989	.975	.047	.033-.061

Note. CFI = Confirmatory Fit Index; TLI = Tucker Lewis Index; RMSEA = Root Mean Square Error Approximation, CI = RMSEA 90% Confidence interval, * p < .001.

As can be seen in Table 2, the more factors the better statistical fit. However, interpretability should also guide the determination of number of factors. Inspection of the factor structure (Table 3) showed that for the parent-reported items, a third factor had only one loading above

.40, namely aggressive behavior (.44), and one loading above .30, namely rule-breaking behavior (.31). However, both these items had large cross-loadings of .86 and .73 with factor 2, respectively. No other items loaded beyond .16 on the third factor. It was therefore concluded that a third factor did not add substantially to a two factor solution.

The two factor solution showed a clear dichotomous structure with KINDL items loading on the first factor with loadings between .92 and .98, whereas all the CBCL items loaded on the second factor with loadings between .64 and .85. There were no cross loadings above .07. As can be seen in Table 3, these findings were closely replicated with respect to self-report data.

Overall, these results strongly suggest that although Gandhi`s (2010) arguments may at face value seem valid on a strictly statistical sense, close inspection of alternative factor solutions and factor loadings reveal that the two factor solution is by far the preferable solution.

Table 3

Factor loadings of the two factor model. Exploratory factor analysis.

	Parent-report		Self-report	
	Factor 1	Factor 2	Factor 1	Factor 2
KINDL-R Physical well-being	.916	-.016	.760	-.006
KINDL-R Emotional well-being	.981	-.005	.884	.066
KINDL-R Self-esteem	.932	-.028	.712	.040
KINDL-R Family	.943	.004	.797	-.052
KINDL-R Friends	.964	.017	.831	.001
KINDL-R School	.944	.053	.720	-.149
CBCL/YSR Anxious/Depressed	.013	.764	-.014	.857
CBCL/YSR Withdrawn	-.067	.739	-.010	.826
CBCL/YSR Somatic complaints	-.007	.637	-.062	.810
CBCL/YSR Social problems	-.070	.809	-.023	.831
CBCL/YSR Thought problems	.020	.644	.043	.823
CBCL/YSR Attention problems	.026	.711	.006	.878
CBCL/YSR Rule breaking behavior	-.004	.751	.040	.690
CBCB/YSR Aggressive behavior	.005	.854	.035	.870

5.7.2. Missing estimation

Full information maximum likelihood was used to handle missing data in Study I and II. According to Poon and Wang (2010), computational difficulties and low convergence rate may arise when a complex model is analyzed with a large amount of missing data. Even though the model in Study III is not particularly complex, there is indeed a large amount of missing data with regard to physical activity owing to few valid registrations. Further, the maximum likelihood estimators cannot be used with more than three or four latent variables,

or otherwise the computational burden is so large that it becomes impractical (B. Muthen & Asparouhov, 2010a). In Study II, four latent variables were included in the model, thus bordering on the maximum number of variables recommended. Another disadvantage of maximum likelihood is that it relies on missing at random (MAR) assumption (Baraldi & Enders, 2010). It is, however, more powerful than traditional data techniques because no data are "thrown out" (Baraldi & Enders, 2010) and is recommended by the American Psychological Association (Wilkinson & American Psychological Association Task Force on Statistical Inference, 1999).

5.8. Conclusions and suggestions for further research

The overall aim of the current thesis was to examine psychosocial functioning and changes in adiposity, diet and physical activity in children with obesity participating in an outpatient family-based treatment program. Several new contributions have been made in this thesis. First, the present study is the first to apply statistical mediation models showing that high levels of psychopathology can explain the impaired QoL found in treatment-seeking children with obesity. Such statistical methods were also applied in Study III, the first study to examine the relative contribution of changes in physical activity and diet in explaining the reduced adiposity obtained during treatment, finding energy intake, but not physical activity to predict changes in body fat. If we succeed in identifying the most curative elements of treatment, we will be better able to increase treatment efficacy. Mediation modeling is a most valuable statistical method for such an approach, but it has rarely been applied in the obesity research field. Future studies should apply such statistical methods to explore the effectiveness of different elements of treatment.

Study II examined parental health cognitions as predictors of change in body fat during treatment, and found that parental emotional barriers significantly affected the reduced adiposity obtained. Parents being the main agents of change, there is a lack of knowledge with regard to which factors affect parents` ability to change the health behavior of the family. Health behavior models are successfully applied in the study of adult obesity interventions, and the current thesis has applied such theories in the search for parental predictors of changes in body fat during treatment. Future studies should further explore the usefulness of such models, especially focusing on how the theories could be adapted to include parents as agents of change rather than as the primary targets of change. Further, in the current study there is an implicit assumption that parental health cognitions affect the family`s health behavior,

therefore predicting the reduced obesity obtained during treatment. This assumption needs to be tested. Future studies should therefore explore the mechanisms of health behavior changes within pediatric obesity treatment by applying a health behavior theoretical framework.

In order to learn more about how to involve parents in pediatric obesity treatment, we have examined the efficiency of parental self-help groups compared with therapist-led groups. Study IV shows that these two interventions were equally efficient in reducing the children's body fat during treatment. It also examined changes in diet from the start to the end of the intervention, and demonstrated that the children's energy intake reduced without compromising the macronutrient composition of their diet. The results show that the reduced body fat and energy intake obtained at six month follow-up was sustained at two years. The two-year follow-up is a major advantage of the current work, since most pediatric obesity intervention studies have much shorter follow-ups. The modest magnitude of the improvements observed indicates the need for a more intense approach to treatment, since moderate to high-intensity interventions have significantly greater effect on weight-outcomes compared to low-intensity interventions (Epstein, et al., 2007; Whitlock, et al., 2010). Intensive treatment may, however, not be realistic for many health care systems. Nonetheless, much work remains to determine the optimal way to involve parents to produce clinically significant, persistent, cost-effective changes in weight status of obese children, although we suggest that self-help groups may be a promising alternative.

Epsteins and Wrotniak (2010) call for effectiveness trials, pointing out that most efficacy trials take place in academic settings, whereas effectiveness research should be implemented in the clinical or community setting in which it will be delivered. The current study was carried out in the clinical setting where it was to be delivered and included all patients attending obesity treatment at the hospital's pediatric department over several years. According to the newly published national recommendations (Helsedirektoratet, 2011), however, treatment of obesity in children and adolescents should take place in the community health setting. Future studies should therefore be aimed at finding the most effective way to treat children with obesity within this setting. Epstein and Wrotniak (2010) suggest that when research is designed to translate efficacious treatments to community settings, it may be worthwhile to systematically vary one factor at a time (e.g. to test an efficacious intervention delivered by the same therapists who implemented the efficacy trial in the same setting, but with a sample more representative of the general population). Further, the recommendations recommend cooperation between the primary and secondary health care systems in the treatment of pediatric obesity in Norway. Since most pediatric obesity intervention studies are

carried out in specialized hospital settings and there have been very few studies that have combined clinical and community resources in the treatment (Epstein & Wrotniak, 2010), future studies should examine interventions involving both levels of the Norwegian health care system. Implementing obesity interventions in the primary care setting is also a necessity, given the increasing numbers of children and adolescents in need of obesity treatment.

In summary, based on the current status of the field, future studies should examine primary care interventions, predictors, mediators and moderators of treatment effectiveness, in order to develop more cost-effective and better tailored treatments. As pointed out by Epstein and Wrotniak (2010), the family-based treatment approach should be considered as a work in progress. As we develop a better understanding of ways to change behavior, and of those factors that influence children's eating and activity, more powerful treatments should evolve (Epstein & Wrotniak, 2010).

References

Achenbach, T. M. (1991). *Manual for the Child Behavior Checklist/4-18 and 1991 profile*. Vermont: Burlington.

Achenbach, T. M., & Rescorla, L. (2001). An Integrated System of Multi-informant Assessment - School-Age forms and Profiles: Library of Congress, USA.

Adkins, S., Sherwood, N. E., Story, M., & Davis, M. (2004). Physical activity among African-American girls: The role of parents and the home environment. [Article]. *Obesity Research, 12*, 38S-45S.

Agras, W. S., & Mascola, A. J. (2005). Risk factors for childhood overweight. *Current Opinion in Pediatrics, 17*(5), 648-652.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211.

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology, 32*(4), 665-683.

Alexy, U., Reinehr, T., Sichert-Hellert, W., Wollenhaupt, A., Kersting, M., & Andler, W. (2006). Positive changes of dietary habits after an outpatient training program for overweight children. [Article]. *Nutrition Research, 26*(5), 202-208.

Andersen, L. F. (2005). Overweight and obesity among Norwegian schoolchildren: Changes from 1993 to 2000. *Scandinavian journal of public health, 33*(2), 99-106.

Andersen, L. F., Lillegaard, I. T. L., Overby, N., Lytle, L., Klepp, K. I., & Johansson, L. (2005). Overweight and obesity among Norwegian schoolchildren: Changes from 1993 to 2000. *Scandinavian Journal of Public Health, 33*(2), 99-106.

Anderssen, S., Kolle, E., Steene-Johannessen, J., Ommundsen, Y., & Andersen, L. (2008). *Physical activity among young people in Norway*. Oslo: Norwegian Directorate of Health, Department for Physical Activity.

Andreasen, C. H., & Andersen, G. (2009). Gene-environment interactions and obesity - Further aspects of genomewide association studies. *Nutrition, 25*(10), 998-1003.

Andrews, K. R., Silk, K. S., & Eneli, I. U. (2010). Parents as Health Promoters: A Theory of Planned Behavior Perspective on the Prevention of Childhood Obesity. *Journal of Health Communication, 15*(1), 95-107.

Angelopoulos, P. D., Milionis, H. J., Grammatikaki, E., Moschonis, G., & Manios, Y. (2009). Changes in BMI and blood pressure after a school based intervention: The CHILDREN study. *European Journal of Public Health, 19*(3), 319-325.

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology, 40*, 471-499.

Armstrong, N., & Welsman, J. R. (2006). The physical activity patterns of European youth with reference to methods of assessment. [Review]. *Sports Medicine, 36*(12), 1067-1086.

Bandura, A. (1977). Self-efficacy - toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), 122-147.

Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Social and Clinical Psychology, 4*(3), 359-373.

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes, 50*(2), 248-287.

Bandura, A. (1998). Health promotion from the perspective of social cognitive theory. *Psychology and health, 13*(4), 623-649.

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology, 52*, 1-26.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education and Behavior, 31*(2), 143-164.

Baraldi, A. N., & Enders, C. K. (2010). An introduction to modern missing data analyses. [Article]. *Journal of School Psychology, 48*(1), 5-37.

Baranowski, T., Cullen, K. W., & Baranowski, J. (1999). Psychosocial correlates of dietary intake: Advancing dietary intervention. *Annual Review of Nutrition, 19*, 17-40.

Baranowski, T., Cullen, K. W., Nicklas, T., Thompson, D., & Baranowski, J. (2003). Are current health Behavioral change models helpful in guiding prevention of weight gain efforts? *Obesity Research, 11*, 23S-43S.

Baranowski, T., Domel, S., Gould, R., Baranowski, J., Leonard, S., Treiber, F., et al. (1993). Increasing fruit and vegetable consumption among 4th and 5th grade students - results from focus groups using reciprocal determinism. *Journal of Nutrition Education, 25*(3), 114-120.

Baranowski, T., Sprague, D., Baranowski, J. H., & Harrison, J. A. (1991). Accuracy of maternal dietary recall for preschool-children. *Journal of the American Dietetic Association, 91*(6), 669-674.

Barlow, S. E. (2007). Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: Summary report. *Pediatrics, 120*, 164-192.

Barsh, G. S. (2000). Genetics of body-weight regulation. *Nature, 404*(6778), 644-651.

Bas, M., & Donmez, S. (2009). Self-efficacy and restrained eating in relation to weight loss among overweight men and women in Turkey. *Appetite, 52*(1), 209-216.

Bastiaansen, D., Koot, H., & Ferdinand, R. (2005). Psychopathology in children: Improvement of quality of life without psychiatric symptom reduction? *European Child and Adolescent Psychiatry, 14*(7), 364-370.

Bastiaansen, D., Koot, H. M., Bongers, I. L., Varni, J. W., & Verhulst, F. C. (2004). Measuring quality of life in children referred for psychiatric problems: Psychometric properties of the PedsQL (TM) 4.0 generic core scales. *Quality of Life Research, 13*(2), 489-495.

Bauman, A. E., Sallis, J. F., Dzewaltowski, D. A., & Owen, N. (2002). Toward a better understanding of the influences on physical activity - The role of determinants, correlates, causal variables, mediators, moderators, and confounders. *American Journal of Preventive Medicine, 23*(2), 5-14.

Bean, M. K., Mazzeo, S. E., Stern, M., Evans, R. K., Bryan, D., Ning, Y., et al. (2011). Six-Month Dietary Changes in Ethnically Diverse, Obese Adolescents Participating in a Multidisciplinary Weight Management Program. [Article]. *Clinical Pediatrics, 50*(5), 408-416.

Beets, M. W., Cardinal, B. J., & Alderman, B. L. (2010). Parental Social Support and the Physical Activity-Related Behaviors of Youth: A Review. [Review]. *Health Education and Behavior, 37*(5), 621-644.

Berge, J. M., Wall, M., Loth, K., & Neumark-Sztainer, D. (2010). Parenting Style as a Predictor of Adolescent Weight and Weight-Related Behaviors. [Article]. *Journal of Adolescent Health, 46*(4), 331-338.

Berge, J. M., Wall, M., Neumark-Sztainer, D., Larson, N., & Story, M. (2010). Parenting Style and Family Meals: Cross-Sectional and 5-Year Longitudinal Associations. [Article]. *Journal of the American Dietetic Association, 110*(7), 1036-1042.

Birch, L. A. (2011). A review of the effectiveness of an established residential weight management intervention on short-term health outcomes in overweight and obese youth. *Journal of Human Nutrition and Dietetics, 24*(3), 277-310.

Birch, L. L., & Fisher, J. O. (1998). Development of eating behaviors among children and adolescents. *Pediatrics, 101*(3), 539-549.

Blaine, B. E., Rodman, J., & Newman, J. M. (2007). Weight loss treatment and psychological well-being - A review and meta-analysis. [Review]. *Journal of Health Psychology, 12*(1), 66-82.

Bleich, S. N., Ku, R., & Wang, Y. C. (2011). Relative contribution of energy intake and energy expenditure to childhood obesity: a review of the literature and directions for future research. *International Journal of Obesity, 35*(1), 1-15.

Blissett, J., & Haycraft, E. (2008). Are parenting style and controlling feeding practices related? [Article]. *Appetite, 50*(2-3), 477-485.

Bos, H. M. W., & Van Balen, F. (2008). Children in planned lesbian families: Stigmatisation, psychological adjustment and protective factors. *Culture Health & Sexuality, 10*(3), 221-236.

Braet, C. (2006). Patient Characteristics as Predictors of Weight Loss after an Obesity Treatment for Children. *Obesity, 14*(1), 148-155.

Braet, C., Mervielde, I., & Vandereycken, W. (1997). Psychological aspects of childhood obesity: A controlled study in a clinical and nonclinical sample. *Journal of Pediatric Psychology, 22*(1), 59-71.

Braet, C., & Van Winckel, M. (2000). Long-term follow-up of a cognitive behavioral treatment program for obese children. *Behavior Therapy, 31*(1), 55-74.

Brambilla, P., Pozzobon, G., & Pietrobelli, A. (2011). Physical activity as the main therapeutic tool for metabolic syndrome in childhood. [Review]. *International Journal of Obesity, 35*(1), 16-28.

Bray, G. A. (2004). Medical consequences of obesity. *Journal of Clinical Endocrinology and Metabolism, 89*(6), 2583-2589.

Brestan, E. V., & Eyberg, S. M. (1998). Effective psychosocial treatments of conduct-disordered children and adolescents: 29 years, 82 studies, and 5,272 kids. *Journal of Clinical Child Psychology, 27*(2), 180-189.

Britz, B., Siegfried, W., Ziegler, A., Lamertz, C., Herpertz-Dahlmann, B. M., Remschmidt, H., et al. (2000). Rates of psychiatric disorders in a clinical study group of adolescents with extreme obesity and in obese adolescents ascertained via a population based study. *International Journal of Obesity, 24*(12), 1707-1714.

Bronfenbrenner, U. (1979). *The ecology of human development: experiments by nature and design*. Cambridge, Mass.: Harvard University Press.

Bruce, A. S., Holsen, L. M., Chambers, R. J., Martin, L. E., Brooks, W. M., Zarcone, J. R., et al. (2010). Obese children show hyperactivation to food pictures in brain networks linked to motivation, reward and cognitive control. *International Journal of Obesity, 34*(10), 1494-1500.

Bruch, H. (1961). Transformation of oral impulses in eating disorders - a conceptual approach. *Psychiatric Quarterly, 35*(3), 458-481.

Bruch, H. (1964). Psychological aspects of overeating and obesity. *Psychosomatics, 5*(5), 269-274.

Bullinger, M., Brutt, A. L., Erhart, M., & Ravens-Sieberer, U. (2008). Psychometric properties of the KINDL-R questionnaire: results of the BELLA study. *European Child and Adolescent Psychiatry, 17*, 125-132.

Bullinger, M., von Mackensen, S., & Kirchberger, I. (1994). KINDL - Ein Fragebogen zur Erfassung der gesundheitsbezogenen Lebensqualität von Kindern. *Sonderdruck Zeitschrift für Gesundheitspsychologie, II*(1), 64-77.

Burrows, T., Warren, J. M., Baur, L. A., & Collins, C. E. (2008). Impact of a child obesity intervention on dietary intake and behaviors. *International Journal of Obesity, 32*(10), 1481-1488.

Burton, P., Smit, H. J., & Lightowler, H. J. (2007). The influence of restrained and external eating patterns on overeating. *Appetite, 49*(1), 191-197.

Caballero, B. (2007). The global epidemic of obesity: An overview. *Epidemiologic Reviews, 29*, 1-5.

Canetti, L., Bachar, E., & Berry, E. M. (2002). Food and emotion. *Behavioural Processes, 60*(2), 157-164.

Carnell, S., & Wardle, J. (2008). Appetitive traits and child obesity: measurement, origins and implications for intervention. *Proceedings of the Nutrition Society, 67*(4), 343-355.

Carr, T. (2003). *Discovering nutrition*. Malden, Mass.: Blackwell Publ.

Christopher, F. S., Fabes, R. A., & Wilson, P. M. (1989). Family televison viewing: Impliactions for family life education. . *Family Relations, 38*, 210-214.

Cliff, D. P., Okely, A. D., Morgan, P. J., Jones, R. A., & Steele, J. R. (2010). The impact of child and adolescent obesity treatment interventions on physical activity: a systematic review. *Obesity Reviews, 11*(7), 516-530.

Cole, T. J., Bellizzi, M. C., Flegal, K. M., & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *British Medical Journal, 320*(7244), 1240-1243.

Cole, T. J., Faith, M. S., Pietrobelli, A., & Heo, M. (2005). What is the best measure of adiposity change in growing children: BMI, BMI %, BMI z-score or BMI centile? *European Journal of Clinical Nutrition, 59*(3), 419-425.

Cole, T. J., Freeman, J. V., & Preece, M. A. (1995). Body-mass index reference curves for the UK, 1990. *Archives of Disease in Childhood, 73*(1), 25-29.

Cole, T. J., Freeman, J. V., & Preece, M. A. (1998). British 1990 growth reference centiles for weight, height, body mass index and head circumference fitted by maximum penalized likelihood. *Statistics in Medicine, 17*(4), 407-429.

Collins, C. E., Okely, A. D., Morgan, P. J., Jones, R. A., Burrows, T. L., Cliff, D. P., et al. (2011). Parent Diet Modification, Child Activity, or Both in Obese Children: An RCT. [Article]. *Pediatrics, 127*(4), 619-627.

Collins, C. E., Warren, J., Neve, M., McCoy, P., & Stokes, B. J. (2006). Measuring effectiveness of dietetic interventions in child obesity - A systematic review of randomized trials. *Archives of Pediatrics and Adolescent Medicine, 160*(9), 906-922.

Collins, C. E., Watson, J., & Burrows, T. (2010). Measuring dietary intake in children and adolescents in the context of overweight and obesity. *International Journal of Obesity, 34*(7), 1103-1115.

Conner, M. (2010). Cognitive determinants of health behavior. In A. Steptoe (Ed.), *Handbook of behavioral medicine* (pp. 19-30). New York: Springer+Business Media, LLC.

Corrigan, P. W., & Watson, A. C. (2002). The paradox of self-stigma and mental illness. *Clinical Psychology-Science and Practice, 9*(1), 35-53.

Dave, D., & Rashad, I. (2009). Overweight status, self-perception, and suicidal behaviors among adolescents. *Social Science and Medicine, 68*(9), 1685-1691.

Davison, K., & Birch, L. (2001). Childhood overweight: A contextual model and recommendations for future research. *Obesity Reviews, 2*, 159-171.

Davison, K. K., & Birch, L. L. (2002). Processes linking weight status and self-concept among girls from ages 5 to 7 years. *Developmental Psychology, 38*(5), 735-748.

de Wit, M., Delemarre-Van De Waal, H. A., Pouwer, F., Gemke, R., & Snoek, F. J. (2007). Monitoring health related quality of life in adolescents with diabetes: a review of measures. [Review]. *Archives of Disease in Childhood, 92*(5), 434-439.

Deforche, B., De Bourdeaudhuij, I., Tanghe, A., Hills, A. P., & De Bode, P. (2004). Changes in physical activity and psychosocial determinants of physical activity in children and adolescents treated for obesity. [Article]. *Patient Education and Counseling, 55*(3), 407-415.

Dencker, M., & Andersen, L. B. (2008). Health-related aspects of objectively measured daily physical activity in children. *Clinical Physiology and Functional Imaging, 28*(3), 133-144.

Dennis, K. E., & Goldberg, A. P. (1996). Weight control self-efficacy types and transitions affect weight-loss outcomes in obese women. *Addictive Behaviors, 21*(1), 103-116.

Diabetes Prevention Program Research Group. (2002). Reduction in the Incidence of Type 2 Diabetes with Lifestyle Intervention or Metformin. *NEJM, 346*, 393-404.

Dietz, W. H., & Robinson, T. N. (2005). Overweight children and adolescents. *New England Journal of Medicine, 352*(20), 2100-2109.

Dwyer, J., Needham, L., Simpson, J. R., & Heeney, E. S. (2008). Parents report intrapersonal, interpersonal, and environmental barriers to supporting healthy eating and physical activity among their preschoolers. *Applied Physiology Nutrition and Metabolism-Physiologie Appliquee Nutrition Et Metabolisme, 33*(2), 338-346.

Edmonds, J., Baranowski, T., Baranowski, J., Cullen, K. W., & Myres, D. (2001). Ecological and socioeconomic correlates of fruit, juice, and vegetable consumption among African-American boys. *Preventive Medicine, 32*(6), 476-481.

Edwardson, C. L., & Gorely, T. (2010). Parental influences on different types and intensities of physical activity in youth: A systematic review. *Psychology of Sport and Exercise, 11*(6), 522-535.

Eisenberg, M. E., Neumark-Sztainer, D., & Story, M. (2003). Associations of weight-based teasing and emotional well-being among adolescents. [Article]. *Archives of Pediatrics and Adolescent Medicine, 157*(8), 733-738.

Eisenmann, J. C. (2006). Insight into the causes of the recent secular trend in pediatric obesity: Common sense does not always prevail for complex, multi-factorial phenotypes. [Review]. *Preventive Medicine, 42*(5), 329-335.

Eiser, C., & Morse, R. (2001). Can parents rate their child's health-related quality of life? Results of a systematic review. *Quality of Life Research, 10*(4), 347-357.

Ekelund, U., Sjostrom, M., Yngve, A., Poortvliet, E., Nilsson, A., Froberg, K., et al. (2001). Physical activity assessed by activity monitor and doubly labeled water in children. *Medicine and Science in Sports and Exercise, 33*(2), 275-281.

Epstein, L. H. (1996). The association of maternal psychopathology and family socioeconomic status with psychological problems in obese children. *Obesity Research, 4*(1), 65-74.

Epstein, L. H., Coleman, K. J., & Myers, M. D. (1996). Exercise in treating obesity in children and adolescents. [Article]. *Medicine and Science in Sports and Exercise, 28*(4), 428-435.

Epstein, L. H., McCurley, J., Wing, R. R., & Valoski, A. (1990). 5-Year follow-up of family-based behavioral treatments for childhood obesity. *Journal of Consulting and Clinical Psychology, 58*(5), 661-664.

Epstein, L. H., Myers, M. D., Raynor, H. A., & Saelens, B. E. (1998). Treatment of pediatric obesity. *Pediatrics, 101*(3), 554-570.

Epstein, L. H., Paluch, R. A., Roemmich, J. N., & Beecher, M. D. (2007). Family-based obesity treatment, then and now: Twenty-five years of pediatric obesity treatment. *Health Psychology, 26*(4), 381-391.

Epstein, L. H., Roemmich, J. N., Robinson, J. L., Paluch, R. A., Winiewicz, D. D., Fuerch, J. H., et al. (2008). A randomized trial of the effects of reducing television viewing and computer use on body mass index in young children. *Archives of Pediatrics and Adolescent Medicine, 162*(3), 239-245.

Epstein, L. H., Smith, J. A., Vara, L. S., & Rodefer, J. S. (1991). Behavioral economic-analysis of activity choice in obese children. *Health Psychology, 10*(5), 311-316.

Epstein, L. H., Valoski, A., Wing, R. R., & McCurley, J. (1990). 10-year follow-up of behavioral, family-based treatment for obese children. *Jama-Journal of the American Medical Association, 264*(19), 2519-2523.

Epstein, L. H., Valoski, A., Wing, R. R., & McCurley, J. (1994). 10-year outcome of behavioral family-based treatment for childhood obesity [Article]. *Health Psychology, 13*(5), 373-383.

Epstein, L. H., & Wrotniak, B. H. (2010). Future Directions for Pediatric Obesity Treatment. *Obesity, 18*, S8-S12.

Erermis, S., Cetin, N., Tamar, M., Bukusoglu, N., Akdeniz, F., & Goksen, D. (2004). Is obesity a risk factor for psychopathology among adolescents? *Pediatrics International, 46*(3), 296-301.

Erickson, S. J., Hahn-Smith, A., & Smith, J. E. (2009). One step closer: Understanding the complex relationship between weight and self-esteem in ethnically diverse preadolescent girls. [Article]. *Journal of Applied Developmental Psychology, 30*(2), 129-139.

Falkner, N. H., Neumark-Sztainer, D., Story, M., Jeffery, R. W., Beuhring, T., & Resnick, M. D. (2001). Social, educational, and psychological correlates of weight status in adolescents. *Obesity Research, 9*(1), 32-42.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175-191.

Field, A. (2005). *Discovering statistics using SPSS: (and sex, drugs and rock 'n 'roll)*. London: Sage.

Firouzbakhsh, S., Mathis, R. K., Dorchester, W. L., Oseas, R. S., Groncy, P. K., Grant, K. E., et al. (1993). Measured resting energy expenditure in children. *Journal of Pediatric Gastroenterology and Nutrition, 16*(2), 136-142.

Fisher, J. O., Johnson, R. K., Lindquist, C., Birch, L. L., & Goran, M. I. (2000). Influence of body composition on the accuracy of reported energy intake in children. *Obesity Research, 8*(8), 597-603.

Fitch, A., & Bock, J. (2009). Effective dietary therapies for pediatric obesity treatment. *Reviews in Endocrine & Metabolic Disorders, 10*(3), 231-236.

Food Safety Authority, the Directorate for Health, & the Department of Nutrition at the University of Oslo. (2006). Norwegian Food Composition Table. Retrieved 28.04.11, 2011, from www.http://matportalen.no/matvaretabellenNorwegian

Ford, A. L., Hunt, L. P., Cooper, A., & Shield, J. P. (2010). What reduction in BMI SDS is required in obese adolescents to improve body composition and cardiometabolic health? *Archives of Disease in Childhood, 95*(4), 256-261.

Francis, L. A., & Susman, E. J. (2009). Self-regulation and Rapid Weight Gain in Children From Age 3 to 12 Years. [Article]. *Archives of Pediatrics and Adolescent Medicine, 163*(4), 297-302.

French, S. A., Story, M., & Perry, C. L. (1995). Self-esteem and obesity in children and adolescents - a literature review. *Obesity Research, 3*(5), 479-490.

Funderburk, J. A., McCormick, B. P., & Austin, J. K. (2007). Does attitude toward epilepsy mediate the relationship between perceived stigma in children and mental health outcomes with epilepsy? *Epilepsy & Behavior, 11*(1), 71-76.

Gable, S., & Lutz, S. (2000). Household, parent, and child contributions to childhood obesity. *Family Relations, 49*(3), 293-300.

Gable, S., & Lutz, S. (2001). Nutrition socialization experiences of children in the Head Start program. [Article]. *Journal of the American Dietetic Association, 101*(5), 572-577.

Gandhi, P. (2010). Optimal measurement model is crucial to identify distinct constructs. *Quality of Life Research, 19*(5), 617-618.

Ganley, R. M. (1989). Emotion and eating in obesity - a review of the literature. *International Journal of Eating Disorders, 8*(3), 343-361.

Gehling, R. K., Magarey, A. M., & Daniels, L. A. (2005). Food-based recommendations to reduce fat intake: An evidence-based approach to the development of a family-focused child weight management programme. [Article]. *Journal of Paediatrics and Child Health, 41*(3), 112-118.

Gershon, T. D., Tschann, J. M., & Jemerin, J. M. (1999). Stigmatization, self-esteem, and coping among the adolescent children of lesbian mothers. *Journal of Adolescent Health, 24*(6), 437-445.

Giles-Corti, B., & Donovan, R. J. (2002). The relative influence of individual, social and physical environment determinants of physical activity. *Social Science and Medicine, 54*(12), 1793-1812.

Golan, M. (2006). Parents as agents of change in childhood obesity - from research to practice. *International Journal of Pediatric Obesity, 1*(2), 66-76.

Golan, M., & Crow, S. (2004). Targeting parents exclusively in the treatment of childhood obesity: Long-term results. *Obesity Research, 12*(2), 357-361.

Golan, M., Kaufman, V., & Shahar, D. R. (2006). Childhood obesity treatment: targeting parents exclusively v. parents and children. *British Journal of Nutrition, 95*(5), 1008-1015.

Golan, M., & Weizman, A. (2001). Familial approach to the treatment of childhood obesity: Conceptual model. *Journal of Nutrition Education, 33*(2), 102-107.

Goldschmidt, A. B., Aspen, V. P., Sinton, M. M., Tanofsky-Kraff, M., & Wilfley, D. E. (2008). Disordered eating attitudes and behaviors in overweight youth. *Obesity, 16*(2), 257-264.

Goldstein, D. J. (1992). Beneficial health-effects of modest weight-loss *International Journal of Obesity, 16*(6), 397-415.

Golley, R. K., Hendrie, G. A., Slater, A., & Corsini, N. (2011). Interventions that involve parents to

improve children's weight-related nutrition intake and activity patterns - what nutrition and activity targets and behaviour change techniques are associated with intervention effectiveness? [Article]. *Obesity Reviews, 12*(2), 114-130.

Golley, R. K., Magarey, A. M., Baur, L. A., Steinbeck, K. S., & Daniels, L. A. (2007). Twelve-month effectiveness of a parent-led, family-focused weight-management program for prepubertal children: A randomized, controlled trial. *Pediatrics, 119*(3), 517-525.

Goossens, L., Braet, C., Van Vlierberghe, L., & Mels, S. (2009). Weight parameters and pathological eating as predictors of obesity treatment outcome in children and adolescents. *Eating Behaviors, 10*(1), 71-73.

Graziano, P. A., Calkins, S. D., & Keane, S. P. (2010). Toddler self-regulation skills predict risk for pediatric obesity. [Article]. *International Journal of Obesity, 34*(4), 633-641.

Griffiths, L. J., & Page, A. S. (2008). The Impact of Weight-related Victimization on Peer Relationships: The Female Adolescent Perspective. [Article]. *Obesity, 16*, S39-S45.

Griffiths, L. J., Parsons, T. J., & Hill, A. J. (2010). Self-esteem and quality of life in obese children and adolescents: A systematic review. *International Journal of Pediatric Obesity, 5*(4), 282-304.

Grimm, K. J., & Ram, N. (2009). Nonlinear Growth Models in Mplus and SAS. *Structural Equation Modeling-a Multidisciplinary Journal, 16*(4), 676-701.

Haines, J., Neumark-Sztainer, D., Eisenberg, M. E., & Hannan, P. J. (2006). Weight teasing and disordered eating behaviors in adolescents: Longitudinal findings from Project EAT (Eating Among Teens). [Article]. *Pediatrics, 117*(2), E209-E215.

Harrison, J. A., Mullen, P. D., & Green, L. W. (1992). A metaanalysis of studies of the health belief model with adults. [Article]. *Health Education Research, 7*(1), 107-116.

Helba, M., & Binkovitz, L. A. (2009). Pediatric body composition analysis with dual-energy X-ray absorptiometry. [Review]. *Pediatric Radiology, 39*(7), 647-656.

Helsedirektoratet. (2008). *Fysisk aktivitet blant barn og unge i Norge. En kartlegging av aktivitetsnivå og fysisk form hos 9- og 15 åringer*. Oslo: Helsedirektoratet.

Helsedirektoratet. (2011). *Forebygging, utredning og behandling av overvekt og fedme hos barn og unge. Nasjonale faglige retningslinjer for primærhelsetjenesten*. Oslo: Helsedirektoratet.

Helseth, S., & Jozefiak, T. (2004). The Norwegian version of the KINDL-R.

Herman, C. P., & Mack, D. (1975). Restrained and unrestrained eating. *Journal of Personality, 43*(4), 647-660.

Herman, C. P., & Polivy, J. (1980). Restrained eating. In A. J. Stunkard (Ed.), *Obesity* (pp. 208-225). Philadelphia: Saunders.

Heshka, S., Anderson, J. W., Atkinson, R. L., Greenway, F. L., Hill, J. O., Phinney, S. D., et al. (2003). Weight loss with self-help compared with a structured commercial program - A randomized trial. [Article]. *Jama-Journal of the American Medical Association, 289*(14), 1792-1798.

Heyerdahl, S., Kvernmo, S., & Wichstrom, L. (2004). Self-reported behavioural/emotional problems in Norwegian adolescents from multiethnic areas. *European Child and Adolescent Psychiatry, 13*(2), 64-72.

Higgins, E. T. (1987). Self-discrepancy - a theory relating self and affect. *Psychological Review, 94*(3), 319-340.

Higgins, J. A., LaSalle, A. L., Zhaoxing, P., Kasten, M. Y., Bing, K. N., Ridzon, S. E., et al. (2009). Validation of photographic food records in children: are pictures really worth a thousand words? *European Journal of Clinical Nutrition, 63*(8), 1025-1033.

Hogan, B. E., Linden, W., & Najarian, B. (2002). Social support - Do they interventions work? [Review]. *Clinical Psychology Review, 22*(3), 381-440.

Hollis, S., & Campbell, F. (1999). What is meant by intention to treat analysis? Survey of published randomised controlled trials. *British Medical Journal, 319*(7211), 670-+.

Holmback, U., Fridman, J., Gustafsson, J., Proos, L., Sundelin, C., & Forslund, A. (2007). Overweight more prevalent among children than among adolescents. *Acta Paediatrica, 96*(4), 577-581.

Holt, C. L., Clark, E. M., & Kreuter, M. W. (2001). Weight locus of control and weight-related attitudes and behaviors in an overweight population. *Addictive Behaviors, 26*(3), 329-340.

Hughes, A. (2008). Randomized, controlled trial of a best-practice individualized behavioral program for treatment of childhood overweight: Scottish childhood overweight treatment trial (SCOTT). *Pediatrics, 121*(3), e539-E546.

Hughes, A. R., Farewell, K., Harris, D., & Reilly, J. J. (2007). Quality of life in a clinical sample of obese children. *International Journal of Obesity, 31*(1), 39-44.

Hughes, A. R., Stewart, L., Chapple, J., McColl, J. H., Donaldson, M. D. C., Kelnar, C. J. H., et al. (2008). Randomized, controlled trial of a best-practice individualized behavioral program for treatment of childhood overweight: Scottish childhood overweight treatment trial (SCOTT). *Pediatrics, 121*(3), E539-E546.

Huitema, B. E. (1980). *The analysis of covariance and alternatives*. New York: Wiley.

Høgsbro, K. (1992). *Sociale problemer og selvorganisert selvhjelp i Danmark*. Samfundslitteratur: Fredriksberg.

International Labour Office. (1990). *ISCO-88 International Standard Classification of Occupation*: Genève: International Labour Office.

IOTF. (2011). International Obesity Task Force. from http://www.iaso.org/iotf/

Janicke, D. (2007). Impact of psychosocial factors on quality of life in overweight youth. *Obesity, 15*(7), 1799-1807.

Jansen, W., van de Looij-Jansen, P. M. V., de Wilde, E. J., & Brug, J. (2008). Feeling fat rather than being fat may be associated with psychological well-being in young Dutch adolescents. *Journal of Adolescent Health, 42*(2), 128-136.

Janssen, I. (2005). Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. *Obesity reviews, 6*(2), 123-132.

Janssen, I., Craig, W. M., Boyce, W. F., & Pickett, W. (2004). Associations between overweight and obesity with bullying behaviors in school-aged children. *Pediatrics, 113*(5), 1187-1194.

Janssens, L., Gorter, J. W., Ketelaar, M., Kramer, W. L. M., & Holtslag, H. R. (2008). Health-related quality-of-life measures for long-term follow-up in children after major trauma. [Review]. *Quality of Life Research, 17*(5), 701-713.

Janz, N. K., & Becker, M. H. (1984). The health belief model - a decade later. *Health Education Quarterly, 11*(1), 1-47.

Jimenez-Pavon, D., Kelly, J., & Reilly, J. J. (2010). Associations between objectively measured habitual physical activity and adiposity in children and adolescents: Systematic review. *International Journal of Pediatric Obesity, 5*(1), 3-18.

Johnston, C. A., Tyler, C., McFarlin, B. K., Poston, W. S. C., Haddock, K., Reeves, R., et al. (2007). Weight loss in overweight Mexican American children: A randomized, controlled trial. *Pediatrics, 120*(6), E1450-E1457.

Jozefiak, T. (2009). *Quality of life and mental health: Child and parent perspectives. Doctoral disertation.*, Norwegian University of Science and Technology, Trondheim.

Jozefiak, T., Larsson, B., Wichstrom, L., Mattejat, F., & Ravens-Sieberer, U. (2008). Quality of Life as reported by school children and their parents: a cross-sectional survey. *Health and Quality of Life Outcomes, 6*(34).

Jozefiak, T., Larsson, B., Wichstrom, L., Wallander, J., & Mattejat, F. (2010). Quality of Life as reported by children and parents: a comparison between students and child psychiatric outpatients. *Health and Quality of Life Outcomes, 8*.

Juliusson, P. B., Eide, G. E., Roelants, M., Waaler, P. E., Hauspie, R., & Bjerknes, R. (2010). Overweight and obesity in Norwegian children: prevalence and socio-demographic risk factors. *Acta Paediatrica, 99*(6), 900-905.

Juliusson, P. B., Roelants, M., Eide, G. E., Hauspie, R., Waaler, P. E., & Bjerknes, R. (2007). Overweight and obesity in Norwegian children: Secular trends in weight-for-height and skinfolds. *Acta Paediatrica, 96*(9), 1333-1337.

Kalavainen, M., Korppi, M., & Nuutinen, O. (2011). Long-term efficacy of group-based treatment for childhood obesity compared with routinely given individual counselling. *International Journal*

of Obesity, 35(4), 530-533.

Kalavainen, M. P., Korppi, M. O., & Nuutinen, O. M. (2007). Clinical efficacy of group-based treatment for childhood obesity compared with routinely given individual counseling. *International Journal of Obesity, 31*(10), 1500-1508.

Kaplan, H. I., & Kaplan, H. S. (1957). The psychosomatic concept of obesity. *Journal of Nervous and Mental Disease, 125*(2), 181-201.

Katz, D. L. (2011). Unfattening our children: forks over feet. *International Journal of Obesity, 35*(1), 33-37.

Kavey, R. E. (2010). Treatment for obese children: a ray of hope? *Journal of Pediatrics, 157*(3), 357-359.

Kazak, A. E. (1989). Families of chronically ill children - a systems and social ecological model of adaptation and challenge. *Journal of Consulting and Clinical Psychology, 57*(1), 25-30.

Keenan, K. (2000). Emotion dysregulation as a risk factor for child psychopathology. [Review]. *Clinical Psychology-Science and Practice, 7*(4), 418-434.

Kelly, P. J., Webster, A. C., & Craig, J. C. (2010). How many patients do we need for a clinical trial? Demystifying sample size calculations. [Article]. *Nephrology, 15*(8), 725-731.

Kidd, S. A. (2007). Youth homelessness and social stigma. *Journal of Youth and Adolescence, 36*(3), 291-299.

Kimm, S. Y. S., Glynn, N. W., Kriska, A. M., Barton, B. A., Kronsberg, S. S., Daniels, S. R., et al. (2002). Decline in physical activity in black girls and white girls during adolescence. *New England Journal of Medicine, 347*(10), 709-715.

Kirk, S., Zeller, M., Claytor, R., Santangelo, M., Khoury, P. R., & Daniels, S. R. (2005). The relationship of health outcomes to improvement in BMI in children and adolescents. *Obesity Research, 13*(5), 876-882.

Kitzmann, K. A., Dalton, W. T., Stanley, C. M., Beech, B. M., Reeves, T. P., Buscemi, J., et al. (2010). Lifestyle Interventions for Youth Who Are Overweight: A Meta-Analytic Review. *Health Psychology, 29*(1), 91-101.

Kitzmann, K. M., & Beech, B. M. (2006). Family-based interventions for pediatric obesity: Methodological and conceptual challenges from family psychology. *Journal of Family Psychology, 20*(2), 175-189.

Klesges, R. C., Hanson, C. L., Eck, L. H., & Durff, A. C. (1988). Accuracy of self-reports of food-intake in obese and normal-weights individuals - effects of parental obesity in reports of children's dietary intake *American Journal of Clinical Nutrition, 48*(5), 1252-1256.

Koot, H. (2001). The study of quality of life: concepts and methods. In H. Koot & J. L. Wallander (Eds.), *Quality of life in child and adolescent illness*. New York: Brunner-Routledge.

Koot, H., & Wallander, J. L. (Eds.). (2001). *Quality of life in child and adolescent illness - concepts, methods and findings* (1 ed.): Brunner-Routledge.

Krebs, N. F., Himes, J. H., Jacobson, D., Nicklas, T. A., Guilday, P., & Styne, D. (2007). Assessment of child and adolescent overweight and obesity. *Pediatrics, 120*, S193-S228.

Kremers, S. P. J. (2010). Theory and practice in the study of influences on energy balance-related behaviors. [Review]. *Patient Education and Counseling, 79*(3), 291-298.

Kremers, S. P. J., De Bruijn, G. J., Schaalma, H., & Brug, J. (2004). Clustering of energy balance-related behaviours and their intrapersonal determinants. [Article]. *Psychology & Health, 19*(5), 595-606.

Kristensen, P. L., Korsholm, L., Moller, N. C., Wedderkopp, N., Andersen, L. B., & Froberg, K. (2008). Sources of variation in habitual physical activity of children and adolescents: the European youth heart study. [Article]. *Scandinavian Journal of Medicine and Science in Sports, 18*(3), 298-308.

Larsson, B., Fossum, S., Clifford, G., Drugli, M. B., Handegard, B. H., & Morch, W. T. (2009). Treatment of oppositional defiant and conduct problems in young Norwegian children Results of a randomized controlled trial. *European Child and Adolescent Psychiatry, 18*(1), 42-52.

Latner, J. D., Stunkard, A. J., & Wilson, G. T. (2005). Stigmatized students: Age, sex, and ethnicity

effects in the stigmatization of obesity. *Obesity Research, 13*(7), 1226-1231.

Latner, J. D., Stunkard, A. J., Wilson, G. T., & Jackson, M. L. (2006). The perceived effectiveness of continuing care and group support in the long-term self-help treatment of obesity. *Obesity, 14*(3), 464-471.

Latner, J. D., Wilson, G. T., Stunkard, A. J., & Jackson, M. L. (2002). Self-help and long-term behavior therapy for obesity. *Behaviour Research and Therapy, 40*(7), 805-812.

Lazaar, N., Aucouturier, J., Ratel, S., Rance, M., Meyer, M., & Duche, P. (2007). Effect of physical activity intervention on body composition in young children: influence of body mass index status and gender. *Acta Paediatrica, 96*(9), 1315-1320.

Libbey, H. P., Story, M. T., Neumark-Sztainer, D. R., & Boutelle, K. N. (2008). Teasing, Disordered Eating Behaviors, and Psychological Morbidities Among Overweight Adolescents. [Article]. *Obesity, 16*, S24-S29.

Lillegaard, I. T. L., Overby, N. C., & Andersen, L. F. (2005). Can children and adolescents use photographs of food to estimate portion sizes? *European Journal of Clinical Nutrition, 59*(4), 611-617.

Linneman, C., Hessler, K., Nanney, S., Steger-May, K., Huynh, A., & Haire-Joshu, D. (2004). Parents are accurate reporters of their preschoolers' fruit and vegetable consumption under limited conditions. *Journal of Nutrition Education and Behavior, 36*(6), 305-308.

Lioret, S., Touvier, M., Balin, M., Huybrechts, I., Dubuisson, C., Dufour, A., et al. (2011). Characteristics of energy under-reporting in children and adolescents. [Article]. *British Journal of Nutrition, 105*(11), 1671-1680.

Livingstone, M. B. E., Robson, P. J., & Wallace, J. M. W. (2004). Issues in dietary intake assessment of children and adolescents. [Proceedings Paper]. *British Journal of Nutrition, 92*, S213-S222.

Lloyd, L. J., Langley-Evans, S. C., & McMullen, S. (2010). Childhood obesity and adult cardiovascular disease risk: a systematic review. [Review]. *International Journal of Obesity, 34*(1), 18-28.

Loos, R. J. F., & Rankinein, T. (2005). Gene-diet interactions on body weight changes. *Journal of the American Dietetic Association, 105*(5), S29-S34.

Lowry, K. (2007). The effects of weight management programs on self-esteem in pediatric overweight populations. *Journal of Pediatric Psychology, 32*(10), 1179-1195.

Lubans, D. R., Foster, C., & Biddle, S. J. H. (2008). A review of mediators of behavior in interventions to promote physical activity among children and adolescents. [Review]. *Preventive Medicine, 47*(5), 463-470.

Lunner, K., Wertheim, E. H., Thompson, J. K., Paxton, S. J., McDonald, F., & Halvaarson, K. S. (2000). A cross-cultural examination of weight-related teasing, body image, and eating disturbance in Swedish and Australian samples. *International Journal of Eating Disorders, 28*(4), 430-435.

Luttikhuis, H. O., Baur, L., Jansen, H., Shrewsbury, V. A., O'Malley, C., Stolk, R. P., et al. (2009). Interventions for treating obesity in children. *Cochrane Database of Systematic Reviews*(1).

Lysaker, P. H., Roe, D., & Yanos, P. T. (2007). Toward understanding the insight paradox: Internalized stigma moderates the association between insight and social functioning, hope, and self-esteem among people with schizophrenia spectrum disorders. *Schizophrenia Bulletin, 33*(1), 192-199.

Madsen, K. A., Garber, A. K., Mietus-Snyder, M. L., Orrell-Valente, J. K., Tran, C. T., Wlasiuk, L., et al. (2009). A Clinic-Based Lifestyle Intervention for Pediatric Obesity: Efficacy and Behavioral and Biochemical Predictors of Response. [Article]. *Journal of Pediatric Endocrinology and Metabolism, 22*(9), 805-814.

Maffeis, C. (2000). Aetiology of overweight and obesity in children and adolescents. [Proceedings Paper]. *European Journal of Pediatrics, 159*, S35-S44.

Maffeis, C. (2008). Physical activity in the prevention and treatment of childhood obesity: Physio-pathologic evidence and promising experiences. [Review]. *International Journal of Pediatric Obesity, 3*, 29-32.

Maffeis, C., & Castellani, M. (2007). Physical activity: An effective way to control weight in children? [Review]. *Nutrition Metabolism and Cardiovascular Diseases, 17*(5), 394-408.

Magarey, A. M., Perry, R. A., Baur, L. A., Steinbeck, K. S., Sawyer, M., Hills, A. P., et al. (2011). A Parent-Led Family-Focused Treatment Program for Overweight Children Aged 5 to 9 Years: The PEACH RCT. [Article]. *Pediatrics, 127*(2), 214-222.

Marild, S., Dahlgren, J., & Hochberg, Z. (2009). Obesity in children and adolescents: pre-treatment predictors of response to interventional life-style studies. A systematic review. *Obesity and Metabolism-Milan, 5*(2), 54-59.

Martos-Moreno, G. A., Barrios, V., Martinez, G., Hawkins, F., & Argente, J. (2010). Effect of Weight Loss on High-Molecular Weight Adiponectin in Obese Children. *Obesity, 18*(12), 2288-2294.

Mattocks, C., Ness, A. R., Leary, S. D., Tilling, K., Blair, S. N., Shield, J., et al. (2008). Use of accelerometers in a large field-based study of children: protocols, design issues, and effects on precision. *Journal of Physical Activity Health, 5*(1), 98-111.

McCarthy, H. D., Cole, T. J., Fry, T., Jebb, S. A., & Prentice, A. M. (2006). Body fat reference curves for children. *International Journal of Obesity, 30*(4), 598-602.

McElroy, S. L., Kotwal, R., Malhotra, S., Nelson, E. B., Keck, P. E., & Nemeroff, C. B. (2004). Are mood disorders and obesity related? A review for the mental health professional. *Journal of Clinical Psychiatry, 65*(5), 634-651.

McGovern, L., Johnson, J. N., Paulo, R., Hettinger, A., Singhal, V., Kamath, C., et al. (2008). Treatment of Pediatric Obesity: A Systematic Review and Meta-Analysis of Randomized Trials. [Review]. *Journal of Clinical Endocrinology and Metabolism, 93*(12), 4600-4605.

McLean, N., Griffin, S., Toney, K., & Hardeman, W. (2003). Family involvement in weight control, weight maintenance and weight-loss interventions: a systematic review of randomised trials. *International Journal of Obesity, 27*(9), 987-1005.

Moens, E., Braet, C., & Van Winckel, M. (2010). An 8-year follow-up of treated obese children: Children's, process and parental predictors of successful outcome. *Behaviour Research and Therapy, 48*(7), 626-633.

MRC Epidemiology Unit. (2010). http://www.mrcepid.cam.ac.uk/Research/PA/Downloads. 2010, from http://www.mrcepid.cam.ac.uk/Research/PA/Downloads

Muthèn, B. (2002). Beyond SEM: general latent variable modeling. *Behaviormetrika, 29*(1), 81-117.

Muthèn, B. (2010). Bayesian Analysis in Mplus: A Brief Introduction. Incomplete draft. Version 3. Retrieved 27.04.11, 2011, from http://www.statmodel.com/download/IntroBayesVersion%203.pdf

Muthen, B., & Asparouhov, T. (2010a). Bayesian analysis of latent variable models using Mplus. Retrieved 27.06.11, 2011, from www.statmodel.com/papers.shtml

Muthen, B., & Asparouhov, T. (2010b). Bayesian SEM: A more flexible representation of substantive theory. Submitted for publication. Retrieved from https://www.statmodel.com/download/BSEMv4.pdf

Muthen, B., & Muthen, L. K. (2010). Introductory and intermediate growth modeling.   Retrieved 14.04.11, 2011, from http://www.statmodel.com/download/Topic3-v.pdf

Muthèn, L. K., & Muthèn, B. O. (1998-2010). *Mplus User`s guide. Sixth Edition*. Los Angeles: Muthen & Muthen.

National Institute for Health and Clinical Excellence. (2006). *Obesity: The prevention, assessment and managment of overweight and obesity in adults and children*.

National Institutes of Health, N. H., Lung, and Blood,. (2000). *The Practical Guide: Identification, Evaluation, and treatment of Overweight and Obesity in Adults*. Washington, DC: National Heart, Lung, and Blood Institute

Ness-Abramof, R., & Apovian, C. M. (2006). Diet modification for treatment and prevention of obesity. *Endocrine, 29*(1), 5-9.

Ness, A. R., Leary, S. D., Mattocks, C., Blair, S. N., Reilly, J. J., Wells, J., et al. (2007). Objectively measured physical activity and fat mass in a large cohort of children. *Plos Medicine, 4*(3), 476-484.

Neumark-Sztainer, D., Bauer, K. W., Friend, S., Hannan, P. J., Story, M., & Berge, J. M. (2010). Family Weight Talk and Dieting: How Much Do They Matter for Body Dissatisfaction and Disordered Eating Behaviors in Adolescent Girls? [Article]. *Journal of Adolescent Health, 47*(3), 270-276.

Neumark-Sztainer, D., Falkner, N., Story, M., Perry, C., Hannan, P. J., & Mulert, S. (2002). Weight-teasing among adolescents: correlations with weight status and disordered eating behaviors. *International Journal of Obesity, 26*(1), 123-131.

Noar, S. M., Chabot, M., & Zimmerman, R. S. (2008). Applying health behavior theory to multiple behavior change: Considerations and approaches. *Preventive Medicine, 46*(3), 275-280.

Norwegian Directory of Health. (2005). Norwegian recommendations for nutrition and physical activity.   Retrieved 23.04.11, 2011, from http://www.helsedirektoratet.no/vp/multimedia/archive/00002/IS-1219_2606a.pdf

Norwegian Directory of Health. (2010). *IS-1734 Nasjonale retningslinjer for primærhelsetjenesten - Forebygging, utredning og behandling av overvekt og fedme hos barn og unge*. Oslo: Norwegian Directory of Health.

Nova, A., Russo, A., & Sala, E. (2001). Long-term managment of obesity in paediatric office practice: experimental evaluation of two different types of intervention. *. Ambulatory Child Health, 7*(3/4), 239-248.

Nowicka, P., & Flodmark, C. E. (2006). *Barnövervikt i praktiken: evidensbaserad familjeviktskola*. [Lund]: Studentlitteratur.

Nøvik, T. S. (1999). Validity of the Child Behaviour Checklist in a Norwegian sample. *European Child and Adolescent Psychiatry, 8*(4), 247-254.

Nøvik, T. S. (2000). Child Behavior Checklist item scores in Norwegian children. *European Child and Adolescent Psychiatry, 9*(1), 54-60.

Ogden, C. L., Yanovski, S. Z., Carroll, M. D., & Flegal, K. M. (2007). The epidemiology of obesity. [Review]. *Gastroenterology, 132*(6), 2087-2102.

Okorodudu, D. O., Jumean, M. F., Montori, V. M., Romero-Corral, A., Somers, V. K., Erwin, P. J., et al. (2010). Diagnostic performance of body mass index to identify obesity as defined by body adiposity: a systematic review and meta-analysis. *International Journal of Obesity, 34*(5), 791-799.

Overby, N. C., Lillegaard, I. T. L., Johansson, L., & Andersen, L. F. (2004). High intake of added sugar among Norwegian children and adolescents. *Public Health Nutrition, 7*(2), 285-293.

Palmeira, A. L., Teixeira, P. J., Branco, T. L., Martins, S. S., Minderico, C. S., Barata, J. T., et al. (2007). Predicting short-term weight loss using four leading health behavior change theories. *International Journal of Behavioral Nutrition and Physical Activity, 4*.

Pauli-Pott, U., Albayrak, O., Hebebrand, J., & Pott, W. (2010). Association between Inhibitory Control Capacity and Body Weight in Overweight and Obese Children and Adolescents: Dependence on Age and Inhibitory Control Component. [Article]. *Child Neuropsychology, 16*(6), 592-603.

Pesa, J. A., Syre, T. R., & Jones, E. (2000). Psychosocial differences associated with body weight among female adolescents: The importance of body image. *Journal of Adolescent Health, 26*(5), 330-337.

Peterson, C. B., Mitchell, J. E., Crow, S. J., Crosby, R. D., & Wonderlich, S. A. (2009). The Efficacy of Self-Help Group Treatment and Therapist-Led Group Treatment for Binge Eating Disorder. [Proceedings Paper]. *American Journal of Psychiatry, 166*(12), 1347-1354.

Peterson, C. B., Mitchell, J. E., Engbloom, S., Nugent, S., Mussell, M. P., Crow, S. J., et al. (2001). Self-help versus therapist-led group cognitive-behavioral treatment of binge eating disorder at follow-up. *International Journal of Eating Disorders, 30*(4), 363-374.

Petsios, K., Priftis, K. N., Tsoumakas, C., Hatziagorou, E., Tsanakas, J. N., Galanis, P., et al. (2011). Level of Parent--Asthmatic Child Agreement on Health-Related Quality of Life. [Article]. *Journal of Asthma, 48*(3), 286-297.

Pierce, J. W., & Wardle, J. (1997). Cause and effect beliefs and self-esteem of overweight children. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 38*(6), 645-650.

Pietrobelli, A., Boner, A. L., & Tato, L. (2005). Adipose tissue and metabolic effects: new insight into measurements. *International Journal of Obesity, 29*, S97-S100.

Pietrobelli, A., Faith, M. S., Allison, D. B., Gallagher, D., Chiumello, G., & Heymsfield, S. B. (1998). Body mass index as a measure of adiposity among children and adolescents: A validation study. [Article]. *Journal of Pediatrics, 132*(2), 204-210.

Pine, C. J. (1985). Anxiety and eating behavior in obese and nonobese American Indians and white Americans. [Comparative Study]. *Journal of Personality and Social Psychology, 49*(3), 774-780.

Pinhas-Hamiel, O., Singer, S., Pilpel, N., Fradkin, A., Modan, D., & Reichman, B. (2006). Health-related quality of life among children and adolescents: associations with obesity. *International Journal of Obesity, 30*(2), 267-272.

Plasqui, G., & Westerterp, K. R. (2007). Physical activity assessment with accelerometers: An evaluation against doubly labeled water. *Obesity, 15*(10), 2371-2379.

Pollak, K. I., Alexander, S. C., Ostbye, T., Lyna, P., Tulsky, J. A., Dolor, R. J., et al. (2009). Primary Care Physicians' Discussions of Weight-Related Topics with Overweight and Obese Adolescents: Results from the Teen CHAT Pilot Study. *Journal of Adolescent Health, 45*(2), 205-207.

Poon, W. Y., & Wang, H. B. (2010). Analysis of a Two-Level Structural Equation Model With Missing Data. [Article]. *Sociological Methods & Research, 39*(1), 25-55.

Poskitt, E. M. E. (2000). Body mass index and child obesity: are we nearing a definition? *Acta Paediatrica, 89*(5), 507-509.

Pott, W., Frohlich, G., Albayrak, O., Hebebrand, J., & Pauli-Pott, U. (2010). Conditions for success in a lifestyle intervention weight-reduction programme for overweight or obese children and adolescents. *Zeitschrift Fur Kinder-Und Jugendpsychiatrie Und Psychotherapie, 38*(5), 351-360.

Pryer, J. A., Vrijheid, M., Nichols, R., Kiggins, M., & Elliott, P. (1997). Who are the 'low energy reporters' in the dietary and nutritional survey of British adults? *International Journal of Epidemiology, 26*(1), 146-154.

Puhl, R. M., & Latner, J. D. (2007). Stigma, obesity, and the health of the nation's children. *Psychological Bulletin, 133*(4), 557-580.

Ravens-Sieberer, U. (2001). The revised KINDL-R: Final results on reliability, validity and responsiveness of a modular HRQOL instrument for children and adolescents. 8. Jahrestagung der International Society for Quality of life Research (ISOQOL). *Quality of Life Research, 10*(3), 199.

Raykov, T., & Marcoulides, G. A. (2006). *A first course in structural equation modeling* (2nd ed.). New Jersey: Lawrence Erlbaum Associates, Inc..

Reichert, F. F., Menezes, A. M. B., Wells, J. C. K., Dumith, S. C., & Hallal, P. C. (2009). Physical Activity as a Predictor of Adolescent Body Fatness A Systematic Review. *Sports Medicine, 39*(4), 279-294.

Reilly, J. J. (2002). Assessment of childhood obesity: National reference data or international approach? *Obesity Research, 10*(8), 838-840.

Reilly, J. J. (2005). Descriptive epidemiology and health consequences of childhood obesity. *Best Practice & Research Clinical Endocrinology & Metabolism, 19*(3), 327-341.

Reilly, J. J. (2010). Assessment of obesity in children and adolescents: synthesis of recent systematic reviews and clinical guidelines. *Journal of Human Nutrition and Dietetics, 23*(3), 205-211.

Reilly, J. J., & Dorosty, A. R. (1999). Epidemic of obesity in UK children. *Lancet, 354*(9193), 1874-1875.

Reilly, J. J., Dorosty, A. R., Emmett, P. M., & Alspac Study Team. (2000). Identification of the obese child: adequacy of the body mass index for clinical practice and epidemiology. *International Journal of Obesity, 24*(12), 1623-1627.

Reilly, J. J., & McDowell, Z. C. (2003). Physical activity interventions in the prevention and treatment of paediatric obesity: systematic review and critical appraisal. *Proceedings of the Nutrition Society, 62*(3), 611-619.

Reilly, J. J., Methven, E., McDowell, Z. C., Hacking, B., Alexander, D., Stewart, L., et al. (2003). Health consequences of obesity. *Archives of Disease in Childhood, 88*(9), 748-752.

Reilly, J. J., Penpraze, V., Hislop, J., Davies, G., Grant, S., & Paton, J. Y. (2008). Objective measurement of physical activity and sedentary behavior: review with new data. *Arch Dis Child, 93*, 614-619.

Reinehr, T. (2011). Child-centred physical activity programme and parent-centred dietary programme alone or combined lead to sustainable reductions in BMI in 5-10-year-olds: diet alone or diet plus activity programmes seemed most effective. *Evid Based Nurs, 14*(1), 12-13.

Reinehr, T., Kleber, M., Lass, N., & Toschke, A. M. (2010). Body mass index patterns over 5 y in obese children motivated to participate in a 1-y lifestyle intervention: age as a predictor of long-term success. *American Journal of Clinical Nutrition, 91*(5), 1165-1171.

Reinehr, T., Kleber, M., & Toschke, A. M. (2009). Lifestyle intervention in obese children is associated with a decrease of the metabolic syndrome prevalence. *Atherosclerosis, 207*(1), 174-180.

Reinehr, T., Schaefer, A., Winkel, K., Finne, E., Toschke, A. M., & Kolip, P. (2010). An effective lifestyle intervention in overweight children: Findings from a randomized controlled trial on "Obeldicks light". *Clinical Nutrition, 29*(3), 331-336.

Rhee, K. E., Lumeng, J. C., Appugliese, D. P., Kaciroti, N., & Bradley, R. H. (2006). Parenting styles and overweight status in first grade. *Pediatrics, 117*(6), 2047-2054.

Riazi, A., Shakoor, S., Dundas, I., Eiser, C., & McKenzie, S. A. (2010). Health-related quality of life in a clinical sample of obese children and adolescents. [Article]. *Health and Quality of Life Outcomes, 8*.

Ricciardelli, L. A., & McCabe, M. P. (2001). Children's body image concerns and eating disturbance: A review of the literature. [Article]. *Clinical Psychology Review, 21*(3), 325-344.

Riddoch, C. J., Andersen, L. B., Wedderkopp, N., Harro, M., Klasson-Heggebo, L., Sardinha, L. B., et al. (2004). Physical activity levels and patterns of 9-and 15-yr-old European children. *Medicine and Science in Sports and Exercise, 36*(1), 86-92.

Riddoch, C. J., Leary, S. D., Ness, A. R., Blair, S. N., Deere, K., Mattocks, C., et al. (2009). Prospective associations between objective measures of physical activity and fat mass in 12-14 year old children: the Avon Longitudinal Study of Parents and Children (ALSPAC). *British Medical Journal, 339*.

Riddoch, C. J., Mattocks, C., Deere, K., Saunders, J., Kirkby, J., Tilling, K., et al. (2007). Objective measurement of levels and patterns of physical activity. *Archives of Disease in Childhood, 92*(11), 963-969.

Robinson, T. N. (2001). Television viewing and childhood obesity. *Pediatric Clinics of North America, 48*(4), 1017-+.

Rodriguez, G., & Moreno, L. A. (2006). Is dietary intake able to explain differences in body fatness in children and adolescents? [Review]. *Nutrition Metabolism and Cardiovascular Diseases, 16*(4), 294-301.

Rodriguez, G., Moreno, L. A., Sarria, A., Fleta, J., & Bueno, M. (2002). Resting energy expenditure in children and adolescents: agreement between calorimetry and prediction equations. *Clinical Nutrition, 21*(3), 255-260.

Rollnick, S., Miller, W. R., & Butler, C. (2008). *Motivational interviewing in health care: helping patients change behavior*. New York: Guilford Press.

Rosenstock, I. M., Strecher, V. J., & Becker, M. H. (1988). Social learning theory and the health belief model. *Health Education Quarterly, 15*(2), 175-183.

Rowlands, A. V., & Eston, R. G. (2007). The measurement and interpretation of children's physical activity. [Review]. *Journal of Sports Science and Medicine, 6*(3), 270-276.

Ruderman, A. J. (1986). Dietary restraint - a theoretical and empirical review. *Psychological Bulletin, 99*(2), 247-262.

Sacher, P. M., Kolotourou, M., Chadwick, P. M., Cole, T. J., Lawson, M. S., Lucas, A., et al. (2010). Randomized Controlled Trial of the MEND Program: A Family-based Community Intervention for Childhood Obesity. *Obesity, 18*, S62-S68.

Sameroff, A. (2000). Developmental systems and psychopathology. *Development and Psychopathology, 12*(3), 297-312.

Sameroff, A. (2010). A Unified Theory of Development: A Dialectic Integration of Nature and Nurture. [Editorial Material]. *Child Development, 81*(1), 6-22.

Savage, E., Riordan, A., & Hughes, M. (2009). Quality of life in children with acute lymphoblastic leukaemia: A systematic review. [Review]. *European Journal of Oncology Nursing, 13*(1), 36-48.

Savoye, M., Shaw, M., Dziura, J., Tamborlane, W. V., Rose, P., Guandalini, C., et al. (2007). Effects of a weight management program on body composition and metabolic parameters in overweight children - A randomized controlled trial. *Jama-Journal of the American Medical Association, 297*(24), 2697-2704.

Sawyer, M. G., Whaites, L., Rey, J. M., Hazell, P. L., Graetz, B. W., & Baghurst, P. (2002). Health-related quality of life of children and adolescents with mental disorders. *Journal of the American Academy of Child and Adolescent Psychiatry, 41*(5), 530-537.

Schachter, S., Goldman, R., & Gordon, A. (1968). Effects of fear food deprivation and obesity on eating *Journal of Personality and Social Psychology, 10*(2), 91-&.

Schifter, D. E., & Ajzen, I. (1985). Intention, perceived control, and weight-loss - an application of the theory of planned behavior. *Journal of Personality and Social Psychology, 49*(3), 843-851.

Schofield, W. N. (1985). Predicting basal metabolic rate, new standards and review of previous work. *Hum Nutr Clin Nutr, 39 Suppl 1*, 5-41.

Schubert, M. T., Herle, M., & Wurst, E. (2003). A pilot study of the quality of life in children and adolescents with psychological disorders. *Zeitschrift Fur Kinder-Und Jugendpsychiatrie Und Psychotherapie, 31*(4), 285-291.

Schutz, Y., & Jèquier, E. (2004). Resting energy expenditure, thermic effect of food, and total energy expenditure In G. A. Bray & C. Bouchard (Eds.), *Handbook of obesity: etiology and pathophysiology* (pp. 615-630). New York: Marcel Dekker.

Schwimmer, J. (2003). Health-related quality of life of severely obese children and adolescents. *JAMA, 289*(14), 1813-1819.

Seo, D. C., & Sa, J. (2010). A Meta-Analysis of Obesity Interventions Among US Minority Children. *Journal of Adolescent Health, 46*(4), 309-323.

Shalitin, S., Ashkenazi-Hoffnung, L., Yackobovitch-Gavan, M., Nagelberg, N., Karni, Y., Hershkovitz, E., et al. (2009). Effects of a Twelve-Week Randomized Intervention of Exercise and/or Diet on Weight Loss and Weight Maintenance, and Other Metabolic Parameters in Obese Preadolescent Children. *Hormone Research, 72*(5), 287-301.

Shroff, H., & Thompson, J. K. (2004). Body image and eating disturbance in India: Media and interpersonal influences. *International Journal of Eating Disorders, 35*(2), 198-203.

Shypailo, R. J., Butte, N. F., & Ellis, K. J. (2008). DXA: Can it be used as a criterion reference for body fat measurements in children? *Obesity, 16*(2), 457-462.

Sichert-Hellert, W., Kersting, M., & Schoch, G. (1998). Underreporting of energy intake in 1 to 18 year old German children and adolescents. *Zeitschrift fur Ernahrungswissenschaft, 37*(3), 242-251.

Silventoinen, K., Rokholm, B., Kaprio, J., & Sorensen, T. A. (2010). The genetic and environmental influences on childhood obesity: a systematic review of twin and adoption studies. *International Journal of Obesity, 34*(1), 29-40.

Singh, A. S., Mulder, C., Twisk, J. W. R., van Mechelen, W., & Chinapaw, M. J. M. (2008). Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obesity Reviews, 9*(5), 474-488.

Sklar, C. A., Mertens, A. C., Walter, A., Mitchell, D., Nesbit, M. E., O'Leary, M., et al. (2000). Changes in body mass index and prevalence of overweight in survivors of childhood acute lymphoblastic leukemia: Role of cranial irradiation. *Medical and Pediatric Oncology, 35*(2), 91-95.

Slater, A., Bowen, J., Corsini, N., Gardner, C., Golley, R., & Noakes, M. (2010). Understanding parent concerns about children's diet, activity and weight status: an important step towards

effective obesity prevention interventions. [Article]. *Public Health Nutrition, 13*(8), 1221-1228.

Slochower, J. A. (1983). *Excessive eating: the role of emotions and environment*. New York: Human Sciences Press.

Smith, B., Grunseit, A., Hardy, L. L., King, L., Wolfenden, L., & Milat, A. (2010). Parental influences on child physical activity and screen viewing time: a population based study. [Article]. *Bmc Public Health, 10*, 11.

Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leinhardt (Ed.), *Sociological Methodology 1982* (pp. 290-312). Washington DC: American Sociological Association.

Sopher, A. B., Thornton, J. C., Wang, J., Pierson, R. N., Heymsfield, S. B., & Horlick, M. (2004). Measurement of percentage of body fat in 411 children and adolescents: A comparison of dual-energy X-ray absorptiometry with a four-compartment model. *Pediatrics, 113*(5), 1285-1290.

Sothern, M. S., von Almen, T. K., & Schumacher, H. (2001). *Trim Kids*. New York: Harper Collins Publishers.

Spear, B. A., Barlow, S. E., Ervin, C., Ludwig, D. S., Saelens, B. E., Schetzina, K. E., et al. (2007). Recommendations for treatment of child and adolescent overweight and obesity. *Pediatrics, 120*, S254-S288.

Speliotes, E. K., Willer, C. J., Berndt, S. I., Monda, K. L., Thorleifsson, G., Jackson, A. U., et al. (2010). Association analyses of 249,796 individuals reveal 18 new loci associated with body mass index. *Nature Genetics, 42*(11), 937-U953.

Spieth, L. (2001). Generic Health-Related Quality of Life Measures for Children and Adolescents. In H. Koot & J. L. Wallander (Eds.), *Quality of Life in Child and Adolescent Illness.* New York: Brunner_Routledge.

Strauss, R. S., & Pollack, H. A. (2003). Social marginalization of overweight children. *Archives of Pediatrics and Adolescent Medicine, 157*(8), 746-752.

Stroebe, W. (2000). *Social psychology and health*. Buckingham: Open University Press.

Stroebe, W. (2008). *Dieting, overweight, and obesity. Self-regulation in a food-rich environment.* Washington DC: American Psychological Association.

Strong, W. B., Malina, R. M., Blimkie, C. J. R., Daniels, S. R., Dishman, R. K., Gutin, B., et al. (2005). Evidence based physical activity for school-age youth. *Journal of Pediatrics, 146*(6), 732-737.

Swahn, M. H., Reynolds, M. R., Tice, M., Miranda-Pierangeli, M. C., Jones, C. R., & Jones, I. R. (2009). Perceived Overweight, BMI, and Risk for Suicide Attempts: Findings from the 2007 Youth Risk Behavior Survey. *Journal of Adolescent Health, 45*(3), 292-295.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics*. Boston: Pearson/Allyn and Bacon.

Tanofsky-Kraff, M., Goossens, L., Eddy, K. T., Ringham, R., Goldschmidt, A., Yanovski, S. Z., et al. (2007). A multisite investigation of binge eating behaviors in children and adolescents. *Journal of Consulting and Clinical Psychology, 75*(6), 901-913.

Taylor, R. W., Brown, D., Dawson, A. M., Haszard, J., Cox, A., Rose, E. A., et al. (2010). Motivational interviewing for screening and feedback and encouraging lifestyle changes to reduce relative weight in 4-8 year old children: design of the MInT study. [Article]. *Bmc Public Health, 10*.

Teixeira, P. J., Going, S. B., Sardinha, L. B., & Lohman, T. G. (2005). A review of psychosocial pre-treatment predictors of weight control. [Review]. *Obesity Reviews, 6*(1), 43-65.

Telama, R., Yang, X. L., Viikari, J., Valimaki, I., Wanne, O., & Raitakari, O. (2005). Physical activity from childhood to adulthood - A 21-year tracking study. *American Journal of Preventive Medicine, 28*(3), 267-273.

The Directorate for Health and Social Affairs. (2004). National plan for self-help. Retrieved 13.04.11, 2011, from <http://www.selvhjelp.no/filestore/Nasjononal_plan_IS-1212_engelsk.pdf>.

Toschke, A. M., Thorsteinsdottir, K. H., Von Kries, R., & G.M.E. Study Group. (2009). Meal frequency, breakfast consumption and childhood obesity. *International Journal of Pediatric Obesity, 4*(4), 242-248.

Trost, S. G. (2001). Objective measurement of physical activity in youth: current issues, future directions. *Exercise and Sport Sciences Reviews, 29*, 32-36.

Trost, S. G., Kerr, L. M., Ward, D. S., & Pate, R. R. (2001). Physical activity and determinants of physical activity in obese and non-obese children. *Int J Obes Relat Metab Disord, 25*(6), 822-829.

Trost, S. G., Pate, R. R., Freedson, P. S., Sallis, J. F., & Taylor, W. C. (2000). Using objective physical activity measures with youth: How many days of monitoring are needed? *Medicine and Science in Sports and Exercise, 32*(2), 426-431.

Tsiros, M. D., Olds, T., Buckley, J. D., Grimshaw, P., Brennan, L., Walkley, J., et al. (2009). Health-related quality of life in obese children and adolescents. *International Journal of Obesity, 33*(4), 1-14.

Turner, J. E., Markovitch, D., Betts, J. A., & Thompson, D. (2010). Nonprescribed physical activity energy expenditure is maintained with structured exercise and implicates a compensatory increase in energy intake. [Article]. *American Journal of Clinical Nutrition, 92*(5), 1009-1016.

Upton, P., Lawford, J., & Eiser, C. (2008). Parent-child agreement across child health-related quality of life instruments: A review of the literature. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care & Rehabilitation, 17*(6), 895-913.

Uzark, K. C., Becker, M. H., Dielman, T. E., Rocchini, A. P., & Katch, V. (1988). Perceptions held by obese children and their parents - implications for weight control intervention. *Health Education Quarterly, 15*(2), 185-198.

van Wijnen, L. G. C., Boluijt, P. R., Hoeven-Mulder, H. B., Bemelmans, W. J. E., & Wendel-Vos, G. C. W. (2010). Weight Status, Psychological Health, Suicidal Thoughts, and Suicide Attempts in Dutch Adolescents: Results From the 2003 E-MOVO Project. *Obesity, 18*(5), 1059-1061.

Varni, J. W., Limbers, C. A., Bryant, W. P., & Wilson, D. P. (2010). The PedsQL (TM) Multidimensional Fatigue Scale in pediatric obesity: Feasibility, reliability and validity. [Article]. *International Journal of Pediatric Obesity, 5*(1), 34-42.

Varni, J. W., Seid, M., & Kurtin, P. S. (2001). PedsQL (TM) 4.0: Reliability and validity of the pediatric quality of life Inventory (TM) Version 4.0 generic core scales in healthy and patient populations. *Medical Care, 39*(8), 800-812.

Vila, G. A. (2004). Mental disorders in obese children and adolescents. *Psychosomatic Medicine, 66*(3), 387-394.

Waling, M., Lind, T., Hernell, O., & Larsson, C. (2010). A One-Year Intervention Has Modest Effects on Energy and Macronutrient Intakes of Overweight and Obese Swedish Children. *Journal of Nutrition, 140*(10), 1793-1798.

Wallander, J. L. (2001). Theoretical and developmental issues in quality of life for children and adolescents. In H. Koot & J. L. Wallander (Eds.), *Quality of life in child and adolescent illness - consepts, methods and findings*: Brunner-Routledge.

Wallander, J. L., Schmitt, M., & Koot, H. M. (2001). Quality of life measurement in children and adolescents: Issues, instruments, and applications. *Journal of Clinical Psychology, 57*(4), 571-585.

Wang, Y., & Lobstein, T. (2006). Worldwide trends in childhood overweight and obesity. *International Journal of Pediatric Obesity, 1*(1), 11-25.

Wardle, J. (2005). Understanding the aetiology of childhood obesity: implications for treatment. *Proceedings of the Nutrition Society, 64*(1), 73-79.

Wardle, J., & Cooke, L. (2005). The impact of obesity on psychological well-being. *Best Practice & Research Clinical Endocrinology & Metabolism, 19*(3), 421-440.

Warren, J. M., Golley, R. K., Collins, C. E., Okely, A. D., Jones, R. A., Morgan, P. J., et al. (2007). Randomised controlled trials in overweight children: Practicalities and realities. *International Journal of Pediatric Obesity, 2*(2), 73-85.

Webster-Straton, C. (2011). The Incredible Years. Parents, teachers, and children training series., from http://www.incredibleyears.com/

Webster-Stratton, C., & Reid, M. J. (2010). The incredible years parents, teachers, and children training series. A multifaceted treatment approach for young children with conduct disorders. In J. R. Weisz & A. E. Kazdin (Eds.), *Evidence-based psychotherapies for children and adolescents* (pp. 194-210). New York: Guilford Press.

Webster-Stratton, C., Reid, M. J., & Hammond, M. (2004). Treating children with early-onset conduct problems: Intervention outcomes for parent, child, and teacher training. *Journal of Clinical Child and Adolescent Psychology, 33*(1), 105-124.

Welk, G. J., Corbin, C. B., & Dale, D. (2000). Measurement issues in the assessment of physical activity in children. *Research Quarterly for Exercise and Sport, 71*(2), S59-S73.

Wells, J. C. K. (2001). A critique of the expression of paediatric body composition data. *Archives of Disease in Childhood, 85*(1), 67-72.

Wells, J. C. K., & Fewtrell, M. S. (2006). Measuring body composition. *Archives of Disease in Childhood, 91*(7), 612-617.

Wells, J. C. K., & Fewtrell, M. S. (2008). Is body composition important for paediatricians? [Review]. *Archives of Disease in Childhood, 93*(2), 168-172.

Wells, J. C. K., Fewtrell, M. S., Williams, J. E., Haroun, D., Lawson, M. S., & Cole, T. J. (2006). Body composition in normal weight, overweight and obese children: matched case-control analyses of total and regional tissue masses, and body composition trends in relation to relative weight. *International Journal of Obesity, 30*(10), 1506-1513.

Wells, J. C. K., Haroun, D., Williams, J. E., Wilson, C., Darch, T., Viner, R. M., et al. (2010). Evaluation of DXA against the four-component model of body composition in obese children and adolescents aged 5-21 years. *International Journal of Obesity, 34*(4), 649-655.

Whitlock, E. P., O'Connor, E. A., Williams, S. B., Beil, T. L., & Lutz, K. W. (2010). Effectiveness of Weight Management Interventions in Children: A Targeted Systematic Review for the USPSTF. [Review]. *Pediatrics, 125*(2), E396-E418.

WHO. (2000). Obesity: Preventing and managing the global epidemic. Geneva: WHO.

Wildes, J. E., Marcus, M. D., Kalarchian, M. A., Levine, M. D., Houck, P. R., & Cheng, Y. (2010). Self-reported binge eating in severe pediatric obesity: impact on weight change in a randomized controlled trial of family-based treatment. *International Journal of Obesity, 34*(7), 1143-1148.

Wilfley, D. (2007). Lifestyle interventions in the treatment of childhood overweight: A meta-analytic review of randomized controlled trials. *Health Psychology, 26*(5), 521-532.

Wilkinson, L., & American Psychological Association Task Force on Statistical Inference. (1999). Statistical methods in psychology journals: Guidelines and explanations. *American Psychologist, 54*, 594-604.

Wille, N., Bullinger, M., Holl, R., Hoffmeister, U., Mann, R., Goldapp, C., et al. (2009). Health-related quality of life in children and adolescents seeking treatment for obesity. *Acta Paediatrica, 98*, 268-268.

Williams, D. P., Going, S. B., Lohman, T. G., Harsha, D. W., Srinivasan, S. R., Webber, L. S., et al. (1992). Body fatness and risk for elevated blood-pressure, total cholesterol, and serum-lipoprotein ratios on children and adolescents. *American Journal of Public Health, 82*(3), 358-363.

Wright, C. M., Emmett, P. M., Ness, A. R., Reilly, J. J., & Sherriff, A. (2010). Tracking of obesity and body fatness through mid-childhood. *Archives of Disease in Childhood, 95*(8), 612-617.

Wu, T. J., Dixon, W. E., Dalton, W. T., Tudiver, F., & Liu, X. F. (2011). Joint Effects of Child Temperament and Maternal Sensitivity on the Development of Childhood Obesity. *Maternal and Child Health Journal, 15*(4), 469-477.

Yackobovitch-Gavan, M., Nagelberg, N., Demol, S., Phillip, M., & Shalitin, S. (2008). Influence of weight-loss diets with different macronutrient compositions on health-related quality of life in obese youth. [Article]. *Appetite, 51*(3), 697-703.

Young, K. M., Northern, J. J., Lister, K. M., Drummond, J. A., & O'Brien, W. H. (2007). A meta-analysis of family-behavioral weight-loss treatments for children. *Clinical Psychology Review, 27*(2), 240-249.

Yu, C. Y. (2002). *Evaluating cutoff criteria of model fit indices for latent variable models with binary and continuous outcomes.* Unpublished Doctoral dissertation, University of California, Los Angeles.

Zametkin, A. J., Zoon, C. K., Klein, H. W., & Munson, S. (2004). Psychiatric aspects of child and adolescent obesity: A review of the past 10 years. *Journal of the American Academy of Child and Adolescent Psychiatry, 43*(2), 134-150.

Zhu, X. (2009). *Assessing fit of item response models for performance assessments using Bayesian analysis.* University of Pittsburgh, Pittsburgh.

Paper I

Paper II

ELSEVIER

Treatment of obesity in children: Parent's perceived emotional barriers as predictor of change in body fat

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Summary
Aim: Research supports the use of family-based interventions in the treatment of obesity in children, but there is a lack of knowledge about what factors affect parents' ability to carry out the lifestyle changes necessary to reduce their child's obesity. The aim of the present study was to examine whether parents' self-efficacy, perceived emotional barriers, subjective norms, and attitudes could predict change in their children's body fat at 6 month and 2 year follow-ups after a family-based treatment of obesity.
Methods: Body Mass Index Standard Deviation Scores (BMI SDS) were calculated and body fat (dual-energy X-ray absorptiometry) were measured in 99 treatment-seeking children with obesity (ages 7—12; 48 girls, 51 boys; mean BMI SDS = 2.99) at baseline, after 6 month and after 2 year follow-up. Parental cognitions regarding diet and physical activity were examined by parent-completed questionnaires. Structural equation modeling (SEM) was used to test whether the selected health cognitions could predict treatment outcome.
Results: Parental perceived emotional barriers was a significant predictor of change in body fat at 6 month ($\beta = -.32$, $p = .001$) and 2 year ($\beta = -.38$, $p = .002$) follow-up when the initial body fat values were controlled. Self-efficacy, subjective norms and attitudes did not improve the amount of variance explained.

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Conclusion: Parents' perceived emotional barriers significantly predict change in total body fat in children treated for obesity. In order to increase treatment-efficacy, perceived emotional barriers should be addressed.

Introduction

It is generally agreed that family-based behavioral interventions focusing on diet and physical activity are effective in the treatment of obesity in children [1]. Treatment of pediatric obesity concerns changing health behavior, namely the promotion of healthy eating and physical activity, and parents are important agents of change [2]. Parents influence the development of children's health attitudes and behaviors related to health [3,4] and family functioning has shown to affect treatment outcomes in pediatric obesity [5]. Families with a greater ability to implement health behavior changes may have children who do better in obesity treatment [6]. In order to design more effective and better tailored treatments, we therefore need to know what factors affect parents' ability to carry out changes in diet and physical activity.

Health behavior theories attempt to describe why people engage in particular health behaviors [7], focusing on cognitive processes that underlie the onset and change of health-relevant behaviors. The thoughts and feelings a person associates with a particular health behavior are often referred to as health cognitions, and these models are collectively referred to as social cognitive models since they all use sets of cognitions that are assumed to determine behavior [8]. There is a considerable overlap between the models and the key health cognitions they identify [8]. The models tap into the belief domain (e.g., self-efficacy and perceived barriers), the social domain (e.g., subjective norms) and the affective domain (e.g., attitudes). Health cognitions have shown to affect weight-loss in adults [9,10], but with the exception of two studies, such constructs have not been examined as potential predictors of outcome in the study of pediatric obesity treatment. However, population based studies exist on how parents' health cognitions affect the promotion of physical activity and healthy eating in their children, finding self-efficacy [11,12], perceived barriers [13], subjective norms and attitudes [14] to be of importance. Based on such findings and the assumption of parents as important agents of change in pediatric obesity interventions, the current study therefore examined whether parental

self-efficacy, perceived barriers, subjective norms, and attitudes can predict treatment outcome in children with obesity.

Self-efficacy is an important part of Bandura's Social Cognitive Theory and refers to the individual's belief in his or her ability to perform and succeed in specific situations or activities [15]. Perceived barriers is a construct within the Health Belief Model and describes a person's perception of both the difficulties in performing the specific behavior of interest and the negative outcomes that may result from performing those behaviors [10]. Most studies address physical or practical barriers to promoting healthy eating and physical activity, showing the accessibility of healthy food [13,16], costs [11], lack of time [13] and weather [17] to be of importance. However, the concept of perceived barriers includes a wide range of disparate items from financial costs and physical barriers to personality and emotional characteristics [18]. We have experienced within a clinical setting of pediatric obesity treatment that emotional barriers are just as often reported by parents as obstacles to health behavior change as practical or physical barriers, e.g., the feeling of guilt or getting bad conscious if reducing the child's food-intake or limiting screen-time hours. We therefore hypothesized that such barriers may affect treatment outcome. Thus, in the present study the ''barriers'' construct captures the emotional aspects rather than practical or physical aspects, and will therefore be named *perceived emotional barriers*.

The Theory of Planned Behavior [19] is one of the behavior models most extensively applied to health behavior. Subjective norm constitutes one of the elements of the Theory of Planned Behavior and refers to the subject's perception of the general social pressure to perform the behavior in question. Another concept of the Theory of Planned Behavior is attitude, which reflects the individual's global positive or negative evaluations of performing a particular behavior [20].

To our knowledge, only two studies have examined parental health cognitions as potential predictors of treatment outcome in children with obesity. Becker et al. [21] evaluated the ability of the Health Belief Model to predict and explain

Table 1   Characteristics of the sample.

	Baseline Mean (SD)(*N* = 99)	6 month Mean (SD)(*N* = 88)	2 years Mean (SD)(*N* = 80)
Age	10.3 (1.7)	10.9 (1.7)	12.1 (1.7)
Weight (kg)	62.7 (16.3)	64.9 (17.1)	75.1 (18.1)
Height (cm)	146.8 (11.3)	151.9 (11.4)	157.9 (11.5)
BMI	28.60 (4.1)	27.3 (3.7)	29.8 (4.9)
BMI SDS	2.99 (.5)	2.79 (.5)	2.83 (.5)
Body fat (%)	40.55 (4.1)	38.33 (54.9)	38.5 (5.6)
Maternal BMI	31.86 (7.3)	32.48 (7.2)	31.85 (7.1)
Paternal BMI	29.88 (3.6)	29.47 (3.3)	29.1 (3.7)

mothers' adherence to a diet prescribed for their obese child and found perceptions related to the benefits of and barriers to the diet to be positively related to weight loss. In a study of inpatient treatment of obesity in adolescents, Uzark et al. [22] found parental attitude or the expectation that the child was less likely to be overweight in the future to be associated with greater weight loss compliance. Other parental health cognitions did not predict outcome in the study by Uzark et al. Both these studies were conducted more than twenty years ago and had short follow-ups (eight and twenty weeks, respectively). In addition to the lack of studies examining parental health cognitions as predictors of treatment outcome in children with obesity, few studies have compared several constructs from health behavior change theories within the same sample and intervention in order to evaluate their relative merits [9]. In the current study we therefore address the ability of prominent constructs from health behavior models to predict outcome among children undergoing treatment for obesity. We hypothesize that parental self-efficacy, perceived emotional barriers, attitudes, and subjective norms predict change in body fat at 6 month and 2 year follow-up.

Methods and procedures

Participants

The participants were 99 children (48 girls, 51 boys) with a mean age of 10.3 (SD = 1.7) years and a mean BMI SDS of 2.99 (SD = .46). All but two of the children were ethnic Norwegians (Caucasian); one was of African origin and the other of Latin-American origin. None of the participants had endocrine or chromosomal disorders and none of them used medication related to obesity or endocrine disease. Measured height and weight showed that fathers (*N* = 54) had a BMI of 29.9 (SD = 3.6) and mothers

(*N* = 91) had a BMI of 31.9 (SD = 7.3) at baseline. Based on the International Standard of Classification of Occupations (ISCO-88) 5% of the parents were classified as unskilled workers, 2% were farmers/fishermen, 42% were skilled workers, 21% were lower professionals, 9% were higher professionals, and 10% were leaders. Fifty-nine children were living with both parents, 16 were living with a single parent, and 16 were living with a single parent and his/her new partner. Five of the children were living half time with each parent, and two were living with foster parents. Baseline characteristics are presented in Table 1.

Study design

All children who were referred to outpatient obesity treatment at St. Olav University Hospital, the general hospital in Trondheim, Norway, between April 2005 and February 2008 were consecutively recruited after meeting three inclusion criteria: BMI ≥ 2 Standard Deviation Score (BMI SDS) [23] where BMI SDS is the difference between the patient's BMI and the age- and sex-specific mean BMI divided by the BMI standard deviation of the reference group [24]; participation of at least one parent; and ability to participate in a group setting. Participants with endocrine or chromosomal disorders were excluded from the study. Eighty percent of those who met the inclusion criteria joined the treatment program, leaving a sample of 99 children (48 girls, 51 boys). Of the 99 attending patients, 2 dropped out after pre-treatment assessment and then 8 children dropped out during the first 6 month treatment-period, which yielded a 6 month follow-up sample of 89 children. Nine more children dropped out between the six month and 2 year follow-up. Reasons for drop-out included lack of capacity to participate in the treatment program due to family situation (*n* = 8), not being motivated for treatment (*n* = 1), no further need of treatment (*n* = 1) or because the family moved away (*n* = 2).

Seven families did not report any reason for dropout.

Data were collected in the hospital setting by the members of the treatment staff at baseline (before onset of treatment), after six months treatment and after 2 years of treatment. The body composition measures were conducted by trained personnel not involved in the treatment. Written informed consent was obtained from all parents, and the study was approved by the Regional Ethical Committee for Medical Research.

Treatment program

The treatment program aimed at increasing the families' daily physical activity, reducing sedentary behavior and establishing healthy dietary habits with proper nutrition for the entire family. Based on international and national recommendations [25,26] the intervention focused on regular mealtimes, more fruit and vegetables, less sugar and fat, more fiber dense food, at least 1 h of moderate physical activity a day and reduced sedentary behavior. Daily life physical activity involved walking rather than riding in a car, taking the stairs rather than the elevator, playing outside, bicycling and exercising. The aim was accomplished by arranging for the children to gain positive experiences in physical activity and to increase nutritional knowledge while enhancing the parents' competence and skills to accomplish the necessary lifestyle changes using behavior change techniques. Behavior change techniques such as monitoring, goal-setting, modeling, self-talk and reward was used. The treatment was family-based and took place in an outpatient hospital setting where parents participated in parent groups and the children participated in age-specific children's groups. All groups met every second week for ten 2-h sessions during the first six months of the treatment period. In addition, the family met once a month with a physiotherapist and a clinical dietician for an individual consultation to discuss the family's lifestyle changes and to define new goals to work on. Over the next 18 months, the groups met five times at the hospital.

Measures

Anthropometry and total body fat

Anthropometry was measured with the children wearing light clothing and no shoes. Weight was obtained by a digital scale (Seca 930, Vogel and Halke, Hamburg) and height was measured by stadiometer (Hyssna Limfog AB, Sweden). BMI was calculated in kg/m^2 and BMI SDS was computed according to the international reference values of Cole et al. [23]. Dual Energy X-ray Absorptiometry (DXA, Discovery QDR), considered one of the most accurate methods to measure body composition [27], was used to estimate total body fat (%).

Parental health cognitions

Since no parent questionnaire measuring health cognitions related to diet and physical activity behavior typically promoted in obesity interventions exists, the Parental Health Cognitions Inventory was developed for the current study (Appendix A). Both self-efficacy ($\alpha = .62$) and perceived emotional barriers ($\alpha = .57$) were each assessed by four items. The Theory of Planned Behavior weight management constructs were assessed by a set of 11 items, which measure attitudes ($\alpha = .68$) and subjective norms ($\alpha = .80$). The items were rated on a four-point Likert scale (1 = ''Totally agree,'' 2 = ''Partly agree,'' 3 = ''Disagree,'' 4 = ''Totally disagree''). Treatment of obesity implies changing different health behaviors; all health cognition scales therefore include both diet and physical activity-related items. Higher scores represent higher self-efficacy, attitudes (the higher the score, the stronger attitude related to the health behavior in question) and strongly perceived subjective norms (the higher the score, the more important are others' opinions on the health behavior in question) and less perceived emotional barriers. Mothers' scores ($N = 93$) were used but in some cases they were missing or incomplete; fathers' scores ($N = 6$) were applied.

Statistical analysis

Repeated measures, using SPSS 17.0, were applied to analyze changes in the outcome measures from baseline to 6 months of treatment and end of treatment (2 years). Structural equation modeling (SEM) was used to test whether the selected health cognition variables could predict treatment outcome. The SEM analyses were conducted in Mplus Version 5.1 [28]. The SEM model consisted of a measurement model, which is a confirmatory factor analysis (CFA) for the health cognition variables, and a path model that predicts total body fat (%) at the two follow-ups and controls for initial body fat. In the CFA the health cognition variables were thus latent continuous constructs. The estimates were hence free of measurement error and the path coefficients were therefore not hampered with the moderate reliability of the health cognition constructs. The individual observed items from which these latent variables were construed were treated as ordered categorical variables. A weighted least

Table 2   Body fat (%) and BMI SDS at baseline, 6 month and 2 years follow-up. Repeated measures.

	Baseline (n = 99)	6 month (n = 88)	2 years (n = 80)	Baseline — 6 month				Baseline — 2 year			
	Mean (SD)	Mean (SD)	Mean (SD)	df	F	p	d	df	F	p	d
Body fat	40.54 (4.1)	38.33 (4.9)	38.50 (5.6)	1	64.33	.00	.49	1	17.83	.00	.42
BMI SDS	2.99 (.46)	2.78 (.53)	2.83 (.53)	1	64.52	.00	.41	1	24.58	.00	.34

square parameter estimator (WLSMV) was used, which is robust to non-normality. Full information maximum likelihood was applied to handle missing data, thus information from all 99 subjects were used to estimate the regression coefficients. The comparative fit index (CFI: values approximating .95), the non-normed Fit index (NNFI: values approximating .95), and the root mean square error of approximation (RMSEA: values approximating .05) were used to evaluate the overall goodness-of-fit [29].

The size of the sample was equal to the number of patients receiving obesity treatment in a certain period of time, and thus was not based on prospective power analysis. The current sample size enabled us to detect standardized beta weights of .28 in multiple regressions with a power of .80.

Results

There was a significant decrease in the children's BMI SDS and body fat both at six month and 2 year follow-up (Table 2).

The correlation between total body fat (%) from baseline to 6 month follow up was $r = .86$ ($p < .001$), and from baseline to 24 months was $r = .63$ ($p < .001$).

In the CFA, all factor loadings between each indicator and latent variable were statistically significant (ranging from .46 to .88) (Appendix A), and with fit-indices bordering on acceptable values (CFI = .94, NNFI = .94, RMSEA = .07). The ''Self-

efficacy'' construct was significantly correlated to ''Barriers'' ($r = .54$, $p < .001$) and ''Attitude'' ($r = .73$, $p < .001$), but not to ''Subjective norm'' ($r = .07$, $p = .56$). ''Barriers'' was further significantly related to ''Attitude'' ($r = .66$, $p < .001$) and ''Subjective norm'' ($r = .38$, $p < .001$). The correlation between ''Subjective norm'' and ''Attitude'' was $r = .05$ ($p = .73$). To assess the relationship between each of the latent variables and total body fat, univariate analyses were conducted where total body fat was regressed on the health cognition components.

In order to test whether the health cognition variables could predict change in total body fat during treatment, body fat was regressed on the four health cognition variables using a forward step-wise inclusion procedure, adjusting for initial values of total body fat. In this forward procedure, the health cognition constructs entered the model according to their ability to predict total body fat without taking into account the other health cognition constructs (Table 3). Therefore, perceived emotional barriers entered the model first. The inclusion of additional health cognition variables did not improve the model. As the results show, perceived emotional barriers was a significant predictor of change in total body fat both at 6 month and 2 year follow-up when the initial body fat was controlled for. The SEM model revealed acceptable fit indices (CFI = .97, NNFI = .96, RMSEA = .06) but the model could not be improved to increase the fit in any theoretically meaningful way. The results of the structural equation modeling are shown in Fig. 1.

Table 3   Health cognitions as predictors of change in total body fat. Regression analyses.

	Total body fat (%) 6 month follow up (n = 99)			Total body fat (%) 24 month follow up (n = 99)		
	B	SE	β	B	SE	β
Emotional barriers	−2.90[*]	1.18	−.31[**]	−3.25[*]	1.65	−.31[*]
Subjective norms	.55	.38	.08	2.29[*]	.83	.31[*]
Self-efficacy	−.16	.64	−.13	1.40	1.14	.13
Attitudes	.42	2.06	.05	4.24	5.41	.41

Note: Initial total body fat, age and gender were controlled (not shown).
B = regression coefficient, β = standardized regression coefficient.
   [*] $p < .05$.
  [**] $p < .01$.

Note: * = p<0.05, ** = p<0.001
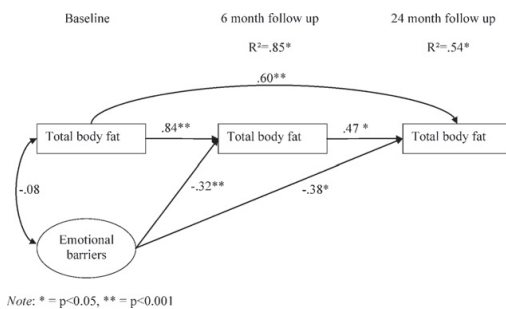
Figure 1 Path model: perceived emotional barriers as predictor of change in total body fat.

Discussion

The aim of the present study was for the first time to examine whether parents' self-efficacy, perceived emotional barriers, subjective norms, and attitudes could predict change in their children's total body fat at 6 months and 2 year follow-up after a family-based treatment of obesity. Parental perceived emotional barriers were a significant predictor of body fat at both follow-ups, even when the initial body fat was taken into account. The findings are strengthened by the fact that there was no significant relationship between emotional barriers and body fat at baseline. Self-efficacy, subjective norms, and attitudes did not improve the amount of variance explained in the overall model. When tested one at a time, subjective norms turned out to be the only significant predictor in addition to perceived emotional barriers at 2 year follow-up. At 6 month follow-up, perceived emotional barriers were the only significant predictor of those examined. There was a significant decrease in BMI SDS and total body fat (%) both at 6 month and 2 year follow-up, with effect sizes comparable to other findings [2].

In a review of 46 studies, Janz et al. [30] concluded that perceived barriers was the most powerful health belief dimension across various study designs and behavior of adults. These findings seem to extend to weight loss as well [31]. Becker et al. [21], on the other hand, found that mothers' rating of how difficult it would be to do something about their child's overweight was not significantly related to weight-loss two months later. However, other barrier-items measured in the same study (e.g., worries about going on a diet causing health problems) did predict weight-loss.

Finding parents' perceived emotional barriers to predict change in obese children's body fat during and at end of treatment raises two questions. The most obvious question first: Why do emotional barriers predict treatment outcome? It is reasonable to assume that those parents who perceive several emotional barriers will have more difficulties in carrying out the necessary health behavior changes. Their emotional barriers, the feeling of guilt or having bad conscious, are probably deterrents for them to limit their child's intake of unhealthy food or reduce sedentary behavior. Consequently, they are less able to reduce the child's overweight. Child resistance has been shown to be the most common factor reported when parents are asked what difficulties they face in achieving a healthy diet [17]. It is reasonable to assume that the emotional barriers perceived will add to this, i.e., the child's resistance is harder to manage if you feel guilty for reducing the child's food intake or limiting the access of sweets.

According to the Theory of Planned Behavior, perceived behavioral control denotes a subjective degree of control over performance of the behavior in question and is related to health behavior change [19,32]. The concept of perceived control is in several ways similar to the concept of perceived barriers [32]; simplified, the more barriers perceived by a person, the less control that person will perceive in performance of a behavior. Uzark et al. [22] found that weight-loss in obese adolescents was significantly related to personal control over weight. The study also showed that the adolescents who felt less personal control over their weight had parents who perceived more barriers related to management of the child's weight problem. Uzark et al. measured barriers as the degree of difficulty a parent felt in helping the adolescent lose weight. Thus, perceived barriers seem not only to affect parents' ability to carry out the lifestyle changes, but might also affect the child's own possibility to change health behavior, thereby further decreasing the chance to succeed in reducing obesity.

The second question raised by the current finding is why some parents report more emotional barriers than others. An authoritative parenting style in which parents are both warm and supportive, assume a leadership role regarding health behavior change, and grant appropriate child autonomy has been shown to be one of the most consistent predictors of healthy family behaviors [33]. A permissive parenting style was associated with less reduction of obesogenic load at home and less weight loss in a family based treatment of obesity in children [33]. Further, obesity treatment programs that included parent training in general behavior management generated effect-sizes that were 3 times larger than those that did not [2]. Although

not tested in the current study, it is reasonable to assume that parents who report more emotional barriers in regard to health behavior changes are more permissive than those who do not report such barriers.

The present results should be interpreted in the context of several limitations. First, the current study did not use a validated measure of health cognitions. Although there are several measures of health cognitions relating to adults' own health behavior (e.g., barriers toward physical activity) [34], such measures are of limited use when adults as health promoters are in question (e.g., barriers toward promoting physical activity in their children). Since there might be other factors that influence one's own health behavior compared to factors affecting behavior directed toward one's children, measures should be tailored to address the role of the adult as an agent of change rather than the primary target of change. In addition, cognitions concerning a specific behavior (e.g., self-efficacy concerning exercise) predict that behavior better than general measures (e.g., global self-efficacy) [35]. Thus, when assessing parental self-efficacy, attitude, subjective norms and perceived emotional barriers related to change in diet- and physical activity behavior *in their children*, these topics should be addressed specifically. It may be considered a limitation of the current study though that the measure used is not an adaptation of existing measures or items from such measures. To the best of our knowledge, however, there are no measures tapping parents' cognitions about changing their child's dieting and level of physical activity, as these health behaviors are addressed in the treatment of obesity. Such a questionnaire was therefore developed in the present study. One possible avenue in the development of this measure was drawing on other questionnaires tapping into cognitions on adults' or children's own health behavior. In doing so the modifications must have been extensive in order to capture the fact that cognitions concerning control and encouragement of parents toward their children were in focus, and not the parents' own health behavior. It was therefore decided to develop an entirely new measure. The internal consistency in the resulting measure was only moderate. On the other hand, the results of the CFA show that the measures had satisfactory factorial validity. In addition, Ajzen [32] refers to an unpublished meta-analysis of 90 studies that assessed perceived behavioral control as defined by TPB; an average alpha coefficient of .65 was found (Cheung and Chan, 2000). Thus, although we obtained moderate internal consistency in our measures, this is in line with the general trend in the field. The moderate internal consistency of health cognitions measures are probably caused by measuring cognitions concerning a relatively wide set of health behaviors. Since different health behaviors such as dieting and physical activity have shown to be only weakly correlated [36], we cannot expect a high internal consistency when measuring different health behaviors by the same scale. The low alphas obtained may therefore indicate that the health cognition constructs measured are comprehensive and not narrowly defined. Further, it is difficult to obtain high alpha-values when using only four to six items, as is the case in the current study, because Cronbach's alpha increases as the number of items on a scale increases [37]. Finally, it should be further noted that the moderate reliability might not have affected the findings since the health cognition constructs were treated as latent constructs and thus were free of measurement error.

We assumed that perceived emotional barriers affects parental health behavior toward their children, which in turn affects the children's total body fat at follow-up. This assumption is theoretically based, but is not explicitly tested in the current study. The sample size implied moderate statistical power, a possible explanation for why only one of the four health cognition variables explored turned out to be a significant predictor of total body fat in the overall model. Involving a larger sample might therefore have rendered self-efficacy, subjective norm, or attitudes as significant predictors of total body fat in addition to perceived emotional barriers.

One of the strengths of the current study is the representativeness of the sample; it includes almost all the children referred to outpatient treatment at the hospital during several years and the drop-out rate is relatively small. Using total body fat as the outcome variable further strengthens the findings because this measure is more specific when measuring obesity and more sensitive to change compared to measures of height and weight [38]. In addition, using body fat rather than BMI SDS as an outcome measure is of importance when addressing both physical activity and diet, due to the possibility for a rise in lean mass to mask a decrease of body fat [39]. The use of both a short and a long time follow-up further strengthens the finding. In addition, the statistical analysis, which is based on structural equation modeling, allows for simultaneous evaluation of multiple relationships.

According to the current findings, parental lowered emotional barriers with regard to changing diet and physical activity behavior are predictive

of a decrease in their children's total body fat after a family-based treatment of obesity. This result indicates that treatment of obesity would be more efficient if parents perceived fewer emotional barriers with regard to health behavior change. The findings may therefore have important clinical implications for increasing treatment efficacy by targeting parental perceived emotional barriers. Addressing parental emotional barriers at the onset of and during treatment could include discussing thoughts and feelings related to their perceived barriers, e.g., source of parental guilt about setting limits on food intake and reducing sedentary behavior, how parents handle feeling badly for their child when he/she is not allowed to eat the same amount of sweets as other children, etc. It is reasonable to assume that by addressing such thoughts and feelings the parents will feel more confident and less emotionally ambivalent about making the necessary health behavior changes. The results thus highlight the potential value of motivational interviewing techniques in the treatment of obesity in children, a style of counseling where emotional ambivalence with regard to changing health behavior is explicitly addressed [40].

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

Appendix A. Parental health cognitions inventory. Items and factor loadings.

Construct	Item	Coefficient
Barriers	I would have a bad conscience if my child wasn't allowed to play as much on the computer or watch as much TV as other children.	.66*
	I would feel guilty if I had to deny my child soda and sweets in the middle of the week when other children are allowed to have them.	.51*
	It would feel wrong if I didn't allow my child to drink something other than water outside mealtimes because, after all, it is quite normal for children to drink juice when they are thirsty.	.67*
	I think it would be sad if we didn't have ''comfort food'' like cookies, cakes and snacks around.	.64*
Subjective norms	I don't care very much what others think of my child's physical activity level.	.73*
	What people I know think about whether my child walks, cycles or is driven to school is completely unimportant to me.	.58*
	What people think about how much fruit and vegetables my child eats does not matter to me.	.88*
	It is actually quite important to me what other people think about how much time my child should be allowed to use on TV/computer/games.	.59*
	It is important to me what others think about the type of foods that are available to my child.	.78*
	I do not care at all what others think about how much time my child and I together engage in physical activities such as cycling, skiing, ball games or playing outside.	.71*

Construct	Item	Coefficient
Self-efficacy	It would not be a problem for me to have my child drink water as a thirst-quencher.	.55*
	I am convinced that I can see to it that my child is physically active one hour a day, not only for a period of time, but in the long run.	.51*
	I believe that I can make a lasting change in diet that also includes the adults in the family.	.75*
	I am convinced that in the long run I can follow through with a permanent rule that my child will only drink soda and eat sweets on Saturday.	.64*
Attitudes	I think it is fantastic that my child is active at least one hour every day.	.48*
	To stop the rapid weight gain, it is necessary that my child is physically active 1 h every day.	.85*
	It is fundamentally very good that my child and I do things together that involve physical activity.	.70*
	If my child is going to stop gaining weight, I believe it is crucial that I, as his/her parent, also practice the same diet principles: sweets only on Saturdays, ''five a day'', water as a thirst-quencher, etc.	.70*
	If we are going to do something about the weight gain that my child struggles with, it is extremely important that we not have sweets and snacks in the cabinets.	.73*

Note: Pearson's correlation coefficient is used.
$*p > 0.001.$

References

[1] Luttikhuis HO, Baur L, Jansen H, Shrewsbury VA, O'Malley C, Stolk RP, et al. Interventions for treating obesity in children. Cochrane Database of Systematic Reviews; 2009.

[2] Kitzmann KM. Lifestyle Interventions for youth who are overweight. Health Psychol 2010;29:91—101.

[3] Edwardson CL, Gorely T. Parental influences on different types and intensities of physical activity in youth: a systematic review. Psychol Sport Exerc 2010;11:522—35.

[4] Birch LL, Davison KK. Family environmental factors influencing the developing behavioral controls of food intake and childhood overweight. Pediatr Clin North Am 2001;48:893—907.

[5] Kitzmann KM, Dalton WT, Buscemi J. Beyond parenting practices: family context and the treatment of pediatric obesity. Fam Relat 2008;57:13—23.

[6] Dalton WT, Kitzmann KM, Burghen GA, Mallare JT, Stender SS. Family functioning and children's response to primary care treatment for overweight: a preliminary study. J Pediatr Nurs 2010;25:282—8.

[7] Noar SM, Chabot M, Zimmerman RS. Applying health behavior theory to multiple behavior change: considerations and approaches. Prev Med 2008;46:275—80.

[8] Conner M. Cognitive determinants of health behavior. In: Steptoe A, editor. Handbook of behavioral medicine. New York: Springer+Business Media, LLC; 2010. p. 19—30.

[9] Palmeira AL, Teixeira PJ, Branco TL, Martins SS, Minderico CS, Barata JT, et al. Predicting short-term weight loss using four leading health behavior change theories. Int J Beh Nutr Phys Act 2007:4.

[10] Baranowski T, Cullen KW, Nicklas T, Thompson D, Baranowski J. Are current health Behavioral change models helpful in guiding prevention of weight gain efforts? Obes Res 2003;11:23S—43S.

[11] Smith B, Grunseit A, Hardy LL, King L, Wolfenden L, Milat A. Parental influences on child physical activity and screen viewing time: a population based study. BMC Public Health 2010;10:11.

[12] Adkins S, Sherwood NE, Story M, Davis M. Physical activity among African-American girls: the role of parents and the home environment. Obes Res 2004;12:38S—45S.

[13] Dwyer J, Needham L, Simpson JR, Heeney ES. Parents report intrapersonal, interpersonal, and environmental barriers to supporting healthy eating and physical activity among their preschoolers. Physiol Appl Nutr Metabol 2008;33:338—46.

[14] Andrews KR, Silk KS, Eneli IU. Parents as health promoters: a theory of planned behavior perspective on the prevention of childhood obesity. J Health Commun 2010;15:95—107.

[15] Bandura A. Self-efficacy — toward a unifying theory of behavioral change. Psychol Rev 1977;84:191—215.

[16] Davis AM, James RL, Curtis MR, Felts SM, Daley CM. Pediatric obesity attitudes, services, and information among rural parents: a qualitative study. Obesity 2008;16:2133—40.

[17] Slater A, Bowen J, Corsini N, Gardner C, Golley R, Noakes M. Understanding parent concerns about children's diet, activity and weight status: an important step towards effective obesity prevention interventions. Public Health Nutr 2010;13:1221—8.

[18] Rosenstock IM, Strecher VJ, Becker MH. Social learning theory and the health belief model. Health Educ Q 1988;15:175—83.

[19] Ajzen I. The theory of planned behavior. Organ Behav Hum Decis Process 1991;50:179—211.

[20] Armitage CJ, Conner M. Efficacy of the theory of planned behaviour: a meta-analytic review. Br J Soc Psychol 2001;40:471—99.

[21] Becker MH, Maiman LA, Kirscht JP, Haefner DP, Drach-
man RH. Health belief model and prediction of dietary
compliance — field experiment. J Health Soc Behav
1977;18:348—66.

[22] Uzark KC, Becker MH, Dielman TE, Rocchini AP, Katch V.
Perceptions held by obese children and their parents —
implications for weight control intervention. Health Educ
Q 1988;15:185—98.

[23] Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing
a standard definition for child overweight and obe-
sity worldwide: international survey. Br Med J 2000;320:
1240—3.

[24] Sklar CA, Mertens AC, Walter A, Mitchell D, Nesbit ME,
O'Leary M, et al. Changes in body mass index and
prevalence of overweight in survivors of childhood acute
lymphoblastic leukemia: role of cranial irradiation. Med
Pediatr Oncol 2000;35:91—5.

[25] Norwegian Directory of Health. Norwegian recommen-
dations for nutrition and physical activity. Oslo 2005
[IS-1219]. Available from: http://www.helsedirektoratet.
no/vp/multimedia/archive/00002/IS-1219_2606a.pdf.

[26] Barlow SE. Expert committee recommendations regarding
the prevention, assessment, and treatment of child and
adolescent overweight and obesity: summary report. Pedi-
atrics 2007;120:164—92.

[27] Helba M, Binkovitz LA. Pediatric body composition analy-
sis with dual-energy X-ray absorptiometry. Pediatr Radiol
2009;39:647—56.

[28] Muthèn LK, Muthèn BO. Mplus user's guide. 6th ed. Los
Angeles: Muthen & Muthen; 1998—2010.

[29] Raykov T, Marcoulides GA. Model-testing and fit evaluation.
In: Raykov T, Marcoulides GA, editors. A first cource in struc-
tural equation modeling. New Jersey: Lawrence Erlbaum
Associates; 2006. p. 38—51.

[30] Janz NK, Becker MH. The health belief model — a decade
later. Health Educ Q 1984;11:1—47.

[31] Teixeira PJ, Going SB, Houtkooper LB, Cussler EC, Mar-
tin CJ, Metcalfe LL, et al. Weight loss readiness in
middle-aged women: Psychosocial predictors of success
for behavioral weight reduction. J Behav Med 2002;25:
499—523.

[32] Ajzen I. Perceived behavioral control, self-efficacy, locus
of control, and the theory of planned behavior. J Appl Soc
Psychol 2002;32:665—83.

[33] Golan M. Parents as agents of change in childhood obe-
sity — from research to practice. Int J Pediatric Obes
2006;1:66—76.

[34] Sechrist KR, Walker SN, Pender NJ. Development and psy-
chometric evaluation of the exercise benefits and barriers
scale. Res Nurs Health 1987;10:357—65.

[35] Ajzen I, Timko C. Correspondance between health attitudes
and behavior. Basic Appl Soc Psychol 1986;7:259—76.

[36] Kremers SPJ, De Bruijn GJ, Schaalma H, Brug J. Clustering
of energy balance-related behaviours and their intraper-
sonal determinants. Psychol Health 2004;19:595—606.

[37] Holt CL, Clark EM, Kreuter MW. Weight locus of control and
weight-related attitudes and behaviors in an overweight
population. Addict Behav 2001;26:329—40.

[38] Wells JCK, Fewtrell MS. Is body composition important for
paediatricians? Arch Dis Child 2008;93:168—72.

[39] Sacher PM, Kolotourou M, Chadwick PM, Cole TJ, Lawson
MS, Lucas A, et al. Randomized controlled trial of the MEND
program: a family-based community intervention for child-
hood obesity. Obesity 2010;18:62—8.

[40] Resnicow K, Davis R, Rollnick S. Motivational interview-
ing for pediatric obesity: conceptual issues and evidence
review. J Am Diet Assoc 2006;106:2024—33.

Paper III

Paper IV

Is not included due to copyright

Appendix

<div align="center">**"Akkurat passe BARN"**</div>

<div align="center">**Forespørsel om å delta i en vitenskapelig behandlingsstudie av overvektige barn**</div>

Bakgrunn

Dette er en forespørsel om å delta i et forskningsprosjekt hvor vi ønsker å finne ut hvordan overvektige barn best kan bli normalvektig og oppnå bedre helse. Det finnes per i dag ingen "oppskrifter" på gode behandlingsopplegg, men det er sterke holdepunkter for at tett foreldremedvirkning er avgjørende for at barna skal lykkes med å bli normalvektige.

Målsetning

Å teste ut effekten av et strukturert foreldreopplæringsprogram med tanke på reduksjon av barnets overvekt

Deltakelse i prosjektet

Klart overvektige barn mellom 7 og 12 år kan bli med i dette prosjektet. Barna må være innstilt på å delta i gruppe med andre barn på samme alder, og foreldre/foresatte må akseptere loddtrekning mtp hvilken av de to foreldreoppleggene de skal delta i.

Metode

Barna får lik behandling i tverrfaglige grupper ledet av fysioterapeut og klinisk ernæringsfysiolog. Her sikres opplæring og positive opplevelser knyttet til riktig kosthold og fysisk aktivitet.

Foreldrene fordeles på to ulike opplegg ved hjelp av loddtrekning. Den ene foreldregruppa går inn i et strukturert foreldreopplæringsprogram som ledes av psykolog, mens den andre foreldregruppa organiserer seg i såkalte selvhjelpsgrupper hvor man bevisstgjøres gjennom råd og innspill til hverandre. Begge foreldregruppene samles samtidig som barna har sin gruppesamling, og det er samlinger hver annen uke i 5 måneder, dvs 10 samlinger. Deretter vil det bli et oppfølgingsprogram der en samles sjeldnere, og etter hvert vil oppfølgningen skje i hjemkommunen. I alt vil deltagerne følges i 2 år. Det er helt nødvendig at minst en forelder deltar i gruppene, helst begge hvis det lar seg gjøre. Som ledd i behandlingen vil også hvert barn/familie få en individuell plan som følges opp underveis i programmet.

For å lære mest mulig av hvordan gruppene virker på kort og lang sikt må alle deltagere testes før oppstart, etter ½ og 2 år. Dette foregår ved hjelp av spørreskjema, test av fysisk form, måling av kroppens fettprosent ved hjelp av røntgenmetode, samt en blodprøve. Alle foreldregrupper videofilmes for senere dataanalyser, men det er mulig å delta i gruppene uten å bli filmet.

Frivillig å delta

Det er frivillig å delta i prosjektet. Du kan når som helst trekke deg uten å oppgi noen grunn, og be om at dine data slettes. Det får ingen innvirkninger på ditt behandlingstilbud i framtida om du ikke ønsker å delta, eller trekker deg. Alle data vil bli behandlet konfidensielt og alle medarbeidere i prosjektet er underlagt taushetsplikt. Prosjektet avsluttes i februar 2010. Da langtidseffekten av slike behandlingstilbud er lite kjent kan dere bli forespurt om en oppfølgingsstudie etter 5 år. Dersom dere ikke har blitt kontaktet igjen innen 28. februar 2015 vil

datamaterialet anonymiseres og alle persongjennkjennbare data slettes, dette gjelder også videomaterialet fra foreldresamlingene.

Risiko
Prosjektet antas å ha liten risiko. Det er vurdert og godkjent av Regional komité for medisinsk forskningsetikk. Prosjektet er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste AS. Alle deltakere er dekket av pasientskadeerstatningsordningen.

Rønnaug Astri Ødegård,
Overlege, dr.med.
Tlf: 92855174
e-post: ronnaug.odegard@stolav.no

Samtykkeerklæring

Jeg har lest informasjonsskrivet og hatt anledning til å stille spørsmål. Jeg samtykker i å delta i prosjektet **"Akkurat passe BARN"**

Sted, dato   Underskrift

....

Sted, dato   Underskrift foresatt

....

Jeg samtykker i at foreldresamlingene jeg deltar i videofilmes

Sted, dato   Underskrift

....

Samtykkeerklæringen leveres til en av prosjektledelsen eller sendes til:

Rønnaug Ødegård
Avdeling for barn og ungdom, St Olavs Hospital
Olav Kyrres gt 17,
7006 Trondheim

Spørreskjema for barn

Kid-KINDL[R]
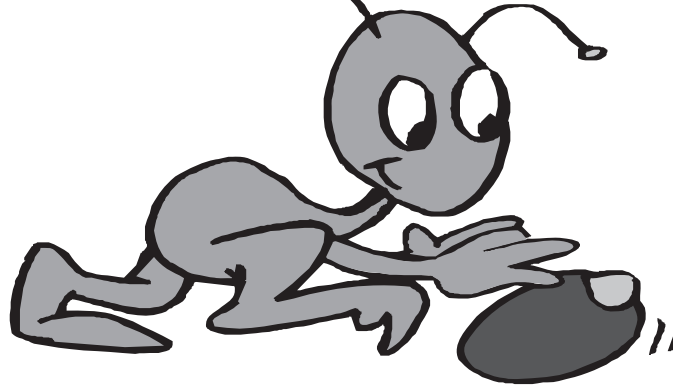
Hei,

vi vil gjerne vite hvordan du har det for tiden. Derfor har vi tenkt ut noen spørsmål som vi ber deg svare på.

⇨ Vær vennlig å les gjennom hvert spørmål.

⇨ Tenk over hvordan det var i siste uke.

⇨ Kryss <u>i hver del</u> av på det svaret som passer best for deg.

Det finnes ingen riktige eller gale svar.

Det som er viktig for oss er din mening.

Et eksempel: 🖉	aldri	sjelden	av og til	ofte	alltid
Den siste uka hadde jeg lyst til å høre på musikk	☐	☐	☐	☒	☐

Skjema utfylt den:

_____

Dag/måned/år

Fortell oss så noe om deg selv. Kryss av eller fyll ut !

Jeg er   □ Jente   □ Gutt

Jeg er   _____ år gammel

Hvor mange søsken har du? □ 0 □ 1 □ 2 □ 3 □ 4 □ 5 □ over 5

Hvilken skole går du på?   □ Barneskole
                                    □ Ungdomsskole
                                    □ Videregående skole
                                    □ Privat skole

1. Først vil vi vite noe om kroppen din, ...

I den siste uka...	aldri	sjelden	av og til	ofte	alltid
1. ... følte jeg meg syk	□	□	□	□	□
2. ... har jeg hatt vondt i hodet eller magen	□	□	□	□	□
3. ... var jeg trøtt og slapp	□	□	□	□	□
4. ... følte jeg meg sterk og full av energi	□	□	□	□	□

2. ... så noe om hvordan du føler deg

I den siste uka...	aldri	sjelden	av og til	ofte	alltid
1. ... lo jeg mye og hadde det moro	□	□	□	□	□
2. ... kjedet jeg meg	□	□	□	□	□
3. ... følte jeg meg alene	□	□	□	□	□
4. ... var jeg redd	□	□	□	□	□

3. ... og hva du synes om deg selv.

I den siste uka...	aldri	sjelden	av og til	ofte	alltid
1. ... var jeg stolt av meg selv	□	□	□	□	□
2. ... følte jeg meg bra	□	□	□	□	□
3. ... likte jeg meg selv	□	□	□	□	□
4. ... hadde jeg mange gode ideer	□	□	□	□	□

4. I de neste spørsmålene handler det om din familie ...

I den siste uka...	aldri	sjelden	av og til	ofte	alltid
1. ... hadde jeg det bra sammen med foreldrene mine	☐	☐	☐	☐	☐
2. ... hadde jeg det hyggelig hjemme	☐	☐	☐	☐	☐
3. ... kranglet vi hjemme	☐	☐	☐	☐	☐
4. ... nektet foreldrene meg ting	☐	☐	☐	☐	☐

5. ... og så om venner.

I den siste uka...	aldri	sjelden	av og til	ofte	alltid
1. ... lekte jeg med venner	☐	☐	☐	☐	☐
2. ... likte de andre barna meg	☐	☐	☐	☐	☐
3. ... hadde jeg det bra sammen med vennene mine	☐	☐	☐	☐	☐
4. ... følte jeg at jeg var annerledes enn de andre	☐	☐	☐	☐	☐

6. Nå vil vi gjerne vite noe om skolen.

I den siste uka da jeg var på skolen ...	aldri	sjelden	av og til	ofte	alltid
1. ... klarte jeg oppgavene på skolen godt	☐	☐	☐	☐	☐
2. ... syntes jeg at undervisningen var god og interessant	☐	☐	☐	☐	☐
3. ... bekymret jeg meg for fremtiden	☐	☐	☐	☐	☐
4. ... var jeg redd for å gjøre det dårlig på skolen eller å få dårlige karakterer	☐	☐	☐	☐	☐

7. Er du for øyeblikket på sykehuset eller har du en langvarig sykdom?

☐ **Ja**   ☐ **Nei**

vær vennlig å svar på de
neste seks spørsmålene   da er du ferdig nå

I den siste uka...	aldri	sjelden	av og til	ofte	alltid
1. ... var jeg redd for at sykdommen min kunne bli verre	☐	☐	☐	☐	☐
2. ... var jeg lei meg på grunn av sykdommen	☐	☐	☐	☐	☐
3. ... taklet jeg sykdommen min godt	☐	☐	☐	☐	☐
4. ... behandlet foreldrene mine meg som et lite barn på grunn av sykdommen min	☐	☐	☐	☐	☐
5. ... ville jeg ikke at noen skulle merke noe til sykdommen min	☐	☐	☐	☐	☐
6. ... gikk jeg glipp av noe på skolen på grunn av sykdommen min	☐	☐	☐	☐	☐

TUSEN TAKK FOR SAMARBEIDET!

Spørreskjema om livskvalitet for barn og ungdom

8 – 16 år
Foreldreversjon KINDL[R]

Kjære foreldre/foresatte,

Takk for at du har sagt ja til å fylle ut dette spørreskjema om ditt barns trivsel og helsemessige livskvalitet.

Vær vennlig å ta hensyn til følgende når du svarer:

⇨ Les nøye gjennom hvert spørsmål,

⇨ tenkt over hvordan barnet ditt hadde det den siste uka, og

⇨ kryss av det svaret som passer best for barnet ditt.

Et eksempel: I siste uka ...	aldri	sjelden	av og til	ofte	alltid
... sov barnet mitt godt	☐	☐	☐	☒	☐

Barnet mitt er: jente ☐   gutt ☐   Barnets alder: __ __ år

Du er :   Mor ☐   Far ☐   Annet ☐ _____

Dato for utfylling: __ / __ / __ (Dag / Måned / År)

1. Fysisk velvære

I den siste uka...	aldri	sjelden	av og til	ofte	alltid
1. ... følte barnet mitt seg syk	☐	☐	☐	☐	☐
2. ... har barnet mitt hatt vondt i hodet eller magen	☐	☐	☐	☐	☐
3. … var barnet mitt trett og slapp	☐	☐	☐	☐	☐
4. ... følte barnet mitt seg sterk og full av energi	☐	☐	☐	☐	☐

2. Psykisk velvære

I den siste uka...	aldri	sjelden	av og til	ofte	alltid
1. ... lo barnet mitt mye og hadde det moro	☐	☐	☐	☐	☐
2. ... hadde barnet mitt ikke lyst til noe	☐	☐	☐	☐	☐
3. ... følte barnet mitt seg alene	☐	☐	☐	☐	☐
4. ... følte barnet mitt seg engstelig eller usikker	☐	☐	☐	☐	☐

3. Selvbildet

I den siste uka…	aldri	sjelden	av og til	ofte	alltid
1. ... var barnet mitt stolt av seg selv	☐	☐	☐	☐	☐
2. ... følte barnet mitt seg helt på topp	☐	☐	☐	☐	☐
3. ... likte barnet mitt seg selv	☐	☐	☐	☐	☐
4. ... hadde barnet mitt mange gode ideer	☐	☐	☐	☐	☐

4. Familie

I den siste uka...	aldri	sjelden	av og til	ofte	alltid
1. ... kom barnet mitt godt overens med oss foreldre	☐	☐	☐	☐	☐
2. ... hadde barnet mitt det hyggelig hjemme	☐	☐	☐	☐	☐
3. ... kranglet vi hjemme	☐	☐	☐	☐	☐
4. ... følte barnet mitt seg dominert av meg	☐	☐	☐	☐	☐

5. Venner

I den siste uka...	aldri	sjelden	av og til	ofte	alltid
1. ... gjorde barnet mitt noe sammen med venner	☐	☐	☐	☐	☐
2. ... ble barnet mitt godt likt av andre	☐	☐	☐	☐	☐
3. ... kom barnet mitt godt overens med vennene sine	☐	☐	☐	☐	☐
4. ... hadde barnet mitt følelsen av å være annerledes enn de andre	☐	☐	☐	☐	☐

6. Skole

I den siste uka da barnet mitt var på skolen ...	aldri	sjelden	av og til	ofte	alltid
1. ... klarte barnet mitt oppgavene på skolen godt	☐	☐	☐	☐	☐
2. ... syntes barnet mitt at undervisningen var god og interessant	☐	☐	☐	☐	☐
3. ... bekymret barnet mitt seg for fremtiden	☐	☐	☐	☐	☐
4. ... var barnet mitt redd for å gjøre det dårlig på skolen eller å få dårlige karakterer	☐	☐	☐	☐	☐

7. Er barnet ditt for øyebliket på sykehus eller har det en langvarig sykdom?

☐ **Ja**

Vær vennlig å svar på de neste seks spørsmålene

☐ **Nei**

Så er spørre-skjemaet slutt

I den siste uka...	aldri	sjelden	av og til	ofte	alltid
1. ... var barnet mitt redd for at sykdommen kunne bli verre	☐	☐	☐	☐	☐
2. ... var barnet mitt lei seg på grunn av sykdommen	☐	☐	☐	☐	☐
3. ... taklet barnet mitt sykdommen sin godt	☐	☐	☐	☐	☐
4. ... behandlet jeg barnet mitt som om det var et lite barn på grunn av sykdommen	☐	☐	☐	☐	☐
5. ... ville ikke barnet mitt at noen skulle merke noe til sykdommen	☐	☐	☐	☐	☐
6. ... gikk barnet mitt glipp av noe på skolen på grunn av sykdommen	☐	☐	☐	☐	☐

Tusen takk for samarbeidet!

VEILEDNING FOR KOSTREGISTRERING

Vi ber deg notere ned alt du spiser og drikker i 4 dager, også det som spises/drikkes mellom måltidene. Det er viktig at du spiser som vanlig disse dagene. **Begynn registrering en onsdag eller søndag og registrer fire dager fortløpende.**

Skriv opp **klokkeslettet** for måltidet,
beskriv **innholdet i måltidet** så godt du kan,
drikken i måltidet og
alt som spises og drikkes **mellom måltidene**, også slikt som pastiller og vann.
Notér etter hvert, venter du til kvelden vil mye være glemt.

Registreringen skal næringsberegnes ved hjelp av et dataprogram og det er viktig å kjenne detaljene i måltidene. Derfor er det viktig at de enkelte ingrediensene i måltidet er beskrevet så nøyaktig som du klarer. Bruk husholdningsmål som teskje, spiseskje, desiliter, antall øser, skiver og stykker. Det er viktig at du husker på slike små ting som sukker i te, fløte i kaffen, sjokoladebiten til kaffen, bananen etter middagen, fløteskvetten i sausen, smørklatten på pastaen eller grønnsakene, saftglasset til kvelds osv.

Slik beskriver du innholdet i måltidet:

Matvare	*angi om det er f.eks.*
- brød	= kneip, loff, grahambrød, müslibrød
- knekkebrød	= mørkt knekkebrød, lyst knekkebrød, Rugsprø
- kaffebrød	= hvetebolle, wienerbrød, lefse, bløtkake, sjokoladekake
- margarin	= meierismør, soyamargarin, Letta, Brelett
- olje	= soyaolje, olivenolje, solsikkeolje
- ost	= fløtemysost F33, Norvegia H30 (17%)
- kjøttpålegg	= salami, fårepølse, servelat, skinke, sylte
- melk	= kefir, helmelk, lettmelk, Cultura, skummet melk
- grønnsaker	= gulrot, kinakål, grønnsaksblanding med erter, gulrot og blomkål

Begynn på nytt ark for hver dag. Skriv ned drikken i høyre felt, matvarene i midterste feltet og klokkeslettet ut til venstre.

Med vennlig hilsen

Klinisk ernæringsfysiolog

Navn: Kari Nordmann f. 00.00.91

mandag den 15/8 2003

kl.	Matvare (mengde beskrives i husholdningsmål, stykker, biter, skiver, ts, ss, dl, ml, gram bare hvis det er mulig)	Drikke i ml/dl
07:15	2 skiver Kneip 2 ts. soya margarin 4 skiver Norvegia F45	1,5 dl lett melk 0,5 dl eplejuice
11:00	1 skive grovt brød 1 ts soya margarin eple - 1 liten 1 ss leverpostei - go og mager	2 dl lett melk
14:30	go'morgen yoghurt med müsli - 1 stk	1 dl appelsin- juice
16:00	1 potet 1 karbonade 1 ss ertestuing 1 ts tyttebærsyltetøy	2 dl vann
20:00	¼ pizza - Grandiosa	2 dl saft
	1 ts tran	