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LIFESTYLE INTERVENTIONS IN TREATMENT OF OBESE ADULTS

*EATING BEHAVIOUR AND OTHER FACTORS
AFFECTING WEIGHT LOSS AND MAINTENANCE*

UNIVERSITY OF OULU, FACULTY OF MEDICINE,
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**LIFESTYLE INTERVENTIONS IN
TREATMENT OF OBESE ADULTS**

Eating behaviour and other factors affecting weight
loss and maintenance

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Abstract

The prevalence of working-aged weight losers is high because of high prevalence of obesity. Unfortunately, the loss of weight is often temporary. The aim of the present study was to investigate the effect of intensive counselling on maintained weight loss and eating behaviour (cognitive restraint, emotional eating, uncontrolled eating and binge eating). Additionally, the associations of eating behaviour with maintained weight loss, discontinuation, dietary intake and anhedonia were studied.

Eighty-two overweight or obese subjects (body mass index >27) participated in either intensive (n=35) or short-term (n=47) weight loss counselling (based on the Finnish Current Care guidelines) in a randomized weight loss follow-up study lasting 18 months.

The subjects in the intensive counselling group lost more weight than those in the short-term counselling group at the 6 months follow-up (5.0±5.7kg, 2.4±2.5kg, respectively). The weight loss results were not maintained in either of the groups. The cognitive restraint increased and the emotional eating, uncontrolled eating and binge eating symptoms decreased in both groups. There were subjects in both counselling groups who succeeded in weight loss (weight loss result 9.3±6.3%) and those who failed (gained 3.3±1.7% of body weight). Those who succeeded had the highest score for cognitive restraint and lowest for uncontrolled eating, binge eating and emotional eating. In failure group, the scores for uncontrolled eating and binge eating were the highest already at the beginning of study. Those with the highest cognitive restraint at 18 months reported low intake of energy and fat while their intake of carbohydrates and fibre was high. Anhedonia existed in 24.4% of the participants at least once during the study period. They had higher binge eating scores continuously, more uncontrolled eating and emotional eating at 6 months and they lost less weight than those without anhedonia. Thirty-two participants (39%) discontinued the study. Discontinuation was independently associated with a lack of free-time and a high weight loss goal.

The association of eating behaviour with weight loss and dietary intake suggest that enhancing eating behaviour could be a target for improving the success of weight loss. The assessment and then the treatment of psychological factors (such as anhedonia), focus on setting realistic weight loss targets as well as emphasizing the fact that counselling visits and lifestyle changes are time consuming processes should be included in weight loss counselling.

Keywords: anhedonia, counselling, depression, diet, eating behavior, obesity, weight loss

Keränen, Anna-Maria, Elintapainterventiot aikuisten lihavuuden hoidossa. Syömiskäyttäytyminen ja muut laihtumiseen sekä painonhallintaan vaikuttavat tekijät

Oulun yliopisto, Lääketieteellinen tiedekunta, Kliinisen lääketieteen laitos, Sisätaudit, Psykiatria, PL 5000, 90014 Oulun yliopisto; Kliinisen tutkimuksen keskus, Oulun yliopistollinen sairaala, PL 10, 90029 OYS, Oulu; Työterveyslaitos, Oulun aluetoimipiste, Aapistie 1, 90220 Oulu

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Tiivistelmä

Lihavuuden lisääntyessä myös työikäisten laihduttajien määrä kasvaa. Laihdutustulos jää valitettavan usein väliaikaiseksi. Tämän työn tavoitteena oli tutkia tehostetun ohjauksen vaikutusta laihtumistulokseen ja syömiskäyttäytymiseen (tietoinen syömisen hillintä, tunnesyöminen, impulsiivinen syöminen ja ahmimistaipumus). Lisäksi tutkittiin syömiskäyttäytymisen yhteyksiä laihtumistulokseen, tutkimuksen keskeyttämiseen, energiaravintoaineiden saantiin sekä anhedoniaan.

Tutkimukseen osallistui 82 ylipainoista tai lihavaa henkilöä (painoindeksi $>27\text{kg/m}^2$). Heidät satunnaistettiin kahteen tutkimusryhmään: tehostetun ohjauksen ($n=35$) ja lyhytohjauksen ryhmään ($n=47$). Ohjaus perustui aikuisten lihavuuden Käypä hoito -suositukseen. Tutkimuksen kesto ohjaus- ja seurantajakson kanssa oli 18 kuukautta.

Tehostetun ohjauksen ryhmässä henkilöt laihtuivat ensimmäisen kuuden kuukauden aikana enemmän kuin lyhytohjauksryhmässä ($5.0\pm 5.7\text{kg}$ ja $2.4\pm 2.5\text{kg}$). Laihtumistulos ei kuitenkaan ollut pysyvä. Syömiskäyttäytymisessä tapahtui pysyvä muutos kummassakin tutkimusryhmässä; tietoinen hillintä lisääntyi, ja samanaikaisesti tunnesyöminen, impulsiivinen syöminen ja ahminen vähenivät. Kummassakin ryhmässä oli laihtumisessa onnistuneita (laihtumistulos $9.3\pm 6.3\%$) sekä epäonnistuneita (paino nousi $3.3\pm 1.7\%$). Onnistujilla esiintyi enemmän tietoista syömisen hillintää ja samanaikaisesti vähiten tunnesyömistä, impulsiivista syömistä ja ahmimistaipumusta. Epäonnistujat söivät jo alkutilanteessa impulsiivisemmin, ja heillä oli enemmän ahmimistaipumusta kuin onnistujilla. Henkilöt, joilla oli korkein tietoinen syömisen hillintä, saivat vähiten energiaa ja rasvaa mutta eniten hiilihydraatteja ja kuitua. Anhedoniaa esiintyi 24.4 %:lla tutkituista ainakin kerran tutkimuksen kuluessa. Anhedoniaan yhdistyi myös muita korkeammat ahmimistaipumusasteet koko tutkimuksen ajan, eniten impulsiivista syömistä ja tunnesyömistä kuuden kuukauden seurannassa ja vähäisempi laihtuminen kuin henkilöillä, joilla ei esiintynyt anhedoniaa. Tutkimuksen keskeytti 39 % mukaan lähteneistä. Keskeyttämisen itsenäisiä riskitekijöitä olivat vapaa-ajan puute ja suuri laihtumistavoite.

Syömiskäyttäytymisen yhteys sekä laihtumiseen että energiaravintoaineiden saantiin osoittaa, että syömiskäyttäytymisen ohjaus tulisi olla keskeinen osa laihdutusohjausta. Myös anhedonian arviointi ja hoito sekä keskustelu realistisesta painotavoiteesta ja elämäntilanteen kuorimittavuudesta voisivat tehostaa laihdutuksen onnistumista.

Asiasanat: anhedonia, laihdutus, lihavuus, masennus, ravitsemusneuvonta, ruokavaliot, syömiskäyttäytyminen

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Abbreviations and terms

ANCOVA	analysis of covariance
ANOVA	analysis of variance
BES	binge eating scale
BMI	body mass index
CBT	cognitive behavioural therapy
CR	cognitive restraint
E%	percentage of energy
EE	emotional eating
ES	effect size
LITE study	Lifestyle Intervention Treatment Evaluation study
LOCF	last observation carried forward
TFEQ-18	three factor eating questionnaire -18
UE	uncontrolled eating
VLCD	very low caloric diet
Binge eating	recurrent episodes of uncontrolled eating: large amount of food is eaten rapidly with a sense of lack of control
Cognitive restraint	control over food intake in order to influence body weight and body shape
Dietary intake	intake of energy, energy nutrients, alcohol and fibre
Eating behaviour	psychological traits of eating such as EE, UE, CR
Emotional eating	overeating during dysphoric mood states
Uncontrolled eating	over all difficulties in the regulation of eating

List of original publications

The thesis is based on the following original articles, which are referred to in the text by their Roman numerals:

- I Keränen AM, Savolainen MJ, Reponen AH, Kujari ML, Lindeman SM, Bloigu RS & Laitinen JH (2009) The effect of eating behavior on weight loss and maintenance during a lifestyle intervention. *Prev Med* 49: 32–38.
- II Keränen AM, Reponen A, Kujari M, Savolainen M & Laitinen J. Predictors of discontinuation of weight loss programme. Manuscript.
- III Keränen AM, Rasinaho E, Hakko H, Savolainen M & Lindeman S (2010) Eating behavior in obese and overweight persons with and without anhedonia. *Appetite* 55: 726–729.
- IV Keränen AM, Strengell K., Savolainen M J & Laitinen J. (2011) Effect of weight loss intervention on the association between eating behaviour measured by TFEQ-18 and dietary intake in adults. *Appetite* 56: 156–162.

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1 Introduction

The prevalence of working aged individuals trying to lose weight is high all over the world because of the high prevalence of obesity. In Finland, in 2008 more than one of every five (22%) of men and one in three (35%) of women were trying to lose weight in 2008 (Helakorpi *et al.* 2009). In U.S.A, in 1998, 28% of overweight men and 49% of overweight women were trying to lose weight in 1998 (Kruger *et al.* 2004). Among obese, these numbers are 50% and 58%, respectively. The most widely used weight-loss strategies in U.S.A are eating fewer calories and taking exercise more (Kruger *et al.* 2004). However, regardless of the method (diet, very low caloric diet, physical exercise or combination of these), almost 75% of the lost weight is regained within 4–5 years of its termination (Anderson *et al.* 2001).

In general, weight management has three goals: 1) preventing weight gain, 2) achieving weight loss and 3) maintaining weight loss (Hill *et al.* 2005). The first point needs some behavioural change in the individual but also a change in the environment. The second needs individual behavioural changes, mainly in food restriction and increasing the amount of physical activity. The third aspect, maintaining the achieved weight loss, entails perhaps the most individual investment in behaviour changes (Hill *et al.* 2005).

Therefore, even though the weight loss results are often poor, one should not simply give up the fight against obesity since the weight loss has favourable effect on health (Chaput *et al.* 2005, Kaukua *et al.* 2003, Lindström *et al.* 2006). For example, the risk for type 2 diabetes decreases significantly by modest weight loss and by simple lifestyle changes (Tuomilehto *et al.* 2001). There are also many other studies which indicate that a sustained weight loss could be achieved by modest and maintained changes in lifestyle (Hollis *et al.* 2008, Kruger *et al.* 2006, Phelan *et al.* 2006, Raynor *et al.* 2005, Teixeira *et al.* 2004), such as high levels of physical activity, eating low caloric and low fat diet, eating breakfast, weighing oneself, maintaining a consistent eating pattern and “catching “slips” before they turn into larger weight gains “(Wing & Phelan 2005). In addition, there are research findings about the psychological factors which are known to associate with obesity or successful weight loss. For example, one previous study has shown that 1) reducing emotional eating, 2) having a flexible dietary restraint pattern, 3) promoting exercise self-efficacy and 4) motivation are all essential if one wishes to maintain weight loss (Teixeira *et al.* 2010). Moreover, including different forms of psychotherapy counselling have been proven to improve the

weight loss counselling (Werrij *et al.* 2009). These results are not unexpected because food intake is the end point of physiological, sensory, environmental and psychological factors (Bellisle 2003) and obesity is a consequence of many complex problems having inputs from physiological, psychological, social and environmental factors (Tsigos *et al.* 2008). For example, about 50% of patients of seeking dietary treatment for obesity exhibited some symptoms of depression (Werrij *et al.* 2006). Moreover, in all human beings, emotions affect dietary choices and eating behaviour. In obese individuals, these emotion-related associations are stronger than in non-obese individuals (Canetti *et al.* 2002).

Even though this information is available, the most often used strategies for weight loss management are suggestions: “increase physical activity, reduce consumption of fast foods, reduce portion sizes and reduce soda consumption” (Phelan *et al.* 2009) and the used style is “advice giving” by physician (Shiffman *et al.* 2009). Not even is behavioural guidance given, i.e., self-weighing, recording food intake and decreasing television viewing (Phelan *et al.* 2009). Moreover, very often health care professionals do not have theoretical education in issues related to obesity counselling (Melin *et al.* 2005, Phelan *et al.* 2009). Furthermore, most of the obesity prevention intervention studies have also been focused on dietary intake or physical activity and the counselling methods are unclear (Lemmens *et al.* 2008). These studies also most often address the problem of how to achieve weight loss, but it is quite rare to study how to maintain the weight loss result over long term. Therefore there is an urgent need for understanding the entirety of the obesity problem, as well as to develop weight loss counselling which will help to achieve the third goal (Hill *et al.* 2005): maintaining the achieved weight loss.

Many countries have published guidelines for weight loss in order to improve weight loss counselling. In Finland, the Current Care (evidence based treatment guidelines) for Adult Obesity was published in 2002 and it has been updated this year (Adult Obesity: Current Care 2011, Aikuisten lihavuus: käypä hoito-suositus 2002). Its purpose is to improve the treatment of obesity in order to prevent obesity related comorbidities in Finland. In the first version of that guideline, the recommended weight loss method was basic counselling and if the basic counselling was not possible to be organized, a short-term counselling could be used. In the updated version, the basic counselling is renamed as “lifestyle counselling on eating and exercise behaviours”. The European guidelines were published in 2008 (Tsigos *et al.* 2008).

More knowledge is needed about effectiveness of weight loss programs and favourable changes in lifestyle and the psychological factors leading to maintained weight loss. The aim of the present study was to investigate the effect of intensive weight loss counselling (based on the Finnish Current Care guidelines) in maintained weight loss and eating behaviour in a Lifestyle Intervention Treatment Evaluation (LITE) study. Moreover, the associations were studied between eating behaviour (cognitive restraint, emotional eating and uncontrolled eating) with maintained weight loss, discontinuation, dietary intake and anhedonia.

2 Review of the literature

2.1 The obesity problem

Obesity is a very rapidly increasing health problem in the world to which many co morbidities are associated (Tsigos *et al.* 2008). In Europe, the prevalence of obesity varies between 10–25% in men and 10–30% in women. Furthermore, the prevalence has increased by 10–40% in many European countries (Tsigos *et al.* 2008). In Finland, in 2007, almost half of all men were overweight (body mass index 25–30kg/m²) and every fifth was obese (body mass index over 30kg/m²) (Peltonen *et al.* 2008). In women, the prevalence of overweight is lower than in men (39%), but also 20% of women were obese (Peltonen *et al.* 2008). The costs of obesity are increasing, and in 2008 was estimated that the direct health-care costs were responsible for about 7% of total health care costs (Tsigos *et al.* 2008).

Obesity increases the risk of death from cardiovascular diseases and cancers. Its metabolic complications as well as the increased risk of respiratory diseases, osteoarthritis, gastrointestinal problems together with problems in reproductive health or psychological and social consequences are all severe implications of long-term obesity (Tsigos *et al.* 2008). Moreover, obesity is associated with sleep-problems and they contribute to the weight gain (Lyytikäinen *et al.* 2010).

However, though the weight loss results are often poor, the co morbidities which are associated with obesity can be helped by even modest weight loss. For example, a maintained 6.15% weight loss by four years achieved by an intensive lifestyle intervention, decreased haemoglobin A_{1c} and blood pressure in a group of type 2 diabetes subjects (Look AHEAD Research Group & Wing 2010). In the same study, in the first year, the intensive lifestyle intervention improved the health-related quality of life as compared to diabetes support and education (Williamson *et al.* 2009). In addition, the moderate weight loss (8.0 kg), with or without medication reduce the prevalence of metabolic syndrome from 34.8% to 27.2% (Phelan *et al.* 2007), which is more than could be achieved with medication alone. It is important that health-care providers should be made aware of the significance of their role in the management of obesity. Overweight or obese subjects who are actively advised to lose weight are more likely to attempt to lose weight (Thande *et al.* 2009). However, only 65% of obese and 27% of overweight individuals report that they have received advice to lose weight (Thande *et al.* 2009).

2.2 The guidelines for obesity management

The management of obesity includes caloric restriction, increased physical activity and behavioural therapy (Noel & Pugh 2002). Pharmacotherapy can be considered and surgical procedures can be used in morbid obesity. The health benefits are achieved, if the sustained weight loss is 5–10% of initial body weight (Noel & Pugh 2002).

In Finland, the evidence-based guidelines for adult obesity management were published in 2002 and the latest update was completed this year (Adult Obesity: Current Care 2011, Aikuisten lihavuus: käypä hoito-suositus 2002). The European evidence-based guidelines were published in 2008 (Tsigos *et al.* 2008). Both the European and Finnish guidelines state that the goals of weight management are improvement of health and a decrease in health risks. These goals can be achieved by lifelong changes in dietary habits and physical activity. The Finnish guideline emphasizes the importance of patient centred methods in counselling and the patient's own responsibility for the changes. The European guidelines stress the need for follow-up and continued supervision after successful weight loss which is also included in the updated version of Finnish guidelines, though it was not in the first version. Both, Finnish and European guidelines state that the management should contain diet and physical activity guidance, and if needed, also pharmacological treatment and surgery. In the updated version of Finnish guidelines, the emphases of counselling elements have changed from the previous version. Now, the emphasis is on the process of the changes and control of eating whereas the first guidelines stressed the dietary and physical activity elements (Adult Obesity: Current Care 2011). The European guideline emphasises also the importance of receiving support for solving psychological issues.

2.2.1 Guidelines for diet

Weight loss occurs when the energy intake is less than the energy expenditure. Therefore, the restriction of food amounts and the intake of energy rich foodstuffs form the basis of weight loss counselling. In general, the energy intake has a large variation depending on subject's gender, age, body mass index, fat free mass, genetic factors, hormones and physical activity (National Nutrition Council 2005). A healthy diet which contains the recommended levels of energy nutrients and fibre is the basis of the weight loss diet (Adult Obesity: Current Care 2011,

Aikuisten lihavuus: käypä hoito-suositus 2002, Tsigos *et al.* 2008). The Finnish Nutrition Recommendations for those nutrients are presented in table 1.

Table 1. The Finnish Nutrition Recommendations of energy and energy nutrients (National Nutrition Council 2005).

Nutrient	Recommendation
Energy	personally determined
Fat	25-35% of energy
Protein	10-20% of energy
Carbohydrates	55-60% of energy
Sucrose	< 10% of energy
Fibre	25-35 g/d or 3g/MJ
Alcohol	< 5 E% of energy

In both sets of guidelines, energy restriction is the basis of weight loss as well as the need to increase a fibre intake. In the European guidelines of obesity, healthy eating is encouraged (Tsigos *et al.* 2008). This means decreasing the energy density of foods and drinks (table 2), i.e. the diet should be rich in fibre and low in fat. The Finnish Current Care of Adult Obesity carries the same message with some different emphases (table 2). The updated version includes more practical information than the previous edition and the weight loss and weight maintenance phases are now separated (Adult Obesity: Current Care 2011). The Finnish guidelines describe the intake of alcohol, macronutrients and sugar and European guidelines offer specific, practical advices in decreasing energy intake. There is a difference of opinion about the glycemic index of food. The European guidelines refer also more cautiously to the use of Very Low Caloric Diet (industrial meal replacement products) than the Finnish Guidelines. If the VLCD is used alone, the daily energy intake is less than 800 kcal and the intake of protein and minerals is at the recommended level. The VLCD products could be used alone as long as 16 weeks if no medical contraindications do exist (Adult Obesity: Current Care 2011, Aikuisten lihavuus: käypä hoito-suositus 2002).

Table 2. The essentials of aspects in dietary advice in the Finnish and European guidelines for weight loss treatment (Adult Obesity: Current Care 2011 Aikuisten lihavuus: käypä hoito-suositus 2002, Tsigos et al. 2008).

Dietary advices	Finnish guidelines (2002)	Finnish guidelines (2011)	European guidelines
Basic of the diet	Low-energy diet: 1200-1500 kcal/d or decrease of 500-1000 kcal of current energy intake. The weight loss period and maintenance period are separated.	Low-energy diet: 1200-1500 kcal/d or decrease of 500-1000 kcal of current energy intake. The weight loss period and weight maintenance period are separated	Low-energy diet: 15-30% decrease of current energy intake, energy deficit of 600 kcal.
Nutrient intake	No special recommendation about macronutrient intake. Carbohydrates may range 35-58E%. Low fat, rich in protein. If energy intake is above 1200kcal and diet has low energy density, supplementation is not necessary	Fat 25-35E% (<10% saturated), protein 15-25E%, carbohydrates 40-60 E%. If energy intake is <1200kcal and diet has low energy density, supplementation is not necessary. Multivitamin supplementation may be used if diet continues for several months. Intake of calcium and vitaminD should be ensured.	No special recommendation about macronutrient intake. Energy restriction should be individualised. The different macronutrient intake does not improve weight, except low-glycaemic load diets. Diets under 1200 kcal /d might lead to micronutrient deficits.
Practical advices	Decreasing in energy density, portion size or both. Decreasing fat intake. Increasing fibre intake, moderate intake of sugar, decreasing alcohol consumption.	Dietary changes are based on subject's previous habits. Regular mealtimes. Decreasing energy density, portion size or both. Increasing use of vegetables, berries and fruits, decreasing alcohol consumption, avoiding sugar containing soft drinks.	Decreasing energy density and portion sizes, avoid snacking between meals, skipping breakfast and eating in the night-time. Increasing consumption of grain, cereals and fibre, vegetables and fruits, use low fat dairy products and meats. Food-diaries can be used.

Dietary advices	Finnish guidelines (2002)	Finnish guidelines (2011)	European guidelines
Control of eating	Control of eating should be improved	Control of eating is emphasized more than previously	Control of eating should be improved
Meal replacements or VLCD products	Meal replacement may be used. VeryLowCaloricDiet might be used if no contraindications exist. VLC-diet might be used for 6-12 weeks supported by behavioural changes	Meal replacement may be used. After recommendation of physician specialized in obesity, a VLC-diet might be used for 6-12 weeks	Meal replacement may be used. VeryLowCaloricDiet might be used if no contraindications exist under guidance of obesity specialist. The use should be limited for specific patients and for short periods.
Extremely modified diets	Low-fat lacto-vegetarian diet is as effective as normal diet	Diets like Atkins and other low carbohydrate diets are not recommended. Glycemic index or calcium content have no significant influence	Food with low-glycemic load might be better in the short-term.

2.2.2 Guidelines for physical activity

Sufficient high physical activity is the other principal aspect in sustained weight loss. Physical activity improves the weight loss maintenance (Tsigos *et al.* 2008) by increasing energy expenditure, promoting fat loss while sparing the fat free mass. The European and Finnish guidelines propose that in order to achieve the health benefits, the subjects should undertake 30–60 min of physical activity of moderate intensity on most days of the week (Adult Obesity: Current Care 2011, Aikuisten lihavuus: käypä hoito-suositus 2002 , Tsigos *et al.* 2008). The updated Finnish guideline suggests also that in order to lose weight, the physical activity should be even more effective; 45–60 min of daily physical activity of moderate intensity which will expend approximately 300 kcal energy. After active weight loss, in order to maintain the weight loss, the recommended daily physical activity level is 60–90 min /day of moderate intensity. Increasing daily activities is a part of physical activity in both guidelines and the European version also describes the importance of decreasing sedentary behaviour (Tsigos *et al.* 2008). In both, the European and Finnish guidelines there is an emphasis that the guidance must be individual so as to include a consideration of the personal attributes in terms of current weight, health, and other abilities (work, free time e.g.). However, physical activity is not sufficient to achieve weight loss without concurrent dietary energy restriction (Tsigos *et al.* 2008).

2.2.3 Guidelines for psychological support

In the European guidelines, the importance of psychological support is emphasized. Personal aspects related to psychological issues like depression, anxiety and stress should be assessed and guidance should be tailored according to their presence (Tsigos *et al.* 2008). The possibility of individual participating in obesity self-help groups and peer- support of obesity treatment groups is stated as being useful. In the first version of the Finnish guidelines, these issues were not emphasized (Aikuisten lihavuus: käypä hoito-suositus 2002). In the last updated version, psychological support is mentioned in terms of the management of stress or via group counselling in order to achieve peer-support (Adult Obesity: Current Care 2011).

2.2.4 Guidelines for pharmacological and surgery

Drug therapy is recommended when there is a body mass index over 30 kg/m² or over 27kg/m² with an obesity related disease (Tsigos *et al.* 2008). In the Finnish guidelines, the BMI limits are 30 kg/m² or over 28 kg/m², respectively (Adult Obesity: Current Care 2011). At the moment, in Finland, there is only one drug which can be used for the treatment of obesity, orlistat. Surgery may be considered for adults 18–60 years if the body mass index is over 40 kg/m² or over 35 kg/m² with an obesity related disease such as type 2 diabetes mellitus (Adult Obesity: Current Care 2011, Tsigos *et al.* 2008). In Finland, the age range for this procedure is 20–60 (-65) years. At the moment, surgery appears to be the most effective treatment for morbid obesity in the long term. The management of obesity patients undergoing surgery needs to be multi-disciplinary (Tsigos *et al.* 2008) and always include lifestyle counselling about eating and exercise behaviours (Adult Obesity: Current Care 2011).

2.3 Guidelines for weight loss counselling

In the first version of the Finnish guidelines, the recommended weight loss method was basic counselling (table 3) (Aikuisten lihavuus: käypä hoito-suositus 2002). It includes issues of diet, physical activity and other behaviours related to eating or physical activity. The basic counselling is recommended to be organized in groups because this is more cost-effective than individual counselling. If it is not possible to organize basic counselling, a short-term counselling can be used. This includes a discussion about the obesity and potential weight loss methods. This counselling discussion may be with a physician or a public health nurse. In the updated version the name for the recommended weight loss management has been changed from basic counselling to “Lifestyle counselling on eating and exercise behaviours“ (Adult Obesity: Current Care 2011). The emphasis has been moved from dietary issues to behavioural changes and the framework of transtheoretical model of change is recommended (table 3).

In the first version of Finnish Current Care for Adult Obesity (2002), the patient centred methods were recommended to be used together with group counselling and the behavioural changes were recommended to be discussed by patient centred methods and counselling should be based on cognitive theories and learning theories (table 3). In the European guidelines it is recommended to use the Cognitive Behavioural Therapies (CBT) in routine dietary counselling or

an own structured programme which should be provided by all trained health care professionals like physicians, dieticians, exercise physiologists, psychiatrists or psychologists (Tsigos *et al.* 2008). The terms “patient centred methods, cognitive theories, learning theories or therapies” and their theoretical background are not explained in either of the guidelines. The transtheoretical model of change is recommended for use in the updated Finnish Adult Obesity Current Care (2011) and an assessment of the state of change process forms the basis of counselling.

Table 3. The Basic Counselling and Short-term counselling of The Finnish Current care of Adult Obesity (Adult Obesity: Current Care 2011, Aikuisten lihavuus: käypä hoito-suositus 2002).

Basic Counselling (2002)	Lifestyle counselling on eating and exercise behaviours (2011)	Short-term counselling (2002 and 2011)
Aims: Decreasing energy intake. Increasing physical activity. Recognition of thoughts and attitudes, mainly barriers to the change. Improving control of eating	Aims: To recognize the need for change, resources and barriers. Improving control of eating. Decreasing energy intake and ensure nutritional requirements Increasing physical activity	Aims: Discussion about the weight Suggestion of suitable methods for weight loss
Techniques: Behavioural or cognitive behavioural therapy could be used	Techniques: Transtheoretical model of change Patient centered methods, such as motivational interviewing and problem-solution strategies. Counselling should be based on theoretical frameworks.	Techniques: Motivational intervention could be used. Material of diet and physical activity is given.
Model: Primarily group counselling, 10-20 visits	Model: Primarily group counselling, 5-15 visits	Model: One or two follow-up visits could be organized
Counsellor: Nutritionist or other specialist in weight loss	Counsellor: Planning and implementation by multiprofessional team (physician, nurse, nutritionist)	Counsellor: Anyone health care professional

2.4 Weight loss interventions and counselling

There is a lack of proper randomized weight loss interventions with long enough follow-up times and with clinical outcomes as cardiac event or mortality rates (Dansinger *et al.* 2007). The interventions including physical activity, nutrition and counselling or medication are more effective in treatment of obesity than one-component (only physical activity, nutrition or counselling) and two-component interventions in a sample of US multiethnic and minority group adults (Seo & Sa 2008). It is stressed that changes in the diet (Phelan *et al.* 2006, Shick *et al.* 1998) and eating behaviour are needed. Weight loss could be achieved by different weight loss programmes such as a one-year weight loss programme in health care centres and a one-year dietary based weight loss programme (Hakala 1994). Moreover, the attendance at weight loss sessions has been found to be more important in successful weight loss than the component of the diet (Sacks *et al.* 2009). However, irrespective of the method, the weight will be regained (Dansinger *et al.* 2007) i.e. almost $\frac{3}{4}$ of the lost weight is regained within 4–5 years of treatment (Anderson *et al.* 2001). Weight regain has not always been preventable by intensive counselling or repeated control visits (Fogelholm *et al.* 1999, Riebe *et al.* 2005). The results of weight loss maintenance are better if the program includes cognitive–behavioural therapy (Melin & Rössner 2003, Shaw *et al.* 2005) or physical activity training (Fogelholm *et al.* 1999). It has been postulated that a total change in personal lifestyle is needed when the goal is achievement of maintained weight loss (Westenhoefer *et al.* 2004).

Increasing physical activity, reducing consumption of fast foods, reducing portion sizes and reducing soft drinks consumption are the most common strategies by which the physicians encouraged their patients to lose weight (Phelan *et al.* 2009). They based their recommendations on clinical experience. In the USA, only 11.0% of obese subjects have been referred to a formal diet program and 24% to dietician (Shiffman *et al.* 2009). The most widely used method is personal advice giving at the physician appointment (Shiffman *et al.* 2009).

2.4.1 Effect of diet on weight loss or weight maintenance

In a comparison of weight loss diets with different compositions of fat, protein and carbohydrates, no differences were found in terms of either short-term or long-term weight loss (Bray 2008, Sacks *et al.* 2009). The short term (6 months)

weight loss results obtained with in each diet were on average 6 kg, and by 2 years, about 3–3.5 kg (Sacks *et al.* 2009). The commitment to the weight loss program seems to be a more significant factor for the weight loss result than the dietary macronutrient composition, i.e. early adherence to the program and diet is associated with better weight loss (Sacks *et al.* 2009, Williamson *et al.* 2010). In addition, the dieting consistency across the week predicts the weight loss maintenance (Gorin *et al.* 2004).

The DASH (Dietary Approaches to Stop Hypertension) diet is rather similar to the diet recommended in Finnish Current Care for Adult Obesity and the weight change achieved with it was -5.8 (4.4) kg (Hollis *et al.* 2008). Successful weight loss maintenance is associated with a restriction of food amounts and consuming limited variety of food groups (Raynor *et al.* 2005), eating low-calorie, low-fat diet, eating breakfast regularly, self-monitoring weight and maintaining a consistent eating pattern across weekends and weekdays (Wing & Phelan 2005), lower fat intake (Leser *et al.* 2002), low-caloric, moderate fat intake and limited amounts of fast food (Phelan *et al.* 2006) or low energy-density-eating habits (Greene *et al.* 2006). The restriction of energy by choosing low-energy-dense foods but eating satisfying portions might be the key to improve eating control in weight management (Ello-Martin *et al.* 2005, Ledikwe *et al.* 2005) and thus is one way to improve the maintenance of weight loss result. Weighing oneself, planning meals, tracking fat and calories are important components of successful weight loss maintenance (Kruger *et al.* 2006). Regular meal rhythm and frequency, quality of food (low fat, fresh fruit and vegetables) meal situations (taking time, sitting down) restriction of quantity of food together with flexible control and coping with stress are associated with successful weight loss (Westenhoefer *et al.* 2004). High BMI is associated with a high intake of alcohol (Wannamethee & Shaper 2003). Moreover, in a review comparing dietary counselling (advice to change dietary patterns) and usual care, dietary counselling has improved weight loss (Dansinger *et al.* 2007).

The weight loss could be improved by using very low caloric diet (VLCD) products but their long term effect appears to be reversible (Leser *et al.* 2002, Marinilli Pinto *et al.* 2008). Weight loss achieved by VLCD is rapid and effective, but the weight loss achieved by conventional diet and exercise appears to be more sustained (Paisey *et al.* 2002).

However, the studies of optimal macronutrient intake are somewhat restricted due to the inadequate duration of studies (Fabricatore & Wadden 2006). Therefore,

based on the current studies, the optimal diet for weight loss is which is possible to be maintained over the long-term (Fabricatore & Wadden 2006).

2.4.2 Effect of physical activity on weight loss or weight maintenance

Physical exercise together with diet and proper counselling produces a short term weight loss (Okay *et al.* 2009). There is no consensus about the exact amount of the exercise needed to maintain the weight loss (Okay *et al.* 2009). However, high physical activity level is associated with normal weight (Lahti-Koski *et al.* 2002) and with low propensity to regain weight (Befort *et al.* 2008b, Leser *et al.* 2002, Phelan *et al.* 2006, Wing & Hill 2001). In addition, the decrease in physical activity is related to weight regain after a successful weight loss (Wing *et al.* 2008). Increasing physical activity has also other health benefits in addition to supporting to weight loss, e.g. reduction of cardio-metabolic health risks, improvement of cardio-respiratory functioning, and sensations of well-being (Hainer *et al.* 2008, Okay *et al.* 2009). High self-reported physical activity has been the strongest correlate of weight loss in a one year lifestyle intervention with a half a year orlistat medication (Wadden *et al.* 2009). It is noteworthy, that an active lifestyle with increased physical activity is important in weight maintenance and might be more effective than structured exercise (Fabricatore & Wadden 2006). One interesting finding is that the association between exercise and physical activity with positive weight control is explained through eating self-regulation, i.e. increased flexible dietary control and reduced emotional eating (Andrade *et al.* 2010).

2.5 Associations between depression, anhedonia and obesity

Obesity increases the risk of clinically diagnosed depression and conversely depression predicts the risk of developing obesity (Luppino *et al.* 2010). Subjects with depressive symptoms have a higher BMI than non-depressed participants and about 50% of patients seeking dietary treatment for obesity exhibited some symptoms of depression (Werrij *et al.* 2006). The association might be more marked among women (Atlantis & Baker 2008, de Wit *et al.* 2010a, Fabricatore & Wadden 2006). In addition, the severity of obesity has an influence; i.e. extreme obesity was found to increase the risk of depression (Fabricatore & Wadden 2006). However, a large Dutch cross-sectional study found that the

association between obesity and depression was U-shaped (de Wit *et al.* 2009), meaning that also being underweight is associated with depression. In obese women, the association between depression and obesity is explained by 12% of genetic component of depression is shared with obesity (Afari *et al.* 2010). Therefore, it seems that the factors explaining the association between depression and obesity are unclear. It is noteworthy that there is also an association between anxiety disorders and obesity (Garipey *et al.* 2010).

One core symptom of chronic depression is anhedonia, i.e. the failure to experience pleasure (Greenberg & Paivio 1997). Depressed subjects suffer from lack of pleasure (anhedonia) in normally activities (relationships, work etc) (American Psychoanalytic Association 2010) and perhaps therefore are seeking pleasure in other ways, like eating. The association between anhedonia and obesity has been demonstrated in one study where obese adolescents reported depressive symptoms with anhedonia more than overweight or normal-weight subjects (Goldfield *et al.* 2010). An increased risk of depression during inhibition of neural rewarding food stimuli evoked by treatment with an anti-obesity drug is explained by indication of mechanism for inducing anhedonia (Horder *et al.* 2010). Thus, depression with symptoms of anhedonia might be one factor involved in the etiology of obesity.

Stunkard *et al.* (2003) suggest that there could be moderators and mediators which affect the development of obesity and depression. Moderators are, for example, severity of depression, severity of obesity, gender, gene-environment interactions and adverse childhood experiences. If they exist, then they should be identified so that the proper psychiatric treatment can be given. Mediators are eating and physical activity, teasing, disordered eating and stress which might affect the development of obesity or depression (or both) and they need to be identified in order to provide better pharmacological and lifestyle interventions. In other words, obese subjects may suffer from psychological problems which independently or together with obesity, can affect to their success in achieving weight loss. For example, low physical and social activity are associated with depressive disorders and obesity (de Wit *et al.* 2010b).

If one treats obesity this can decrease depression (Stunkard *et al.* 2003) and conversely treating depression might improve weight loss (Werrij *et al.* 2006). It is noteworthy that treatment of depression can have a negative effect on obesity if the medication used affects weight (Stunkard *et al.* 2003). Thus, depression should be recognised and treated together with obesity management taking into account the possible detrimental effect of medication. This type of

psychopathology should be treated similarly as in normal weight subjects. Weight loss counselling is not sufficient.

2.6 Discontinuation in weight loss counselling

Discontinuation is a common problem in clinical treatment of obesity and in weight loss studies (Graffagnino *et al.* 2006, Melin *et al.* 2006) (table 4) and it leads to a waste of health care resources and also from the viewpoint of weight losers, it is a failure that might affect their later success when they try to achieve weight loss (Bautista-Castano *et al.* 2004, Teixeira *et al.* 2004). Several reasons for discontinuation have been studied; the most often reasons are unrealistically high weight loss goals and being under 50 years of age (table 4). Contradictory associations have been found with depression and discontinuation as well as with previous attempts at dieting followed by discontinuation (table 4). Despite its presence being described in several studies, in practice, virtually nothing is being done to prevent this unwanted event. Moreover, even if many of these factors are assessed and recognized before counselling, it may be very difficult to influence them, e.g. work situation, age, history of obesity or obesity-related diseases. Nonetheless, if it was known which issues could be affected by counselling and these were recognized, then the possibilities to prevent discontinuation would be improved.

Table 4. The predictors of discontinuation in weight loss programmes.

Authors year of the publication	Number of subjects (Male/Female), Drop out rate(%)	Study design, last	Country	Main predictors of discontinuation
Clark <i>et al.</i> 1996	143 (45/98), obese. Total number of sessions attended 19.5/26	Weight loss study with VLCD, 26 weeks		Higher level of depression, current smoking, being sedentary, having non-treated hypertension.
Honas <i>et al.</i> 2003	866 (184/682), overweight and obese, drop out rate 31%	Clinic-based weight loss program, 16 weeks	USA	Female, divorced, African Americans, being under 40 years, LR: under 50 years of old
Bautista-Castano <i>et al.</i> 2004	1018 (230/788), overweight or obese, drop out rate 70.4%,	Cross sectional prospective study, 4 years	Spain	Gender (males seldom), more previous w/ programs , high BMI, being older, a history or obesity
Teixeira <i>et al.</i> 2004	158 (0/158), overweight or obese, drop out rate 30%	16 week weight loss program, 1 year follow-up	Portugal	Unrealistically high w/ goal, poorer quality of life, more previous weight loss attempts, excessive weight, exercise minutes, binge eating, psychological healthy, body image, fibre intake. LR: Carbohydrate intake, number of previous diets, happy w/, quality of life.
Dalle Grave <i>et al.</i> 2005	1785 (392/1393), obese, drop out rate 51.7%	Multi-Center weight loss study (Quovadis), 12 m	Italy	Higher expected 1-year w/, lower age, lower dream BMI, LR: lower age, high w/ goal
Dalle Grave <i>et al.</i> 2005	1000 (225/785), obese, drop out rate 84.3%	Multi-Center weight loss study (Quovadis) 36m	Italy	LR: expected one year BMI loss. Reasons: Logistic, unsatisfactory results, lack of motivation,
Graffagnino <i>et al.</i> 2006	418 (1), overweight or obese, drop out rate 53%,	6-month weight loss program, retrospective anal.	USA	Being younger, less likely to be taking medication, and less likely to be caucasian
Inelmen <i>et al.</i> 2005	383 (78/305), overweight or obese, drop-out rate 77.3%	Retrospective clinical trial, 12 months	Italy	lower BMI, full-time job, number of obesity related diseases and depression LR: Full time job
Fabricatore <i>et al.</i> 2009	224 (44/180), obese, drop out rate 17.4%	Controlled clinical trial with medication, 52 weeks	USA	Younger age, education, self-esteem, baseline depressive symptoms, attendance and w/ at 3 weeks (depending on treatment group)

LR, Logistic regression; w/, weight loss

2.7 Weight loss counselling and theoretical background

In Finnish, we always use the term “ohjaus” when we describe the discussion between the health care professional and patient. In English, there are three kinds of terms to describe this “ohjaus”: advice giving, guidance or counselling and they all have a different meaning.

The advice giving is telling subjects what they should do (Feltham 1997). The guidance is “*the process of helping people make important choices that affect their lives, such as choosing a preferred lifestyle*”, i.e. it helps the subjects to choose what they value most (Gladding 2000). Counselling is “*...a principled relationship characterised by the application of one or more psychological theories and a recognised set of communication skills, modified by experience, intuition and other interpersonal factors, to the client’s intimate concerns, problems or aspirations*” (Feltham 1997). Moreover, the American Counselling Association (American Counseling Association 2010) has defined counselling as: “*a professional relationship that empowers diverse individuals, families, and groups to accomplish mental health, wellness, education, and career goals*”. In other words, counselling focuses helping subject to make changes but it is not the same as psychotherapy. Counselling is relationship with 8–12 visits (under 6 months) which focuses on the resolution of developmental and situational problems, in contrast, psychotherapy is defined as a long term relationship that focuses on achieving reconstructive changes in serious problems (Gladding 2000).

2.7.1 Behavioural and cognitive theories

Both Finnish and European current care- recommendations of adult obesity suggest that the behavioural changes are recommended to be discussed based on cognitive and learning theories (Aikuisten lihavuus, Käypä hoito-suositus 2002, Tsigos *et al.* 2008).

In the standard behaviour therapy the basic concept is that the behavioural change is the former and the cognitive change is the latter (Fabricatore 2007). The aim of behavioural treatment is to develop skills which will help to identify and modify eating habits, physical activity and thinking (Foster *et al.* 2005). The behavioural treatment of obesity is based primarily on learning theories, applying the principles of classical and operant conditioning in practice (Fabricatore 2007, Foster *et al.* 2005, Hainer *et al.* 2008, Tsigos *et al.* 2008). The behavioural modification is goal directed, process orientated; it advocates small changes. The

behavioural approaches that are used to improve eating and exercise behaviours are as follows: self-monitoring, goal-setting, stimulus control and behavioural substitution (table 5). It has been proposed that cognitive strategies like problem solving might also be used in behavioural programs to induce behaviour change (Fabricatore 2007, Foster *et al.* 2005).

In cognitive behavioural therapy, obesity is understood as being a consequence of dysfunctional thoughts or misconceived beliefs and the primary aim is to achieve a cognitive change (Fabricatore 2007, Van Dorsten & Lindley 2008). According to the theoretical background of cognitive therapy, the cognitive change is a prerequisite before one has a long-term behaviour change (Van Dorsten & Lindley 2008). In cognitive behavioural therapy the concept is that cognition affects behaviour, cognitions can be changed and this change can achieve a behaviour change. For example, cognitive approaches are problem solving and cognitive restructuring (table 5) and motivational readiness, patient expectations for treatment and cognitive restructuring (Van Dorsten & Lindley 2008).

However, the term cognitive-behavioural therapy is often misused. If obesity is treated as a behavioural problem and the basis of the treatment is to change behaviour, the therapy is behavioural (not cognitive) even though cognitive strategies are being used (Fabricatore 2007, Van Dorsten & Lindley 2008).

Weight reduction can be achieved by standard behaviour therapy of obesity (Bray 2008) but it is difficult to maintain (Fabricatore 2007, Foster *et al.* 2005). Cognitive therapy with dietetic treatment improves the maintained weight loss compared to dietetic treatment with physical exercise (Werrij *et al.* 2009). Cognitive behavioural therapy also improves weight loss irrespective of the content of diet (Rodriguez-Hernandez *et al.* 2009). Moreover, a cognitive behaviour therapy based lifestyle intervention is as effective as individualised dietetic intervention but more effective than simply providing an information letter (Ash *et al.* 2006). Problem solving skills (cognitive counselling method) might make the counselling more effective (Murawski *et al.* 2009).

Both of these treatment methods appear to be rather similar in practice and therefore both cognitive and behavioural methods are recommended for achieving maintained weight loss (Fabricatore 2007).

Table 5. Strategies to improve behavioural and cognitive skills in standard behaviour therapy of obesity (Fabricatore 2007).

Approaches and skills	In practice
Behavioural: Self – monitoring	Food or physical activity diaries
Behavioural: Goal- setting	Describe observable behaviours which are time-limited and realistic
Behavioural: Stimulus Control	Reinforcing desirable behaviour, breaking the associations of non-food cues with eating or limiting the availability of the unhealthy food and increasing that of healthy
Behavioural: Behavioural substitution	Identifying of nonhunger cues to eat like emotions and when finding a compensatory behaviour to that trait.
Cognitive: Problem solving	Multistep iterative process, including the identification of the problem, the chain of events, to develop potential solutions, to find the best one, implementation of the best one and in the end, its evaluation.
Cognitive: Cognitive restructuring	Changing beliefs can alter affective and behavioural outcomes

2.7.2 Group counselling

The weight loss management could be individual counselling or group counselling. Gladding (2000) defines a group as “*two or more people interacting together to achieve a goal for their mutual benefit*”. Group counselling is a good choice because it offers more resources, the possibility of commonality, the opportunity for feedback, for vicarious learning by listening and observing others and it saves time and effort (Jacobs *et al.* 2002). Jacobs *et al.* (2002) have divided the groups into seven categories according to the aspects achieved from the group or the topics considered in the groups: 1) education, 2) discussion, 3) task, 4) growth and experimental, 5) counselling and therapy, 6) support and 7) self-help. Another possible classification is 1) group guidance, 2) group counselling and 3) group psychotherapy (Gladding 2000). If the classification of Jacobs *et al.* (2002) is used, then it could be argued that management of obesity should exploit more often education groups, discussion group and counselling /therapy groups or their combination. In an education group, the counsellor provides information and discusses with group members. In a discussion group, the main idea is that

subjects have the opportunity to share ideas and exchange information. In counselling /therapy groups, subjects belong to the group because of a certain problem and they try to help one another under the counsellor's guidance. Group counselling confers greater benefits than individual counselling, if the subject is suitable for group counselling. However, if the subject is not suitable for group counselling, these benefits are not achieved, and a better choice seems to be the individual counselling (Jacobs *et al.* 2002).

It is noteworthy that the effect of group approaches has been less extensively studied. A review of 24 controlled weight loss studies found that a group approach alone was less effective than using a combination of individual and group approaches (Seo & Sa 2008). Moreover, weight loss results are similar with individual and group counselling (Ash *et al.* 2006, Cresci *et al.* 2007, Minniti *et al.* 2007) but that the discontinuation rate is lower with group counselling (Minniti *et al.* 2007). In a study examining the differences in weight loss between personal telephone counselling and group counselling (via conference call), the weight loss was greater in group counselling (Befort *et al.* 2010).

2.8 Eating behaviour

Eating is an end point of many different psychological, physiological, sensory and environmental factors. Therefore, it is not so simple as just restricting the energy intake i.e. "eat less" as the most widely used advice for weight loss suggests. The subjects live in an environment where many factors affect their dietary choices and selection of food as well as how much physical activity they have.

Psychological factors involved in eating behaviour are important in determining food choices and behaviour (Bellisle 2003). There are three attitudes to food; chronic dietary restraint (or cognitive restraint), disinhibition and hunger sensation (Bellisle 2003). In recent years, when studying the predictors of successful weight loss, the association of these factors to obesity has become evident (table 6). Van Buren et Sinton (2009) have claimed that these psychological aspects of weight loss should be assessed and be taken into account when developing weight loss counselling. Moreover, emotions and eating have associations which should also be considered in weight loss counselling.

In the psychosomatic theory Bruch states that some individuals respond to arousal (anger, fear, anxiety) by excessive eating. which is due to an inability to differentiate between the need for food or other uncomfortable sensations and

feelings originating from early learning experiences (Bruch 1974, Ouwens *et al.* 2003, van Strien & Ouwens 2007).

External eating (heightened sensitivity to food cues, (Van Strien *et al.* 1995)) has been speculated as possible intervening variable in the pathway between impulsivity and increased intake of food or overweight (Ouwens *et al.* 2009). Some individuals have a higher sensitivity towards external, food related stimuli and they eat in response to those stimuli, regardless of their internal state of hunger and satiety (Rodin 1980) .

2.8.1 Cognitive restraint, susceptibility of hunger and disinhibition

The most widely studied eating behaviour factors are chronic dietary restraint, disinhibition and hunger sensation, which are assessed by the Three Factor eating Questionnaire (Stunkard & Messick 1985). Dietary restraint means “control over food intake in order to influence body weight and shape”. Disinhibition is defined as “episodes of loss of control over eating” and hunger as “subjective feelings of hunger and food cravings”.

Dietary restraint is often associated with successful weight loss, maintained weight loss and lower weight (table 6). However, the published study designs have varied extensively, some being cross-sectional studies of cohorts with normal and overweight subjects. Cognitive restraint is associated with issues affecting weight, for example reduced portion size (Bellisle & Dalix 2001) lower energy intake (de Castro & Lilenfeld 2005, Fogelholm *et al.* 1999, Provencher *et al.* 2003, Sarlio-Lähteenkorva & Rissanen 1998) and with the use of low energy density foods (Borg *et al.* 2004, de Castro 1995, Lähteenmäki & Tuorila 1995). Cognitive restraint as assessed by TFEQ can be considered “rigid” or “flexible”. Rigid restraint may lead to higher disinhibition which in turn might lead to losing control over eating (Provencher *et al.* 2003, Westenhoefer *et al.* 1999) and therefore also to poor success in weight loss. Therefore flexible dietary restraint may be more favourable for maintaining weight loss (Provencher *et al.* 2003, Westenhoefer 2001).

Disinhibition is associated with higher body weight or obesity, failing in maintenance (table 6) and issues which increase weight such as excessive intake of energy (Fogelholm *et al.* 1999, Provencher *et al.* 2003). Several studies have indicated that there is an interaction between disinhibition and restraint (Dykes *et al.* 2004, Sarlio-Lähteenkorva & Rissanen 1998, Westerterp-Plantenga *et al.* 1998).

Susceptibility to hunger is seldom associated with obesity related issues (table 6). However, it is higher among past dieters than non-dieters in a subpopulation of currently dieting women (Provencher *et al.* 2004) and it is associated with the level of obesity, i.e. the more obese the subject, the higher is her score for susceptibility to hunger (Provencher *et al.* 2003). However, opposite findings also exist, i.e. high prestudy hunger scores have predicted more weight loss (Fogelholm *et al.* 1999).

Table 6. The previous studies examining the associations of weight loss and eating behaviour measured by TFEQ.

Authors year of the publication	Number of subjects (Male/Female)	Country, Name	Data collection method	Study design, time frame	Main results
Lindroos <i>et al.</i> 1997	179 (0/179) obese, 147 (0/147) normal weight	Sweden	TFEQ	Cross sectional study, with normal weight control	Disinhibition is higher among obese than non-obese subjects.
Foster <i>et al.</i> 1998	223 (0/223) , obese	USA, University of Pennsylvania's Weight and Eating disorders program	Eating Inventory (EI)	Consecutive series of obese women enrolled in clinical trials of weight loss (no drugs), follow –up for 5-6 months.	Before: higher restraint score is associated with lower body weight. Weight loss is associated with increase of restraint and decrease of disinhibition and hunger. Greater weight loss is associated with greater increase of restraint.
Sarlio-Lähteenkorva & Rissanen 1998	9 (0/9), maintained weight loss, 42(0/42) obese control	Finland,	TFEQ	Cross-sectional study with control group. Previously achieved maintained weight loss in Weight Watchers.	Cognitive restraint is high in long term weight maintenance and it correlates negatively with energy intake and resting metabolic rate.
Westerterp-Plantenga <i>et al.</i> 1998	27 (0/27), overweight and obese	Netherlands	TFEQ (Dutch), Herman-Polivy restraint questionnaire	Weight loss intervention study with two intervention periods (2x 8 weeks, with VLCD) and two follow-up periods (2x 52 weeks). No control group.	Cognitive restraint is associated with success in weight loss. Cognitive restraint has a positive correlation to disinhibition.

Authors year of the publication	Number of subjects (Male/Female)	Country, Name	Data collection method	Study design, time frame	Main results
Fogelholm <i>et al.</i> 1999	85 (0/85), overweight or obese	Finland	TFEQ (Finnish)	Weight loss intervention study, 12 weeks weight loss period (VLCD) + 40 weeks maintenance with intervention	High disinhibition predicts poorly maintained weight loss. Restraint eating increases during weight reduction.
Drapeau <i>et al.</i> 2003	75 (30/45), normal- or overweight	Canadian (French), Quebec Family Study	TFEQ (French)	Prospective study, 2 visits with 6 years interval	Eating behaviour is different between women and men. The change of restraint behaviour is associated negatively with change of body weight. In women, high restraint behaviour is associated with weight gain, in men with prevention of weight gain.
Provencher <i>et al.</i> 2003	596 (244/352) also normal weight subjects	Canadian (French), Quebec family study	TFEQ (French Quebec version)	Cross sectional study,	Susceptibility of hunger and disinhibition are higher among obese subjects. Cognitive dietary restraint is not associated with obesity, but rigid and flexible restraint are oppositely associated to obesity status.
Dykes <i>et al.</i> 2004	1470 (0/1470), normal weight and overweight	Great Britain, Whitehall II Study	TFEQ	Cross-sectional study,	Disinhibition and hunger scores are associated with body size. Subjects with low restraint and high disinhibition are the heaviest while low-restraint- low disinhibition are the lightest.
Provencher <i>et al.</i> 2004	596 (244/352) also normal weight	Canadian (French), Quebec family study	TFEQ (French Quebec version)	Cross sectional study	High cognitive restraint and disinhibition are associated in current or past dieting. Women have higher cognitive restraint than men.

Authors year of the publication	Number of subjects (Male/Female)	Country, Name	Data collection method	Study design, time frame	Main results
Vogels <i>et al.</i> 2005	91 (29/62) obese	Netherlands, Maastricht Weight Maintenance study	TFEQ (Dutch translation)	Longitudinal study with Very low caloric diet (VLCD) for with follow-up at least for 2 years	Increased cognitive restraint is associated with maintained weight loss.
Chaput <i>et al.</i> 2005	11 (11/0). Obese	Canada	TFEQ (French version)	Longitudinal weight loss study which last was related to time needed for weight loss. Phase 1 (- 5kg) lasted 86 days, Phase 2 (-10kg) 84 days. No control group	During successful weight loss, cognitive restraint increases, whereas disinhibition and susceptibility to hunger decreases.
Vogels & Westerterp- Plantenga 2007	103 overweight and obese	Netherlands	TFEQ (Dutch translation)	Intervention study, weight loss period for 6 weeks (VLCD), 2- years follow- up, no control group	Increased dietary restraint is associated with success in maintained weight loss.
Dalle Grave <i>et al.</i> 2009	500(21%/79%) , obese	Italian, Quovadis study	Eating Inventory	Subjects treated at medical centres. Longitudinal study for 12 months.	Increased cognitive restraint and decreased disinhibition are independent predictors of BMI change.
Teixeira <i>et al.</i> 2010	225 (0/225), overweight and obese	Portugal	TFEQ	Randomized controlled weight management intervention, 12 months, follow-up at 24 months	Lower emotional eating, increased flexible cognitive restraint mediate 24 month weight loss (also exercise self-efficacy).

2.8.2 Cognitive restraint, uncontrolled eating and emotional eating

The TFEQ questionnaire has been developed further. Karlsson *et al* (Karlsson *et al.* 2000) evaluated the construct validity of TFEQ with Swedish obese subjects and noted that the item-scale convergence was unsatisfactory. They constructed a short, revised TFEQ-18 questionnaire, which included 18 items representing cognitive restraint, uncontrolled eating and emotional eating. Cognitive restraint describes the same behaviour as previously in the TFEQ-version. New factors “uncontrolled eating” and “emotional eating” were created from items representing “hunger” and disinhibition” factors in the earlier version. Thus, the three eating behaviour factors assessed by TFEQ-18 questionnaire are cognitive restraint (control over food intake in order to influence body weight and body shape), uncontrolled eating (overall difficulties in the regulation of eating) and emotional eating (overeating during dysphoric mood states) (Karlsson *et al.* 2000).

This new version of the TFEQ questionnaire is seldom used and the studies where it has been used are mainly cross-sectional focusing on food or dietary intake. The existing studies indicate that cognitive restraint is associated with healthy choices and with use of low energy density foods (de Lauzon *et al.* 2004) and better weight control among subjects losing weight but with problems with eating if the subject is normal weight and never dieting (Konttinen *et al.* 2009).

Uncontrolled eating is associated with higher energy intake or use of foods rich in energy (de Lauzon *et al.* 2004) and with a liking for salty-and-fatty foods (Keskitalo *et al.* 2008). Emotional eating is associated with high consumption of snacks and sweet- and fatty- foods in the normal weight population (de Lauzon *et al.* 2004) and with a liking for sweet-and-fatty foods (Keskitalo *et al.* 2008) and is related to a higher body mass (Konttinen *et al.* 2010). Emotional eating (assessed by EE-questionnaire) mediated the neurotic predisposition and had an effect on weight loss (Canetti *et al.* 2009). Emotional eating as assessed by the Dutch Eating Behaviour Questionnaire (DEBQ), was stated to be a moderator between food intake and food deprivation in a small sample of moderately obese women (van Strien & Ouwens 2003).

2.8.3 Binge eating and weight loss

Binge eating means recurrent episodes of uncontrolled eating: large amount of food is eaten rapidly with a sense of lack of control over eating during the episode (American Psychiatric Association 2010). It can be assessed by the Binge eating

Scale-questionnaire or by DSM-IV diagnostic methods. However, it is not yet designated as a “real” diagnosis in the DSM-IV criteria, but is listed in Appendix “B”. In the future, it is recommended that it will be included in DSM-V (American Psychiatric Association 2010). The binge eating disorder is associated with co-occurring physical and mental illness, impaired quality of life and social functioning (Wilfley *et al.* 2003) and dichotomous reasoning and psychological distress leading to the need for professional help (Ramacciotti *et al.* 2008). In addition, obese subjects with a binge eating disorder are more often depressed and exhibit more severe eating-related psychopathology than obese subjects without BED (Fassino *et al.* 2003). Obese women, subjects with binge-eating or morbidly obese ($BMI > 40 \text{ kg}^2$) are at a greater risk for suffering some psychopathology, i.e. depression (Fabricatore & Wadden 2004).

Literature about the associations between binge eating and success in weight loss is conflicting. High binge eating scores have predicted less weight loss (Fogelholm *et al.* 1999) and reduced binge eating has been associated with weight loss (Dalle Grave *et al.* 2010). Binge eating is associated with emotional eating (Ricca *et al.* 2009) and the existence of BED has some effects on weight loss (Sherwood *et al.* 1999, Yanovski *et al.* 1994). However, counselling and cognitive psychotherapy without medication were not effective ways to treat binge eating (Brambilla *et al.* 2009). Otherwise, Delinsky *et al.* (2006) found that binge eating does not affect the weight loss result when a particular weight loss program has been used. The subjects with subthreshold binge eating and full-syndrome binge eating benefitted from treatment that includes cognitive behavioural therapy (Friederich *et al.* 2007). Subthreshold eating disorders or abnormal eating behaviour are more prevalent than the diagnosed eating disorders (Crow *et al.* 2002, Ricca *et al.* 2009, Stice *et al.* 2009).

2.8.4 Effect of emotions and depression on eating behaviour

The factors mediating the eating psychopathology in obese subjects are still unknown. Heightened response to specific foods or greater pleasure from eating is assumed to be one explanatory issue behind obesity (Mela 2006). Moreover, according to the psychosomatic theory of eating, some individuals respond to arousal (anger, fear, anxiety) by excessive eating which is due to an inability to differentiate between the need for food from other uncomfortable sensations and feelings (Ouwens *et al.* 2003, van Strien & Ouwens 2007). Therefore, it is obvious that emotions affect eating behaviour and in obese individuals, these

emotion-related associations are stronger than in non-obese individuals (Macht *et al.* 2002). Anger increases feelings of hunger and the tendency to impulsive eating, whereas joy increases appetite, food intake and hedonic eating (Canetti *et al.* 2002, Macht 1999, Macht *et al.* 2002). Emotional eating could be one factor explaining the association between depressive symptoms and consumption of sweet foods (Konttinen *et al.* 2010) or a potential mediating mechanism between depression and obesity (Ouwens *et al.* 2009). Moreover, in obese subjects, also the anxiety trait is a risk for emotional eating (Schneider *et al.* 2010).

The development of emotion regulation is essential to the development of self-regulation. In infancy, the child experiences emotions and learns to regulate them. In adulthood, emotional experience and the expression of emotions can be dysfunctional both in terms of under- and over-control. For example, fear of one's own anger, may lead to its suppression, evoking extreme numbing behaviours, like binge eating (Connolly *et al.* 2007, Greenberg & Paivio 1997). This might be the basis for the association between emotions, anhedonia, depression and eating behaviour.

2.9 Physiological, sensory and environmental factors affecting dietary intake and food choices

Physiological factors include hormonal and neural regulation of appetite and satiety. Hormones and cytokines exert long-term-effects of energy balance by controlling feeding and energy expenditure (Ahima & Antwi 2008). Neurons located in the hypothalamus and brainstem are involved in homeostatic regulation of eating and the limbic system mediates the reward and motivation of eating. Of appetite regulating hormones, higher ghrelin levels, are associated with restraint eating (Schur *et al.* 2008). High sensitivity to reward is associated with overeating and a preference for sweet and fatty foods (Davis *et al.* 2007). However, even though these are important issues, it is not possible to change these factors by weight loss counselling. These physiological factors need to be recognised, but at the moment, there is no clinical relevant way in which the knowledge of them can be utilized in the management of obesity.

The sensory (taste, olfactory, visual, tactile, auditory) characteristics of foods are important in food choice and also participate in the biological learning of preferences and aversions (Bellisle 2003). These are not stable during a person's lifetime. Acute or chronic illnesses and aging are able to affect to sensory characteristics, preferences or aversions - or all of them (Bellisle 2003).

The stimuli present in an environment in which the person lives, will have an influence e.g. on selection of the food, food amounts and meal times (Bellisle 2003). Environmental cues and marketing might affect liking and wantings and these can affect food intake (Mela 2006). For example, the portion sizes of many foods have increased and this has been associated with increased intake of energy and thus with obesity (Ello-Martin *et al.* 2005, Rolls *et al.* 2006). Moreover, an individual's socioeconomic characteristics can affect food choices. A low socio-economic position is associated with less healthy food habits (Giskes *et al.* 2006, Lallukka *et al.* 2007). In Finland, also the geographical area in which the individual lives affects abdominal obesity (Lahti-Koski *et al.* 2008). However, in the Netherlands, no area-level socio-economic characteristics of diet were found (Giskes *et al.* 2006). The difference between Finland and the Netherlands may be explained by the area of these countries; Finland is eight times larger than the Netherlands but has only 1/3 of its inhabitants.

The genetic contribution of eating behaviour traits is controversial. Tholin *et al.* (2005) found high heritability of eating behaviour traits. Keskitalo *et al.* (2008) have stated that the uncontrolled eating has a high heritability estimate but other traits have low contribution or are affected by gender. Provencher *et al.* (2005) found that these behaviours have a familial correlation but minor genetic contribution.

2.10 Assessment of dietary intake and eating behaviour

The food record method is based on foods and their amounts actually consumed by an individual on one or more specific days (Buzzard 1998). To avoid misreporting due to memory, the subjects are asked to record the food intake at the time when the foods are eaten. Food amounts are quantified by weighing or using household measures, i.e. "cups", "spoons" etc. Subjects are trained to measure the food amounts and to complete the record accurately. When food records are returned, a trained nutritionist can check the diaries to ensure that there has been an adequate level of detail in describing foods and food preparation methods (Buzzard 1998). The strengths of food records are: the possibility to assess absolute intake of energy and macronutrients, the information does not rely on memory, portion sizes are measured and the open ended booking enables reporting of any food or food combination by the subject (Buzzard 1998). The possible weaknesses of this method are; the method's possible influence on

the eating habits and dietary intake, the question of whether the recorded days can be generalized to overall intake and misreporting.

Energy misreporting is a common problem in dietary intake studies. Misreporting might represent either underreporting or over reporting. Although underreporting is more common (2–85% of various populations), the possibility of over reporting needs to be borne in mind because it has been claimed that between 1–39% of subjects of various populations might over-report (Maurer *et al.* 2006). The association between underreporting and BMI is contradictory, even though a number of studies have found that people with a higher BMI more often underreport their energy intake (Maurer *et al.* 2006). The factors influencing the accuracy of self-reported dietary intake are also conflicting. Social desirability and increased restraint eating have the strongest associations with energy underreporting (Maurer *et al.* 2006) but it has not been shown that it exists in both normal and overweight subjects. In non-obese subjects, high restraint is associated with underreporting in both, women and men as well as with disinhibition in men (Asbeck *et al.* 2002). Among obese weight loss seeking subjects, a lower education, unrealistic weight loss goals, higher perceived exercise competence, more social support to exercise, more body-shape concern and a higher perception of physical condition are factors which are predictive for underreporting (Abbot *et al.* 2008). It does seem that the nutrient intakes, however, expressed as a percentage of total energy intakes are unbiased even when energy intake itself is underreported (Buzzard 1998).

The psychological traits of eating behaviour can be assessed through different kinds of questionnaires; of these the most often used is Three Factor Eating Questionnaire (TFEQ) (Stunkard & Messick 1985). Some others are, the Three Factor eating questionnaire-18, the Three Factor eating questionnaire-21, the EDE-Q, Restraint Scale, DEBQ and EES. The Three Factor Eating Questionnaire-18 (TFEQ-18) is a short revised version of the original TFEQ questionnaire. The item-scale convergence of the original TFEQ was assessed as being unsatisfactory in Swedish obese subjects (Karlsson *et al.* 2000) The TFEQ-18 questionnaire includes 18 items representing cognitive restraint, uncontrolled eating and emotional eating (Karlsson *et al.* 2000). This has been also translated into Finnish and it can be used in clinical practice. The Binge Eating Scale (BES) is one of the self-administered assessments of binge eating disorder symptoms and frequency (Gormally *et al.* 1982). The Eating Disorders Examination Questionnaire with Instructions (EDE-Q-I) is the most versatile for assessing the frequency of binge eating but the BES and the QEWP-R (the Questionnaire for eating and weight

pattern-Revised) perform also satisfactorily as screens for the diagnosis of BED (Celio *et al.* 2004). BES has been translated into Finnish and therefore it can be used in Finnish subjects.

3 Purpose of the present study

The aims of this study were:

1. To study whether intensive counselling is more effective than short-term counselling in improving weight loss and maintenance and in improving eating behaviour. Moreover, it was we studied whether simultaneous improvements in eating behaviour could explain the success in weight loss maintenance.
2. To study the association of pre-existing unhealthy habits, low eating control and poor psychosocial resources (marital status, free time, working, mental resources) with discontinuation from a weight loss program.
3. To study whether individuals suffering from anhedonia would differ from those not suffering from this disorder with respect to eating behaviour and weight loss result.
4. To study the associations between eating behaviour and dietary intake in overweight or obese adults before and after a weight loss intervention and after a follow-up period.

4 Study design, subjects and methods

4.1 Study design

This study was performed as a part of the Life Style Intervention Treatment Evaluation (LITE) –study, which is a randomized weight loss study with a one year follow-up period being conducted in the Oulu University Hospital, Finland. The study was organized by the Department of Internal Medicine in collaboration with the Department of Psychiatry and the Department of Physical Medicine and Rehabilitation. It was conducted between 2002–2004.

The study lasted 18 months. The first study visit was a screening visit at 0 month (baseline) when all subjects provided written informed consent to participate in the study. The counselling started one month after the screening visit. The follow-up visits took place 6, 12 and 18 months after the baseline (figure 1).

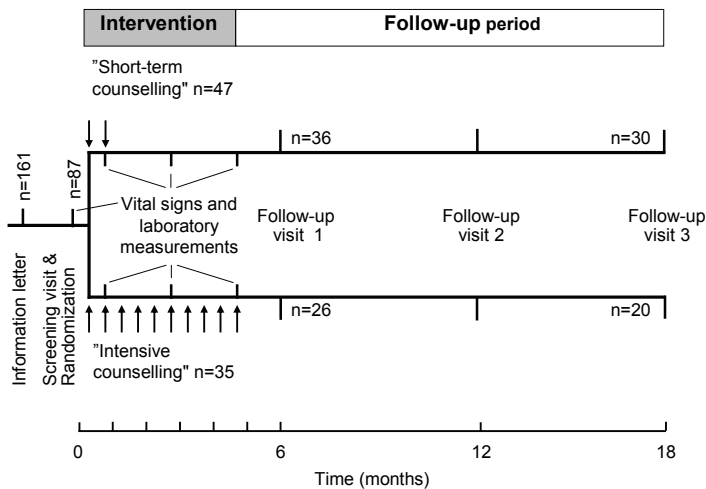


Fig. 1. The study design of LITE-study (I, published by permission of Elsevier).

At the baseline visit and all follow-up visits, a physical examination was conducted by a medical doctor and weight, height, waist circumference and blood pressure were measured by a study nurse and electrocardiograph and laboratory tests were taken. The subjects returned food diaries and filled out questionnaires measuring their eating behaviour and work ability index. Moreover, weight was

measured at every visit (including counselling visits) and blood pressure and waist circumference were measured and food diaries and questionnaires were returned at the counselling visits 6 and 10. Because of the study measurements, the control group had two additional visits at the same time as counselling visits 6 and 10 for the intervention group.

Moreover, a psychiatrist interviewed the subjects at 0, 6 and 12 months. No psychiatric counselling was given, but if depression or other psychiatric disorders were found, the subject was asked to contact the local health care centre. A physician interviewed the subjects and conducted muscle strength tests at 0, 6 and 12 months. Random motion of the spine and neck were measured by a physiotherapist. All subjects were individually encouraged by the physician to increase their physical activity.

The results of health related biomarkers, (such as laboratory results), work ability index, physical capacity and physical activity will be published by other investigators in the study group.

4.2 Subjects

The study subjects were solicited by means of a newspaper article advertising an obesity drug trial. Not all respondents were able to participate due to competitive recruitment of a drug trial and therefore to 161 individuals from 239 who were at first interested in the drug trial, was sent a formal invitation to LITE-study. In all, 87 interested subjects fulfilling the inclusion criteria (age 18–65, body mass index, BMI >27 kg/m²) were invited to a screening visit (baseline visit). Exclusion criteria were current participation in another weight loss program, laboratory test results falling outside of the normal range or a clinically significant illness that contraindicated either weight loss or physical activity. Those who were excluded according to these criteria from LITE-study (n=5) were transferred to the care of normal health care systems.

There was a 82 study subjects (23 male and 59 female) who were randomized into the intensive or short-term counselling groups. The original assumption was that there would be more dropouts in the short-term counselling group because the subjects were seeking help or advice for their weight problem. Therefore, 55% of subjects were randomized to the short-term intervention and 45% to the intensive intervention. This ratio was achieved in the initial randomisation even without blocking, i.e. 48 subjects (55%) in the short-term group and 39 subjects (45%) in the intensive group (n=87). However, later a shift in the ratio occurred,

however. After the first visit only one subject was excluded from the short-term group while four subjects were excluded from the intensive counselling group. Moreover, there were more dropouts in the intensive counselling group at 18 months which explains the difference in the sizes of the intervention groups. At the end, the intensive counselling-group consisted of 35 study subjects with 47 and in the short-term counselling group. The background variables of intervention and control groups are presented in table 5. During the first 6 months (intervention period) 20 subjects (27%) discontinued their participation in the study; 9 of them belonged to the intensive counselling group and 11 to the short-term counselling group (figure 2). In addition, before the end of the study 12 subjects discontinued the study. Consequently 50 subjects were still at the end of the study. The drop-out rate was 39% i.e. a total of 32 discontinued subjects (15 in intensive counselling group and 17 in short-term counselling group).

Table 7. Background characteristics of the LITE-study subjects¹ (I, published by permission of Elsevier).

Characteristics	All randomized n=82			"Completers" n=49		
	All	Intensive n=35	Short-term n=47	All	Intensive n=20	Short-term n=29
Weight (kg, mean)	98±19	97±17	98±20	97±20	98±18	97±21
BMI (kg/m ² , mean)	35±5	35±5	35±5	35±5	35±5	35±6
Age (years, mean)	49±9	50±8	49±9	51±8	52±7	51±9
Male (%)	28	26	30	25	25	24
Non-smoking (%)	71	77	66	80	90	72
Married or co-habited (%)	78	86	72	86	95	79
Working status (%)						
Full-time	66	63	68	61	55	66
Unemployed	6	9	4	8	15	3
Sick leaves or retired	23	26	21	28	30	27
Other	5	3	6	2	0	3
Education (%)						
Comprehensive education	12	9	15	10	11	10
Vocational training	22	24	21	20	16	24
College	42	50	36	43	53	38
University or polytechnic	23	18	28	25	21	28

¹ Values are means ± SD or percentage. No statistical difference between the groups (t-test, chi-squared test or Fisher's exact)

The number of study subjects was 49 in studies 1 and 4, i.e. those who completed the study. One subject was excluded because of the use of medication which affected the body weight. A total of 82 subjects were included studies 2 and 3. In study 4, there were some missing values in food records and TFEQ-18 questionnaires at 18 months and therefore when presenting the results of dietary intake by counselling groups, the number of subjects is 45 and for the correlations between eating behaviour and dietary intake, the number of subjects is 44.

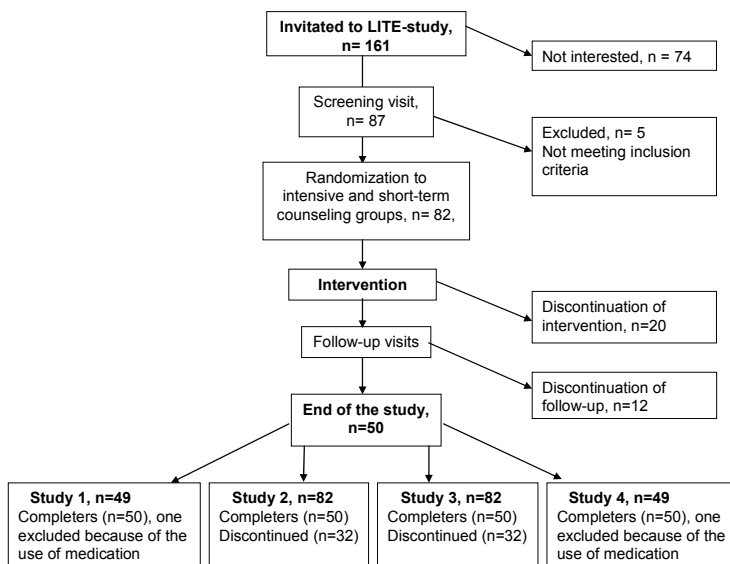


Fig. 2. The flow chart of the study subjects in LITE-study.

4.3 Intervention

The aim of the intervention was to examine the effects of two different weight loss programs on weight loss and maintenance together with the predictors and consequences of sustained weight loss. The frame of the counselling in both groups was based on the first version of Finnish Current Care of Adult obesity (Aikuisten lihavuus: käypä hoito-suositus 2002). The intensive counselling was based on the design of basic treatment and the short-term counselling on the short-term treatment. Realistic weight loss goal setting, Finnish Nutrition recommendations by the National Nutrition Council (National Nutrition Council 2005), regular meal rhythms, sustained small changes in diet and eating habits based on personal earlier choices and habits together with earlier experiences of weight loss formed the basis for dietary counselling in both groups (table 8 and 9). All subjects were individually encouraged by physician to increase physical activity at the same time when the physician interviewed the subjects and recorded muscle strength at 0, 6 and 12 months.

The intensive counselling provided to the intervention group included both individual and group counselling; altogether ten visits every second week lasting for 20 weeks (figure 1, table 8). The main concept was to help subjects to recognize and solve their problems related to diet, eating habits and eating behaviour (mainly stress related eating). The methods used were for example self-monitoring, problem solving and goal-setting. The subjects made homework related to personal diet, eating habits or eating behaviour and they were encouraged to take by themselves the responsibility for the changes. Counselling was conducted by two clinical nutritionists. The group sessions included a short introduction to the theme, teamwork, group conversation and presentation of homework. Homework was rather general, e.g. to bring a healthy packed lunch, or personal (recognize risk situations for overeating) which were discussed in individual counselling visits.

The short-term counselling of the control group included two visits at a two week interval and included only individual dietary counselling given by two nurses who had experience in obesity management (table 9). The content of the dietary counselling was similar to the intensive counselling at the two first visits.

Table 8. The counselling protocol of the intensive counselling group in the LITE-study.

Visits, Theme	Content of the counselling visit, Intensive counselling
1 st visit, personal Preparing for weight loss	Motivation, Realistic weight loss goal, Recognize own dietary habits (by frequency questionnaire, filled before first visit), Principal goals of recommended eating ¹ <i>Homework: planning of personal dietary changes, fat and fibre tests²</i>
2 nd visit, personal Planning of change	Counsellor supports the own planning and gives advices if needed <i>Homework: to plan and bring healthy packed lunch for a snack or a meal</i>
3 rd visit, group Healthy cooking	Group discussion about personal choices for packed lunch; what is important? How to make low fat food; presentation and group discussion
4 th visit, group Recognize emotional and stress eating	What kinds of feelings or habits might induce eating, what is stress related eating <i>Homework: to recognize and find solutions for own emotional or stress related eating by "chain of eating".</i>
5 th visit, group Risky situations of overeating, solutions	Parties, holidays, work, free time: how to manage in those situations <i>Homework: Recognize and find solutions for own risky situations, assessment of personal dietary changes</i>
6 th visit, personal Evaluation and adjustment of dietary changes	Discussion by diet diary and personal assessment (homework) <i>Homework: Adjusted personal changes</i>
7 th visit, personal Risk factors involved in overeating, stress- and emotional eating	Discussion about recognized emotional eating, stress-eating and risky situations and their solutions <i>Homework: practice on how to minimize personal problems</i>
8 th visit, group Barriers to changes	Recognizing the barriers to the dietary or other behavioural changes <i>Homework: Recognize personal barriers to changes</i>
9 th visit, group Benefits and sacrifices of weight loss	Recognizing benefits and sacrifices and find solutions for some of them <i>Homework: Recognize personal benefits and sacrifices</i> <i>Assessment of own lifestyle changes</i>
10 th visit, personal How to continue?	Personal discussion about benefits of achieved weight loss, goals, success and failures of changes, support for independent weight loss and maintenance

¹ Principal goals of recommended eating: regular eating frequency, small portion size: use of plate model, slow eating, balanced diet: vegetables, fruits and berries 500g/d, enough cereal products, milk products and fish or meat, good quality of fat: low fat or fat free meat and dairy products, use of vegetable oil or -margarine, low salt.
These were illustrated by pictures from the Finnish Diabetes Association (1200 kcal and 1800 kcal)

² Fibre-test of the Finnish Bread Information: www.leipatiedotus.fi, Fat-test of the Finnish Heart Association: www.sydanliitto.fi

Table 9. The counselling protocol of the short-term counselling group in the LITE-study.

Visits, Theme	Content of the counselling visit, Short-term Counselling
1 st visit, personal Preparing for weight loss	Motivation, Realistic weight loss goal, Recognize own dietary habits (by frequency questionnaire, filled in before first visit), Principal goals of recommended eating ¹ <i>Homework: planning of personal dietary changes, fat and fibre tests²</i>
2 nd visit, personal Planning of change	Counsellor supports the own planning and gives advices if needed Control of sweet or fatty nibbling, emotional or stress related eating and basics of healthy cooking
3 rd visit	No visit
4 th visit	No visit
5 th visit	No visit
6 th visit	Study measurements
7 th visit	No visit
8 th visit	No visit
9 th visit	No visit
10 th visit	Study measurements

¹ Principal goals of recommended eating: regular eating frequency, small portion size: use of plate model, slow eating, balanced diet: vegetables, fruits and berries 500g/d, enough cereal products, milk products and fish or meat, good quality of fat: low fat or fat free meat and dairy products, use of vegetable oil or -margarine, low salt.

These were illustrated by pictures of from the Finnish Diabetes Association (1200 kcal and 1800 kcal)

² Fibre-test of the Finnish Bread Information: www.leipatiedotus.fi, Fat-test of the Finnish Heart Association: www.sydanliitto.fi

4.4 Methods

4.4.1 Three Factor Eating Questionnaire -18 (TFEQ-18)(Study I,II,III,V)

Cognitive restraint (control over food intake in order to influence body weight), uncontrolled eating (overall difficulties in regulation of eating) and emotional eating (overeating during dysphoric mood states) were assessed by the Three Factor Eating Questionnaire (TFEQ)-18 questionnaire (Karlsson *et al.* 2000). In TFEQ-18, the results are calculated as a percentage of the highest possible value and the score is between 0–100 percent.

4.4.2 Binge Eating Scale (Study I, II, III)

Symptoms of binge-eating disorder were measured by the Finnish version of the Binge Eating Scale (BES)-questionnaire (Gormally *et al.* 1982). The questionnaire has cut-point limits for categories; no binge eating <20 points, Moderate binge eating, 20–30 points, or Severe binge eating >30 points.

4.4.3 Body weight (Study I, II, III, IV)

Body weight was measured with a calibrated scale at every study visit (0, 6, 12 and 18 months) and also at all counselling visits (figure 1). Height was measured and the body mass index (BMI) was calculated as weight in kilograms divided by squared height in meters (kg/m^2). A separate graph was also produced of the weight responses against time (0–6–18 months) for each subject. It was noted that four different subgroups existed: 1) those who succeeded in maintaining their weight loss result, 2) those who succeeded in maintaining their weight loss moderately 3) those who lost weight but were not able to maintain it 4) those who were not able to lose weight at all. These four subgroups of subjects have also been recognized in clinical work and thus this classification has relevance to actual clinical situation. The classification into these four subgroups is also justified by the fact that the maintenance of 10 to 5% weight loss is often recommended as a goal (Adult Obesity: Current Care 2011, Aikuisten lihavuus: Käypä hoito-suositus 2002, Noel & Pugh 2002, Tsigos *et al.* 2008). These four subgroups were named as: 1) *Successful* (weight loss and maintenance at least 5%), 2) *Moderate success* (weight loss and maintenance 4% to 0.5%) 3) *Failure in weight maintenance* (weight loss at least 0.5% but no maintenance 4) *Failure in weight loss* (no weight loss or maintenance).

4.4.4 Discontinuation (Study II)

The discontinuation from the LITE program was evaluated at 6-month and 18-month-follow-up visits. Completers were those who remained in the program throughout the study, whereas drop-outs were those who dropped out of the program.

4.4.5 Health habits (Study II)

The weight loss goal was determined by the question: “What body weight would you like to achieve?” The percentage of weight loss goal from weight measured during screening visit was calculated.

The health habits were assessed by questionnaires at the 0-month visit. The physical activity was evaluated via the question “How many times do you take exercise during one week” with four response options which were recoded into three groups (at least three times / week, once or twice /week, not at all). The current smoking status was asked by a question “Do you smoke?” with three alternatives “not at all, occasionally, regularly” and were also dichotomized (0= not at all, 1=occasionally or regularly). A frequency questionnaire assessed the consumption of alcohol and daily use was calculated.

4.4.6 Psychosocial resources (Study II)

Psychosocial resources (social support, working status, free time, mental resources) were assessed by questionnaires. Social support was measured indirectly by marital status because it was interpreted that marriage was a potential source of social support from the spouse and an indirect reflection of overall social support. Working status and reported free time described the subject’s life situation: opportunities for undertaking part in, and the time for implementing lifestyle changes. Self-reported free time was assessed from the question: “*In your opinion, how much free-time have you got (outside of work or housework)?*”, which contained four response options: “much”, “sufficient”, “some” and “none at all”, and were dichotomized (0= none at all /some and 1= sufficient or much). Mental resources were estimated from the sum scale of three questions of Finnish Work Ability Index (Tuomi *et al.* 1992): *Have you recently been able to enjoy your regular daily activities?; Have you recently felt active and alert?; and Have you recently felt hopeful about the future?* The responses were recoded into a four-point scale from 1= no mental resources to 4= extensive mental resources which were the dichotomized (0=minor or absent resources, 1=sufficient or extensive resources).

4.4.7 Anhedonia (Study III)

The participants were interviewed by a psychiatrist three times at the 0, 6 and 12 months visits. Anhedonia was assessed as one of the core symptoms of major depression or dysthymia by SCID-I (Structured Clinical Interview for DSM-IV Axis I Disorders) (Spitzer *et al.* 1989). Anhedonia was defined to be present if the participants reported suffering major loss of interest during the past month.

4.4.8 Dietary intake (Study IV)

Dietary intake (meaning intake of energy, energy nutrients, alcohol and fibre), was assessed at 0, 3, 6, and 12 and 18 months from the 5-day food record that included two weekend days. The average intakes of total energy (kcal and KJ), fibre (g/1000kcal), and percentage of energy intake from fat, carbohydrates, protein and alcohol were analyzed using the Diet-32 program and is being based on the Finnish Food Composition Database, Fineli (National Institute for Health and Welfare, Nutrition Unit 2010) developed in the National Public Health Institute, Helsinki, Finland. To minimize the possible bias due to energy misreporting, it was requested that the food records should be recorded for consecutive five days (including two weekend days) by using household measures as accurately as possible and after completion the food records were reviewed by a trained nutritionist or experienced nurse to ensure that there was an adequate level of detail in describing foods and food preparation methods. These are recognized methods for increasing the reliability of the data (Buzzard 1998).

4.4.9 Statistical analysis

Data analyses (table 10) were performed with the software package SPSS for Windows (© SPSS Inc., Chicago, USA). (Study 1 and 3 version 13, study 2 version 14 and 16 and study 4 version 16). Differences were considered significant at $p < 0.05$ (two-sided). The total number of subjects recruited was based on a power analysis to detect a 4.2% weight loss for intervention group and 0.8% for control group, which were the one year weight loss results from the Diabetes Prevention Study (Tuomilehto *et al.* 2001). The results of continuous variables are presented as mean values with standard deviation (SD), median with quartiles or 95% confidence intervals. The results of categorical variables are percentages. When reporting the change in dietary intake and eating behaviour

between baseline to 18 months and the food intake by the tertiles of cognitive restraint, the mean or median with CI95% of quartiles are presented.

Study 1

In the statistical analysis, first a suitable summary of the response in the individual was identified and secondly these summary measures were analyzed by simple statistical techniques as though they were raw data (Altman 1991, Matthews *et al.* 1990). Consequently, the overall post-intervention mean of weight (weight loss, kilograms) was calculated for each subject, and a T-test for independent samples was used to test the difference between the counselling groups. The paired samples T-test was used to test the statistical significance of the change in eating behaviour and weight loss within each counselling group. The effect sizes (ES) were also calculated for weight loss.

When studying the effect of eating behaviour on weight loss maintenance, the study subjects (n=49) were classified according to their personal weight responses over time (0–6–18 months) into four subgroups; successful, moderate success, failure in weight maintenance and failure in weight loss. In addition, three subjects did not meet these criteria, because they did not lose weight during intervention but lost weight during the follow-up. These subjects were excluded from the statistical analyses of the subgroups. An ANOVA for independent groups and ANCOVA were used to test the difference in eating behaviour between the four weight loss subgroups.

Study 2

No statistically significant difference in weight loss program discontinuation was detected between the participants in the intensive counselling group and those in short-term counselling group and therefore they were pooled for analysis in order to detect the predictors related to the participants themselves and to obtain a higher statistical power in the analyses.

The statistical differences were analyzed between completers and drop-outs. Pearson's Chi-square test or Fisher's exact test estimated the statistical significance of the association between categorical variables. In the continuous variables, the significance of the differences was tested using the T-test for independent groups or Mann-Whitney-test. Finally, a multivariate logistic

regression analysis was performed to study the independent associations between six explanatory variables and outcome (discontinuation).

Study 3

Differences between the counselling groups for anhedonia were assessed by Pearson's chi-square and Fisher's exact tests. No statistically significant difference in anhedonia was detected between participants from the intensive and the short-term counselling groups and therefore they were pooled for analysis. The statistical significance of group differences in anhedonia (yes/no) in the continuous variables was assessed with Student's t-test and in the categorical variables with Pearson's Chi-square or Fisher's Exact test. All analyses were done in two ways: 1) replacing the missing values by using the LOCF (last observation carried forward) method, and, 2) missing values were not replaced.

Study 4

The differences of normally distributed variables between counselling groups were tested by mixed between-within subjects analysis of variance with Mann-Whitney and Wilcoxon Signed Rank Tests. T-test for independent samples and the significance of change was assessed by T-test for paired samples if there was a significant interaction between counselling groups and time. Pearson or Spearman correlation coefficients were calculated to determine the relationships between eating behaviour and dietary intake in pooled study subjects. Moreover, at 18 months, the study subjects were assigned to three groups by tertiles of their score in the cognitive restraint assessment. These subgroups were "low", "moderate" and "high". Differences in the dietary intake were evaluated between these subgroups by ANOVA with Tukey post-hoc comparisons or with Kruskal-Wallis. The differences in weight loss were also assessed by ANCOVA, because there was a difference in baseline BMI between the tertile groups. With respect to weight loss, the adjusted means and 95% confidence intervals controlled for BMI are also presented.

Dietary intake and weight loss

When studying the effect of dietary intake on weight loss maintenance, the same classification of the study subjects was used as in study 1 (four subgroups;

successful, moderate success, failure in weight maintenance and failure in weight loss). An ANOVA for independent groups and was used to test the difference in dietary intake between the four weight loss subgroups. The intake of alcohol was assessed by Kruskal-Wallis nonparametric test. These results have not previously been published.

Ethical considerations

The study was approved by the ethics committee of Northern Osterbothnia. All subjects gave written informed consent to participate in the study.

Table 10. The statistical tests used in LITE-study.

Statistical test	Used for	Study
Paired samples T-test	Comparing changes from baseline to 6 or 18 months	Study I, IV
Independent samples T-test	Comparing differences between groups (counselling, discontinuation, anhedonia), continuous variables	Study I, II, III, IV
Pearson Chi-square test, Fisher exact	Comparing differences between groups (counselling, discontinuation, anhedonia), categorical	Study I, II, III
Pearsons correlation coefficient	Associations between eating behaviour and dietary intake	Study IV
Spearman correlation coefficient	Associations between eating behaviour and dietary intake	Study IV
Anova	Comparing differences between groups	Study I, IV, Dietary intake and weight loss
Kruskal-Wallis h-test	Comparing differences between groups	Study IV, Dietary intake and weight loss
Tukey post hoc-comparisons	Assess the exact differences between the groups	Study IV
Ancova	Comparing differences between groups (cognitive restraint tertile groups)	Study I,IV
Mann-Whitney U-test	Comparing differences between groups (counselling, discontinuation) continuous variables	Study II, IV
Multivariate logistic regression analysis	To test the model to predict categorical outcomes	Study II
Mixed between-within subjects analysis of variance	Comparing interaction between time and group	Study IV
Wilcoxon Signed Rank Tests	Comparing interaction between time and group	Study IV
Effect size		Study I

5 Results

5.1 Impact of the intervention on eating behaviour, weight loss and dietary intake (studies I,IV)

During the first 3 months, the mean score of cognitive restraint increased and the mean scores of emotional eating, uncontrolled eating and binge eating symptoms decreased significantly ($p < 0.01$, both groups). They were maintained during the follow-up period in both counselling groups, but no statistically significant differences were observed between the counselling groups (figure 3). Both counselling groups lost weight significantly during the intervention period (5.0 ± 5.7 kg in the intervention group and 2.4 ± 2.5 kg in the control group) but the weight loss result was significantly higher in intensive counselling group than short-term counselling group at 6 months (first follow-up visit) (table 11). However, during the follow-up period, the subjects were not able to maintain the weight loss result they had initially achieved and the weight loss result at 18 months (2.6 ± 6 kg and 0.7 ± 3.5 kg) was no longer significant in neither counselling groups.

Table 11. The effect of counselling on weight loss and maintenance in LITE study.

Time period ¹	Intensive counselling kg (%) mean \pm SD n=20,	Short-term counselling kg (%) mean \pm SD n=29	p-value between the groups ²
0-1 month	0.3 \pm 1.0 (0.4 \pm 1.1)	-0.2 \pm 1.7 (-0.3 \pm 1.7)	0.21
1-3 months	-3.7 \pm 4.3 (-3.8 \pm 4.6)	-2.3 \pm 2.3 (-2.5 \pm 2.2)	0.15
1-5 months	-4.4 \pm 5.0 (-4.5 \pm 5.2)	-2.6 \pm 2.2 (-2.9 \pm 2.6)	0.14
1-6 months	-5.0 \pm 5.7 (-5.2 \pm 6.0)	-2.4 \pm 2.5 (-2.8 \pm 2.8)	0.03
1-18 months	-2.6 \pm 6.0 (-2.8 \pm 6.4)	-0.7 \pm 3.5 (-0.8 \pm 3.6)	0.16

¹ 0 = baseline, 1 month = beginning of the counselling, 5 months = end of intensive counselling,

6 months = first follow-up visit, 18 months = end of the study

² p-value for weight loss in kilograms (kg)

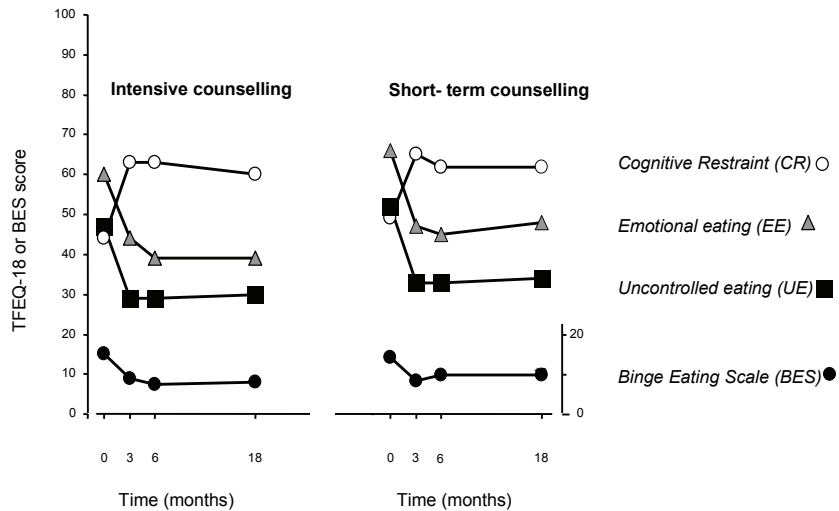


Fig. 3. The change of cognitive restraint, emotional eating, uncontrolled eating, binge eating symptoms and weight loss subdivided according to counselling groups during LITE-study. There were no statistically significant differences between the groups in scores or delta values at any time point. (1, modified and published by permission of Elsevier).

There were no differences between the counselling groups in intake of energy, carbohydrate, fat, sucrose, fibre or alcohol at the baseline (0 months) or 18 months (figure 4). The energy intake was 1810 kcal in the intensive counselling group and 1885 kcal in the short-term counselling group at baseline. The intake decreased during the study being 1769 kcal and 1728 kcal at 18 months though this decrease was not statistically significant. At 18 months, the intake of protein was significantly higher ($p < 0.05$) in the short-term group than in the intensive counselling group (figure 4).

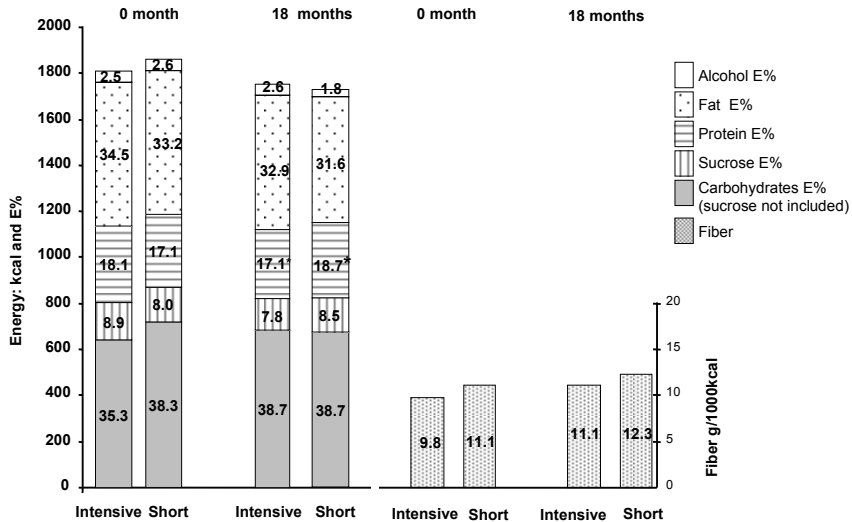


Fig. 4. Intake of carbohydrates, protein, fat and alcohol as energy % of total energy and intake of fibre as g/1000 kcal at 0 and 18 months in intensive counselling group and short-term counselling in LITE –study. *Statistically significant difference between the counselling group, $p < 0.05$.

5.2 Eating behaviour accounting for maintained weight loss and dietary intake

When studying the associations with eating behaviour and maintained weight loss, dietary intake or anhedonia, the counselling groups were combined because no significant differences were observed between them in terms of weight maintenance, eating behaviour, dietary intake or anhedonia between the counselling groups.

5.2.1 Maintained weight loss (study I)

Recommended (5–10% weight loss) and maintained weight loss were achieved by 8 subjects (17%), whereas 7 subjects (15%) failed to lose weight at all (table 12).

Already at the beginning of the study, the scores for uncontrolled eating and binge eating were higher among those who failed to achieve a weight loss

compared to those who succeeded (figure 5, table 12). However, during the first three months, eating behaviour changed similarly in both groups and there were no differences at the 3-month visit between the groups. After that time point, the success in maintained weight loss associated with certain improvements in eating behaviour.

Successful subjects were able to make sustained improvements; increase and maintain their cognitive restraint, and at the same time decrease their binge eating, emotional and uncontrolled eating (figure 5). Their maintained weight loss result was $9.3\pm 6.3\%$ at 18 months (table 12). In those individuals who failed to achieve a weight loss, all alterations in eating behaviour were opposite to those who succeeded and they had gained weight by $3.3\pm 1.7\%$ from 0 to 18 months (table 12). After adjustment for the delta values for 0 month eating behaviour scores, significant differences were observed in the changes in emotional eating, cognitive restraint and binge eating values between the different weight loss subgroups (emotional eating $p<0.03$, cognitive restraint $p<0.01$, binge eating $p<0.02$, ANCOVA).

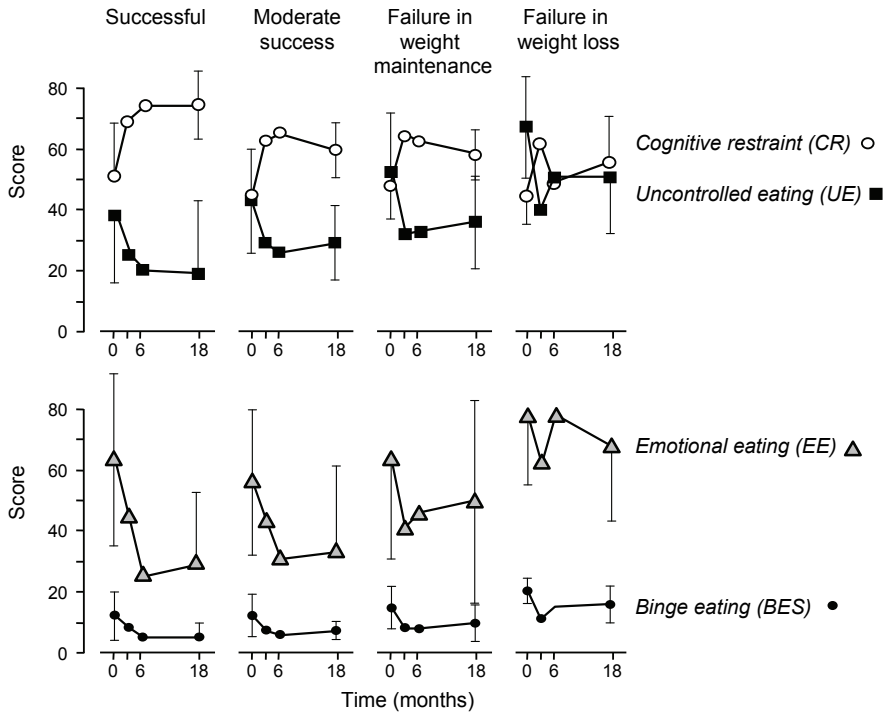


Fig. 5. The eating behaviour scores (mean±SD) of those who were successful, had moderate success, failure in weight maintenance or failure in weight loss in the LITE-study. At 0 months the score for UE was the highest among those who failed in weight loss ($p<0.05$ between the subgroups, ANOVA). The CR and UE were different between the subgroups at 6 and 18 months ($p\leq 0.01$, ANOVA). At 0 months the score for BES was highest among those who failed in weight loss ($p<0.05$, ANOVA). The EE and BES were different between the subgroups at 6 (both $p\leq 0.01$, ANOVA) and 18 months (EE $p<0.05$, BES $p<0.001$, ANOVA). (1, published by permission of Elsevier).

Table 12. Changes in weight (Weight Change, WC) and scores of eating behaviour (cognitive restraint (CR), emotional eating (EE), uncontrolled eating (UE) and binge eating symptoms (BES) during the LITE study according to success in weight loss and maintenance¹.

Weight or eating behaviour factor	Months	Successful n=8 (17%)	Moderate success n=16 (35%)	Failure in weight maintenance n=15 (33%)	Failure in weight loss n=7 (15%)	p-values
WC (%)	3	-7.1±5.3	-3.5±3.8	-2.5±2.1	-0.2±1.5	p<0.01
	6	-9.6±6.9	-4.7±2.6	-3.1±1.7	1.2±1.8	p<0.001
	18	-9.3±6.3	-2.4±1.4	1.4±1.8	3.3±1.7	p<0.001
CR	0	51±17	45±15	49±11	45±9	NS
	3	69±17	63±14	65±12	62±11	NS
	6	74±21	65±12	63±9	49±12	p<0.01
	18 ^a	74±11	60±9	59±8	56±15	p<0.05
EE	0	63±28	56±24	64±32	78±22	NS
	3	44±23	43±30	41±32	62±24	NS
	6	25±13	31±21	46±34	78±29	p<0.01
	18 ^a	29±23	33±28	50±33	68±24	p<0.05
UE	0	38±22	43±17	53±19	68±16	p<0.05
	3	25±17	29±12	32±17	40±13	NS
	6	20±19	26±12	33±17	51±21	p<0.01
	18 ^a	19±24	29±12	36±15	51±18	p<0.01
BES	0	12±8	13±7	15±7	21±4	p<0.05
	3	8±6	8±4	8±5	11±5	NS
	6 ^b	6±4	6±2.5	8±7	15±10	p<0.01
	18 ^a	5±5	7±3	10±6	16±6	p<0.01

¹Values are means ± SD, p-values obtained by ANOVA.

^aScores of three subjects are missing. ^bScore of one subject is missing.

5.2.2 Dietary intake (study IV)

Cognitive restraint had the strongest association with dietary intake. At baseline a high value of cognitive restraint (CR) was associated with low intake of energy ($r=-0.34$, $p=0.02$). At 18 months, it also associated with low fat intake ($r=-0.43$, $p<0.001$) and high intake of carbohydrates ($r=0.39$, $p=0.01$), sucrose ($r=0.33$,

$p=0.03$) and fibre ($r=0.44$, $p<0.001$) (figure 6). Thus, the higher was CR, the lower was the intake of energy and fat and the higher was the intake of carbohydrates, sucrose and fibre. The association between CR, fat, carbohydrates, or fibre was not present prior to the counselling period. The change in CR was associated with improved dietary intake from baseline to 18 months in energy ($r=-0.33$, $p=0.03$) and carbohydrates ($r=0.30$, $p=0.05$). The more the cognitive restraint increased, the more the intake of energy decreased and the more the intake of carbohydrates increased.

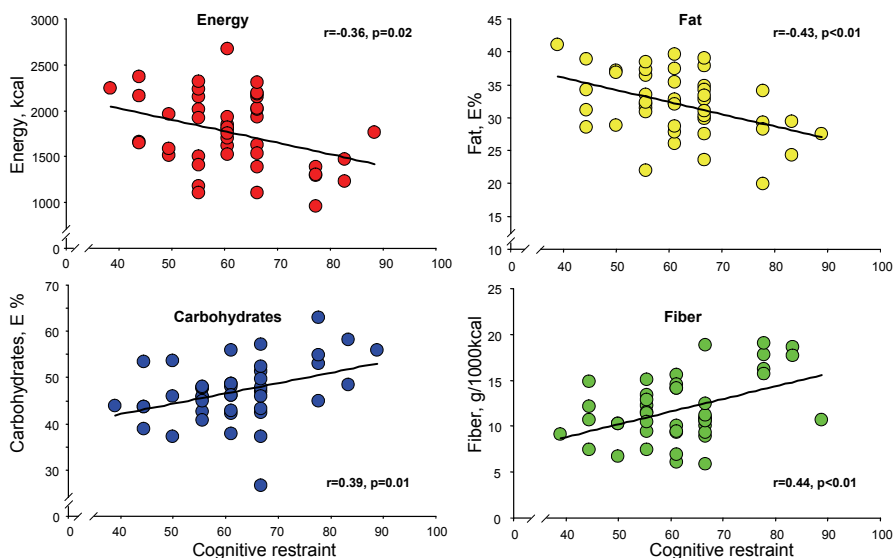


Fig. 6. The correlation of cognitive restraint to energy and energy nutrients at 18 months in LITE study.

At 18 months, the highest tertile of cognitive restraint associated with recommended diet for weight loss. The intakes of fibre (g/d) and carbohydrates (E%) were the highest and the intake of energy and fat (E%) were lowest in those individuals with the highest cognitive restraint (figure 7). The highest tertile of CR had also the highest weight loss result at 18 months compared to the lowest group 7.1kg (CI95%-15.6;1.4) compared to weight gain 0.7 kg (CI95% -0.6;1.9) ($p=0.002$ between the groups). The adjusted means controlled for baseline weight were -6.7 kg (CI95%-10.39;-2.98) weight loss and 0.3 kg (CI95%-2.19;2.82) weight gain, respectively. The other eating behaviour factors (uncontrolled eating

and emotional eating) did not display any major association with dietary intake. Only at the end of study (at 18 months follow-up visit) did uncontrolled eating correlate negatively with the intake of sucrose. Emotional eating exhibited no correlation with dietary intake.

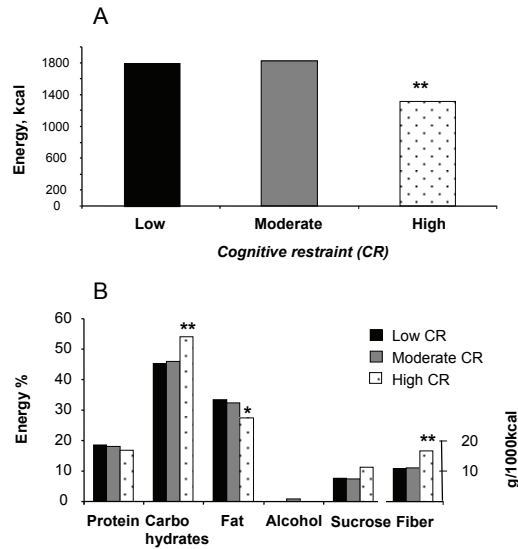


Fig. 7. The energy (A) and energy nutrient (B) intakes in the different cognitive restraint tertile groups at 18 months in LITE-study. * $p < 0.01$, ** $p < 0.001$.

5.2.3 Dietary intake and weight loss

Those who succeeded in weight loss had a lower intake of protein and a higher intake of carbohydrates and sucrose at 18 months (table 13).

Table 13. Dietary intake by success in weight loss and maintenance in LITE-study.

Weight or dietary intake factor	Month	Successful n=7	Moderate success n=16	Failure in weight maintenance n=14	Failure in weight loss n=6	p-values ¹
Weight change, %	18	-9.3±6.3	-2.4±1.4	1.4±1.8	3.3±1.7	p<0.001
Energy Kcal	0	1912±856	1763±543	1872±577	2053±616	0.80
	18	1569±398	1817±405	1795±366	1715±537	0.58
	change	-343±548	53.7±511	-77±502	-338±330	0.22
Protein E%	0	16.2±3.2	17.3±2.7	18.2±1.9	17.6±1.6	0.34
	18	15.8±2.4	17.6±2.2	19.5±2.8	19.1±2.7	0.013
	change	-0.3±2.7	0.3±3.4	1.3±2.9	1.5±2.6	0.60
Carbohydrate E%	0	48.0±6.5	47.0±4.3	42.8±6.2	44.9±1.5	0.09
	18	52.8±7.7	47.5±5.4	44.4±6.2	44.8±2.6	0.02
	change	4.8±7.8	0.4±3.9	1.5±6.9	-0.1±2.4	0.33
Fat E%	0	34.2±8.1	33.3±5.5	34.8±6.0	32.3±5.4	0.84
	18	29.8±6.5	32.2±4.1	32.5±4.9	34.2±5.3	0.45
	change	-4.4±6.8	-1.2±4.6	-2.3±7.1	1.9±1.4	0.24
Alcohol E% ^a	0	0.4 (0.0,1.4)	0.4 (0.0,2.6)	0.6 (0.0,4.6)	1.8 (0.0,10.8)	0.90 ^b
	18	0.03 (0.0,2.2)	0.9 (0.0,3.7)	0.0 (0.0,2.5)	0.0 (0.0,2.2)	0.68 ^b
	change	0.0 (-0.2,0.03)	0 (-0.09,2.2)	0.0 (-2.5,0.09)	-1.8 (-8.3,0.2)	0.21 ^b
Sucrose E%	0	9.6±4.0	9.1±3.3	7.4±3.5	7.9±2.6	0.41
	18	11.0±4.5	9.6±4.1	6.5±3.0	5.1±2.8	0.008
	change	1.3±2.7	0.5±3.1	-0.8±2.7	-2.9±4.6	0.08
Fibre g/1000kcal	0	10.9±4.8	10.6±3.0	10.2±3.8	10.6±2.1	0.98
	18	12.6±5.3	11.4±3.1	11.1±3.0	12.6±2.9	0.72
	change	1.8±4.3	0.8±2.8	0.9±3.0	2.0±1.4	0.80

Values are means±SD; E%, proportion of energy;

¹p-values by ANOVA, ^amedian (Q25,Q75), ^bKruskal-Wallis

5.2.4 Eating behaviour and anhedonia (Study III)

Twenty out of the 82 participants (24.4%) reported experiencing anhedonia at least once during the one year study period.

The participants with anhedonia reported significantly higher scores in binge eating at the baseline and at the follow-ups (table 14). The anhedonia group also reported more uncontrolled eating and emotional eating at the first follow-up (six months). At the baseline, those with and without anhedonia did not differ with

respect to BMI (36.2 and 34.7, respectively). However, at the end of the study period, the change in BMI was smaller in the anhedonia group compared with those participants without anhedonia.

The statistical significance of group differences remained the same when the analysis was replicated with the original values (without LOCF), except for the BMI-change at one year which revealed a trend towards statistical significance ($p=0.089$).

Table 14. Body Mass Index (BMI) and eating behaviour in individuals with and without anhedonia at the Lifestyle Intervention Treatment Evaluation.

Weight or eating behaviour factor	Anhedonia		Group difference p-value ¹
	Yes (n=20)	No (n=62)	
Body Mass Index (BMI , kg/m²)			
At baseline	36.2 (4.6)	34.7 (5.1)	0.269
Change, 6 months – baseline	-0.4(1.3)	-1.0 (1.4)	0.083
Change, 12 months – baseline	-0.1 (1.2)	-0.8 (1.5)	0.038
Cognitive Restraint (CR)			
At baseline	45.0 (13.0)	44.1 (14.8)	0.806
At 6 months	54.4 (15.7)	61.4 (18.2)	0.131
At 12 months	56.7 (18.9)	59.1 (17.0)	0.597
Uncontrolled Eating (UE)			
At baseline	56.4 (19.9)	47.1 (19.7)	0.070
At 6 months	40.9 (20.4)	30.8 (18.0)	0.039
At 12 months	39.4 (20.0)	32.8 (18.9)	0.178
Emotional Eating (EE)			
At baseline	71.7 (24.3)	56.6 (31.5)	0.055
At 6 months	54.4 (33.2)	37.3 (31.8)	0.041
At 12 months	52.8 (34.4)	37.6 (34.4)	0.091
Binge Eating (BES)			
At baseline	19.3 (8.5)	14.5 (7.4)	0.019
At 6 months	13.7 (9.5)	8.5 (5.6)	0.029
At 12 months	13.9 (8.6)	9.2 (5.6)	0.033

Data are mean (SD). Missing data were replaced by using the Last Observation Carried Forward (LOCF) method.

¹ Student's t-test, two-tailed significance

5.3 Discontinuation (Study II)

A total of 32 (39%) participants dropped out of the programme (table 15). In the intensive counselling group, the drop-out rate was 43% (15 subjects) and in the

short-term counselling group it was 36% (17 subjects). Most of the discontinuation occurred during the intervention period (n=18). Two subjects participated throughout the intervention period but discontinued before the first follow-up visit and twelve subjects discontinued during the follow-up period. Since there was no difference between the counselling groups in discontinuation, in the further analysis the two groups were combined.

The drop-outs were younger than the completers (table 15). They consumed more alcohol and had higher initial weight loss goals than the completers (table 15). Furthermore in those participants dropping out, their CR score was lower, severe binge eating symptoms were more prevalent (table 14) and there was less free-time reported (table 15) compared with the study completers. A high weight loss goal (OR(95%CI)1.08 (1.00–1.17), p=0.049) and lack of free time (3.5 (1.01–11.9), p=0.050) associated independently with discontinuation. Those who did not have enough free-time were 3.5 times more likely to drop out of the weight loss program than those who felt they had enough free-time even after controlling for all other factors in the model.

Table 15. Assessed pre-existing factors for possible risk to discontinue the weight loss counselling program.

Pre-existing factor	Discontinuers (n=32)	p-value ¹	OR (95%CI) ²	p-value ²
Background				
Sex	No difference	NS		
Counselling group	No difference	NS		
Age	younger	0.02	0.96 (0.90-1.03)	0.294
Education	No difference	NS		
Health and health habits				
Weight, kg	No difference	NS		
BMI	No difference	NS		
Goal of the weight loss	Higher goal	0.001	1.08 (1.00-1.17)	0.049
Smoking	(more often)	NS		
Physical activity	(more often not at all)	NS		
Use of alcohol g/d	More alcohol	0.015	1.02 (0.97-1.07)	0.498
Eating behaviour				
Binge eating (BES)	More often severe	0.012	0.96 (0.26-3.5)	0.945
BES score	No difference	NS		
Emotional eating	No difference	NS		
Uncontrolled eating	No difference	NS		
Cognitive restraint	Lower score	0.03	0.99 (0.95-1.03)	0.593
Psychosocial resources				
Marital status	(more often single)	NS		
Free time	Less free time	0.044	3.5 (1.01-11.9)	0.05
Working	No difference	NS		
Mental resources	No difference	NS		

¹ Statistically significant difference between completers and discontinuers, $p < 0.05$, Pearson khii squared test (Fisher), Independent samples T-test or Mann-Whitney test.

² Logistic regression, the model included factors that were significantly different between the completers and discontinuers in the previous analysis. OR and p-values of variables that independently associated with discontinuation

6 Discussion

6.1 Study design and subjects

The LITE study was a randomized weight loss intervention. Subjects were recruited from a study population which had been initially enrolled into a weight loss drug trial, but due to the restricted number of subjects, they were not able to be included into that drug trial. The age and BMI ranges of study subjects were quite high, but that is common in clinical weight loss programs (Anderson *et al.* 2001). Thus the study population reflects the ordinary situation in basic health care centres, which are the common sites where the weight loss counselling is recommended to be organized (Adult Obesity: Current Care 2011, Aikuisten lihavuus: käypä hoito-suositus 2002). The recruitment process might have affected the commitment towards the LITE study because the subjects were at first interested participating in a drug trial. However, they were volunteer subjects seeking help with weight loss, and thus were motivated to undergo a lifestyle change and thus a representative population for weight loss intervention. Subjects were randomized into intensive counselling and short-term counselling groups by randomization without blocking. A low personal motivation to group counselling might also decrease the commitment and thus be a reason for discontinuation (Jacobs *et al.* 2002). The high discontinuation rate (39%) might limit the generalization of these results, but this is also a common problem in weight loss studies (Graffagnino *et al.* 2006, Melin *et al.* 2006) and thus an important research area. The major strength in our study was its relatively long follow-up period.

6.2 Methods

Eating behaviour was assessed via a validated questionnaire TFEQ-18 with good internal consistency and scales known to possess a good discriminative capacity for obese subjects (Karlsson *et al.* 2000). It is also short enough (only 18 items) and therefore easy to use also in health care. The structural validity of this questionnaire has been proved to be good also in a Finnish population of young women (Angle *et al.* 2009). Variations of the TFEQ-questionnaires do have some differences in questions or definitions of eating behaviour traits. Despite the methodological differences, all questionnaires assess the same phenomena –

ability to restrain eating, power of disinhibition and effect of emotions to the eating. Therefore, the scores of different factors between LITE study and all published studies are not comparable, but they all have the same aim to evaluate the phenomena which should be recognized in clinical practice. The Binge Eating Scale (BES) is also a valid instrument for describing behaviour and cognitions related to binge eating (Celio *et al.* 2004). BES could also be used in discriminating subjects i.e. in individuals who do not have binge eating problem from those with moderate or severe BES (Gormally *et al.* 1982).

The assessment of dietary intake is problematic because energy underreporting is a very common problem (Maurer *et al.* 2006). The reasons for misreporting might be different in men and women, in normal weight or overweight and partly explained by social desirability and increased restraint eating (Maurer *et al.* 2006). In order to minimize any bias in the daily energy intake and increase the reliability of the data in this study, the subjects were asked to fill in the food records for five consecutive days (including a weekend) as accurately as possible using household measures. The records were reviewed by a trained nutritionist or nurse in order to ensure an adequate level of detail in describing the foods and their preparation. However, the nutrient intakes (protein, carbohydrates, fat) expressed as percentages of total energy intake are usually unbiased (Buzzard 1998). Therefore, even though there might be some dietary misreporting in energy intake, the present results about the energy nutrients are relevant.

The health habits were assessed by questionnaires. This kind of structured model might give less information than open questions, but due to quantitative methodology of this research project the structured questionnaires were preferred here. Anhedonia was assessed by SCID I, which is a properly administered and evaluated psychiatric assessment and a DSM-IV based diagnostic instrument (Spizer *et al.* 1989).

6.3 Impact of the intensive and short-term counselling on weight loss, eating behaviour, and dietary intake

The weight loss result in the intensive counselling group at six months was similar to those obtained in previous lifestyle weight loss studies (e.g. Riebe *et al.* 2005, Tuomilehto *et al.* 2001). Although the weight loss result was not particularly impressive high, similar results have led to marked long-term reduction in the incidence of type 2 diabetes in high risk subjects (Lindström *et al.*

2006). However, the weight loss result was not maintained and thus the intensive counselling failed to achieve its target even though the weight loss at 18 months could be considered as being clinically significant in some subjects. Moreover, in both counselling groups, there were subjects who were successful in maintaining their weight loss and thus the effect of counselling should not be underestimated. Otherwise, there might be other factors affecting successful weight loss than counselling itself.

Weight regain is a common problem (Anderson *et al.* 2001, Dansinger *et al.* 2007, Hakala 1994) and in addition, it is not always preventable by intensive counselling (Fogelholm *et al.* 1999, Melin *et al.* 2003, Riebe *et al.* 2005). Not even a good weight loss result during the intervention will predict a good maintenance, but higher weight loss result leads to higher net weight loss result (Barte *et al.* 2010) and thus has a favourable effect on long term weight loss. From that point of view, the favourable weight loss can be considered as more than 10%.

The significant change in eating behaviour observed in both counselling groups indicates that short-term counselling is also able to improve eating behaviour to a certain degree. Moreover, the similar dietary intake in both groups and the some change towards recommendations suggest that the dietary changes could be achieved by short- term counselling and the extra visits which were arranged in the intensive counselling are not necessary. The change in protein intake (E%) might reflect the recommended change from high fat protein products to low fat protein products, but the change (E%) is insignificant in clinical terms. Otherwise, the dietary intake could have been misreported, which is quite a common problem (Maurer *et al.* 2006). Previously, the intensive weight loss counselling in subjects with high risk for type 2 diabetes improved the dietary intake (Lindström *et al.* 2003) and cognitive behavioural therapy has improved also the diet in overweight and obese adolescents (Tsiros *et al.* 2008).

The similar results in the two counselling groups in terms of long-term weight loss, dietary intake and eating behaviour indicate that counselling programs of different intensity could be provided in primary and occupational health care, so that subjects could choose the program most suitable for them. In both counselling groups, all study subjects participated in the measurements at every follow-up visit, filled in the food diaries, completed the Three Factor Eating -18 questionnaires as well as the Binge eating questionnaires which can be considered as effective counselling methods. The short-term counselling group may have benefitted from these study protocol tasks even though this was not the

intention. For example, self-weighing the body weight protects the weight regain (Wing *et al.* 2008) and avoiding fat and calories is important in weight loss (Kruger *et al.* 2006) as well as having a regular meal frequency and restriction of food (Westenhoefer *et al.* 2004). These advices were given also in the short-term counselling. Moreover, the fact that the short-term counselling was given by study nurses who were experienced in weight loss management could have had an effect on the results. Previously, it has been shown that an inexpensive program involving nurse support is as effective as more intensive counselling in preventing weight gain after successful weight loss (Dale *et al.* 2009). In the LITE study, both of the counselling groups were able to maintain their baseline weight for 1½ years. From that point of view, the short-term counselling was effective in preventing weight gain, which is one of the three goals in weight management (Hill *et al.* 2005). The development of different weight loss programs should be encouraged also because lifestyle interventions in health care settings are relatively cheap; it has been estimated that -5% weight loss for one obese subject costs approximately 110 Euros (Bogers *et al.* 2010).

6.3.1 On the implementation of intensive counselling

The intensive counselling was developed according to “Basic Care” of practical guidelines of adult weight loss counselling (Aikuisten lihavuus: käypä hoito-suositus 2002). The behavioural counselling methods (self-monitoring, goal-setting, stimulus-control, behavioural substitution) were used together with some cognitive strategies (problem solving, recognition of emotions and barriers). Patient-centred methods were used together with group counselling. However, even though behavioural and cognitive methods were used, the framework or theory of the counselling was not defined. This is common in clinical practice. However, the methods used are consistent with practical guidelines (Aikuisten lihavuus: käypä hoito-suositus 2002) and from a retrospective viewpoint, one could state that, the framework of LITE study was behavioural with some cognitive input. In other words, the goal of counselling was to change the behaviour. This framework is relevant because, at the moment, no randomized controlled trials have shown that cognitive approaches would be superior to the standard cognitive and behavioural strategies (Fabricatore 2007). However, in the LITE study, the lack of definition of the framework could have had a negative effect on the counselling. A clear definition of framework could improve the weight loss counselling because then the target of method used is clear. According

to the updated current care: counselling should be based on a theoretical framework (Adult Obesity: Current Care 2011).

The fact that the improvement of eating behaviour was the same in the intensive counselling group as in short-term counselling group, indicates that the intensive counselling methods used in LITE-study (self-monitoring, goal-setting, stimulus-control, behavioural substitution), did not lead to a sufficient improvement of cognitive restraint, emotional eating, uncontrolled eating or binge eating compared to short-term counselling. Behavioural therapy has improved weight loss in short-term (Fabricatore 2007, Foster *et al.* 2005), has prevented the weight regain compared to self-directed or the use of interactive technology (Svetkey *et al.* 2008) and improved body image and psychological well-being (Palmeira *et al.* 2010). However, from the point of view of eating behaviour, the framework of using behavioural therapy might be erroneous because the aim of behavioural therapy is to change behaviour (Fabricatore 2007, Van Dorsten & Lindley 2008). According to the cognitive behavioural framework, disordered eating behaviour (low cognitive control, high emotional eating, uncontrolled eating and binge eating) might be a consequence of the individuals' cognition and emotions. The framework of cognitive behavioural therapy is that obesity is understood to be a consequence of dysfunctional thoughts or misconceived beliefs (Fabricatore 2007, Van Dorsten & Lindley 2008) and some successful studies in cognitive behavioural based weight loss programs (Ash *et al.* 2006, Rodriguez-Hernandez *et al.* 2009, Teixeira *et al.* 2010, Werrij *et al.* 2009) provide some evidence for the conclusion that cognitive behavioural therapy might be more effective than behavioural therapy as a way to improve cognitive restraint, uncontrolled eating and emotional eating. Some cognitive techniques (problem solving, recognition of emotions and barriers) were used in the LITE study but they did not have the expected effect on eating behaviour. However, if the emphasis is on cognition, then the main goal is to change there perceptions which might be contributing to eating behaviour and regain of weight. However, the behavioural counselling would be needed as well, in order to achieve control of impulses and goal setting. For example, in obese subjects without eating disorders the inclusion of cognitive therapy into the weight loss counseling program has reduced the incidence of relapses and binge eating since it has improved eating restraint and the maintenance of weight loss (Werrij *et al.* 2009). This is a topic that needs to be studied in the future.

The intensive counselling of LITE study included group counselling as the Finnish guidelines recommend (Aikuisten lihavuus: käypä hoito-suositus

2002). This did not improve the weight loss results in the long-term, but of course it utilized fewer resources than individual counselling. Even though group counselling is recommended, in fact, only a few studies have compared individual and group counselling, and therefore the impact of group counselling in achieved weight loss is uncertain. In the review of Paul-Ebhohimhen & Avenell (2009) group based treatment was found to be more effective at 12 months in weight loss than individual based treatment. In a study comparing the effect of individual and group cognitive behavioural therapy for binge eating disorder, both treatments appeared to improve the weight loss and reduce binge eating in long term (Ricca *et al.* 2010). Moreover, group counselling improves weight loss in short-term, but weight loss is maintained better by individual counselling (Hakala 1994). Weight loss results have been similar with individual nutritional counselling as in the cognitive behavioural group therapy after six months (Minniti *et al.* 2007). In addition, a group-based intervention with social cognitive theory as the theoretical basis for the program and problem-solving therapy as the method to achieve this goal are able to improve problem-solving skills of the study subjects who experience weight loss over 10% to a higher level, but has less effect in the subjects with weight loss less than 5% (Murawski *et al.* 2009).

However, all subjects are not suitable for group counselling. Subjects who do not want to be a part of a group or who are not ready for that experience do not obtain any benefit and / or might even disrupt the group dynamics (Jacobs *et al.* 2002). Therefore, before forming the group, the counsellor should recognize and select suitable individuals for group counselling and organize also the possibility of individual counselling for those who are not suitable for the group. This was not possible in the LITE study because it was not based on randomization. In practice, this issue should be considered. In addition, when developing group counselling, its function should be planned. According to the classification of groups by Jacobs (2002) the combination of three types of groups could be the most effective way to achieve the best benefit to group counselling targeting to weight loss and maintenance. These groups are: 1) education, discussion, task, growth and experimental group, 2) counselling and therapy group and 3) support or self-help group. Subjects with problems in eating behaviour may benefit most from counselling and therapy groups. In the counselling group, the members try to help each other under the counsellor's guidance. The inclusion into a therapy group is appropriate for subjects having more severe problems (Jacobs *et al.* 2002).

In the Intensive counselling in the LITE study, patient-centred methods were used as much as possible even though all counselling types were used (advice giving, guidance or counselling). Advice giving style was avoided as much as possible. For example, the basics of diet related to weight loss were provided as facts, but when discussing diet changes at the personal level, the interaction was more like guidance or counselling. In the group visits, when group works were conducted, the interaction between the group counsellor and subjects is reminiscent of counselling. In the short-term counselling group, the interaction was meant to be advice giving and guidance. However, because the study nurses were experienced in obesity management, it would be difficult for them to avoid a counselling style. All in all, the counselling methods were in accordance with guidelines (Aikuisten lihavuus: käypä hoito-suositus 2002). In clinical practice, the most often used method in obesity treatment is giving an advice by physicians (Shiffman *et al.* 2009). They base their recommendations on clinical experience (Phelan *et al.* 2009). Moreover, the weight loss counselling provided by primary care physicians with an advice giving style of low or moderate intensity does not achieve clinically meaningful weight loss (Tsai & Wadden 2009). An individual process which is needed to achieve maintained weight loss result, does not occur by being told that: “You should not eat when you are depressed”. These phrases may well lead to reinforcing the patient’s false belief in his own helplessness or confusion and lack of confidence that he/she is capable of achieving the proposed changes (Feltham 1997). The patient-centred approach is essential when the aim is a positive clinical outcome (Butterworth 2008). Therefore, despite the insignificant effect in the LITE study, patient-centred counselling methods should be developed.

One patient-centered counselling method is motivational interviewing which is recommended in both Finnish Adult obesity guidelines though this method was not used deliberately in the LITE study. This is a patient-centred and goal-oriented method for improving motivation to change by improving an individual’s capability to undertake changes; it avoids giving direct advice (Butterworth 2008). Motivational interviewing is effective in promoting positive changes in dietary habits, physical activity and regimen adherence (Van Dorsten 2007). Previously, it has improved eating concern, disinhibition and adherence to the study when it has been utilized as a part of behavioural weight loss treatment aimed at guided self-help (DiMarco *et al.* 2009). Otherwise, in another study, a motivational interview did not improve weight loss compared with health education (Befort *et al.* 2008a). The transtheoretical tailored feedback has been claimed to improve healthy eating,

exercise, managing emotional distress and weight (Johnson *et al.* 2008). According to transtheoretical model of change, the state of change proceeds in six steps; precontemplation, contemplation, preparation, action, maintenance and termination (Prochaska & Velicer 1997, Seals 2007). The state of change could be assessed by simple questions for increasing the motivation to proceed in state of change to the next stage. After that the most effective state-specific intervention could be determined. Those questions could be for example “Do you want to lose weight?”, “Have you already started making diet and/or exercise modifications?”, “When would you like to start?” and “How long have you been trying to lose weight?” (Seals 2007). The LITE study did not include this theory in the framework of the study, but this point of view might be useful in the early phase of weight loss counselling. The updated version of Finnish Adult Obesity Current Care (2011) emphasizes the benefits of the transtheoretical model in behavioural changes.

Clearly, the development of weight loss counselling needs to continue. The best methods and framework to maintain the weight loss, to improve eating behaviour or dietary intake still need to be identified, but according to previous studies and theories, the effect of cognitive behavioural therapy on eating behaviour could be studied. Further studies are needed to evaluate this possibility.

6.4 The association of eating behaviour with maintained weight loss, dietary intake, anhedonia and discontinuation

Eating behaviour measured by TFEQ-18 questionnaire (cognitive restraint, emotional eating and uncontrolled eating) was associated with maintained weight loss and also with dietary intake, discontinuation of weight loss program and anhedonia (figure 8).

These results suggest that effective weight loss counselling should strive to increase cognitive restraint and to decrease emotional eating, uncontrolled eating and binge eating symptoms. The dietary intake would resemble the recommendations if the cognitive restraint increases. However, it might be argued that these results do not establish any causality, i.e. which comes first, a change in behaviour or a change in cognitions. Cognitive behavioural therapy is based on the theory that first comes the change in the cognition of underlying eating behaviours and exercise and after that these related behaviours will change (Fabricatore 2007, Van Dorsten & Lindley 2008). In the cognitive framework, the behaviour leading to obesity is understood to be a consequence of dysfunctional

thoughts or misconceived beliefs (Fabricatore 2007). This theoretical background with the fact that food intake is the end result of many behavioural traits (Bellisle 2003) postulate that improved cognitive restraint, decreased emotional eating and uncontrolled eating are a prerequisite for improved dietary intake and weight loss. These associations may also be in a circular relationship instead of being a simple linear route.

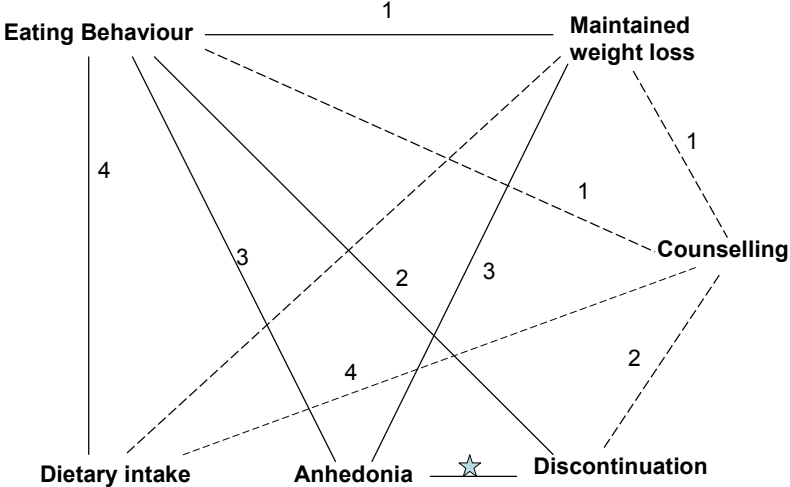


Fig. 8. The associations between maintained weight loss, eating behaviour, counselling, anhedonia, discontinuation and dietary intake. ____ = there is an association, ----- = no association. If there is no line between factors, the association was not studied. 1 = study 1, 2= study 2, 3= study 3, 4=study 4. Star = (Komulainen *et al.* 2011).

6.4.1 Eating behaviour and weight loss

The results of associations with successful weight loss and eating behaviour are similar to those reported in other studies in this area (Dalle Grave *et al.* 2009, Svendsen *et al.* 2008). Moreover, this association between restraint eating and successful weight loss has been observed also in previous studies (Chaput *et al.* 2007, Drapeau *et al.* 2003, Foster *et al.* 1998, Sarlio-Lähteenkorva & Rissanen 1998, Svendsen *et al.* 2008, Vogels & Westerterp-Plantenga 2007, Westerterp-

Plantenga *et al.* 1998). Previously also a reduction in emotional eating and having flexible restraint have been found to be necessary in achieving maintained weight loss (Teixeira *et al.* 2010). In the LITE study the scores of successful subjects were higher with respect to cognitive restraint and lower for binge eating, emotional and uncontrolled eating than the mean score in either of counselling groups. Thus, even though the improvement of eating behaviour in both counselling groups was significant, it was not sufficiently great to achieve successful weight loss. This could lead to the conclusion that it is not enough that eating behaviour should change, but there has to be a change to a certain level before one can achieve sustained weight-loss.

However, the improvement of cognitive restraint might not be as simple as assumed. The possibility of abnormal eating after weight loss should be kept in mind. In theory, two kinds of cognitive restraint, rigid and flexible may exist and the latter may be more favourable for maintaining weight loss (Provencher *et al.* 2003, Teixeira *et al.* 2010). Very rigid restraint may enhance disinhibition, which could in turn lead to a loss of control over eating (Provencher *et al.* 2003, Westenhoefer *et al.* 1999). It is plausible that a shift towards higher cognitive restraint scores and flexibility would be most beneficial for achieving sustained weight loss (Blomquist & Grilo 2010, Westenhoefer 2001). It is possible to assess these two dimensions of cognitive restraint with the original TFEQ, but not with the TFEQ-18 used in LITE study. However, the factors that led to sufficiently large changes in eating behaviour among the successful subjects, remain unknown and need to be studied in further studies.

The pre-existing uncontrolled eating and binge-eating were associated with failure in weight loss. Uncontrolled eating or disinhibition might be an important behavioural trait for the development of obesity, because disinhibition has also previously been associated with increased body weight and obesity (Dykes *et al.* 2004, Fogelholm *et al.* 1999, Lindroos *et al.* 1997, Provencher *et al.* 2003). Moreover, a reduction in internal disinhibition (i.e. eating in response to cognitive and emotional cues) during weight loss period, predicts the successful weight maintenance (Butryn *et al.* 2009) and the higher levels of internal disinhibition at baseline predicts less extensive weight loss (Niemeier *et al.* 2007).

The improvement noted in all eating behaviour factors in the failure group during the first 3 months indicated that those who failed were somehow able to improve their eating behaviour at least for a short period. These observations point to the possibility that uncontrolled eating and binge eating might require more specific counselling and that the failures could probably be avoided or at

least diminished by the provision of a the pre-treatment evaluation of eating behaviour and personalized counselling. Obese subjects with binge eating suffer more often from hostility, criticism, externalized anger and impulsivity (Fassino *et al.* 2003) with the anger being associated with depression (American Psychoanalytic Association 2010, Greenberg & Paivio 1997). Moreover, obese subjects with depression suppress their anger more often than those without depression (Fassino *et al.* 2003). Some studies have shown a positive effect of counselling on weight loss among subjects with disordered eating behaviour: Interpersonal psychotherapy and cognitive behaviour therapy are significantly more effective than behavioural weight loss treatment in eliminating binge eating in the long term (2 years)(Wilson *et al.* 2010). If subjects with binge eating symptoms actively participate in the behavioral weight loss program (Self-Help Behaviour Modification Program) (Delinsky *et al.* 2006) and are able to stop binge eating, then the successful weight loss is achievable (Gorin *et al.* 2008). Even though other eating disorders other than binge eating were not evaluated in these studies, these types of eating behaviour traits (cognitive restraint, emotional eating, uncontrolled eating) may also benefit from these kinds of therapies and this needs to be studied in the future.

6.4.2 Eating behavior and dietary intake

Dietary intake was mainly associated with cognitive restraint and to a lesser degree with uncontrolled eating. The association observed with energy intake is in agreement with earlier findings of cross-sectional studies (de Castro & Lilenfeld 2005, Provencher *et al.* 2003, Sarlio-Lähteenkorva & Rissanen 1998) but the association between improved nutrient intake (lower fat intake, higher intake of carbohydrates and fibre) with cognitive restraint in the long term is a novel finding. In contrast, previous studies have noted an association with high uncontrolled eating and a preference for salty and fatty foods (Keskitalo *et al.* 2008), frequent use of high-energy foods (de Lauzon *et al.* 2004) and high degrees of disinhibition with increased intakes of energy (Fogelholm *et al.* 1999, Lindroos *et al.* 1997) and fat (Fogelholm *et al.* 1999). From this point of view, the finding that a high degree of uncontrolled eating was associated with a low intake of sucrose at 18 months could be a reflection of a preference for salty and fatty foods and aversity to sweet food in subjects with high uncontrolled eating.

Emotional eating in a normal-weight population is associated with use of sweet and/or fatty foods (de Lauzon *et al.* 2004) and it is associated with liking

for these products (Keskitalo *et al.* 2008). However, in the LITE study no association was observed between emotional eating and dietary intake. Emotional eating is often periodic in nature and it is possible that no such behaviour occurred during the food recording periods, and therefore no association between emotional eating and dietary intake was detected in this study.

Those who succeeded in weight loss had a dietary intake similar to the recommended diet (National Nutrition Council 2005). However, there were only a few statistically significant differences between the successful individuals and the others: lower intake of protein and higher intake of carbohydrates (including sucrose) at 18 months. Even though the protein intake was lower in the successful group, it was at the recommended level in order to lose weight (15.8E%). The intake of carbohydrates was also in accordance with the recommendations. The intake of sucrose was higher than the recommendations but it is difficult to assess the exact amount of added sugar because the Diet32-program does not differentiate added sucrose and naturally occurring sucrose. Thus, we could speculate that the increase in sucrose could be at least partly consequence of the use of fruits or berries. However, in fact, weight loss is not possible without a negative energy balance, i.e. intake is lower than energy expenditure. There was no difference in energy intake among those who were successful and those who failed. Therefore, we speculate that there was some underreporting of amounts consumed at least in the unsuccessful group.

Obesity management is unfortunately often reduced to advice giving of about diet or physical activity. Increasing physical activity, reducing consumption of fast foods, reducing portion sizes and reducing soft drink consumption are the most common strategies adopted by physicians to encourage the patient to lose weight (Phelan *et al.* 2009). It could be suggested that if one considers the poor results of previously reported weight loss interventions (Anderson *et al.* 2001) and results of the LITE study about the associations between eating behaviour and dietary intake, then one could argue that an enhanced awareness of caloric intake without any wider application to daily situations may only achieve short-term dieting. Therefore, also from the point of view of recommended dietary intake, in order to develop, more effective weight loss counselling, the methods for elevating cognitive restraint should be developed.

6.4.3 Eating behaviour and anhedonia

Anhedonia is a core symptom of depression which expresses itself as an inability to experience pleasure from normal daily activities and thus might lead to seeking pleasure from other issues, such as eating (or drinking) (American Psychoanalytic Association 2010, Greenberg & Paivio 1997). In the LITE study the hypothesis was that the symptoms of anhedonia might be present in the background of obesity and it was noted that subjects suffering from anhedonia displayed more disordered eating behaviour, namely emotional and binge eating, and poorer weight loss outcome than subjects without anhedonia.

However, it is difficult to determine the direction of the effect of these associations with regard to overweight, obesity, eating behaviour, depression and emotion regulation. Emotional eating is related to two coping strategies: emotion-oriented coping and avoidance distraction indicating that overeating results from inadequate affect regulation and an escape from negative emotions (Spoor *et al.* 2007). Thus, based on the background theories of depression and eating behaviour and the findings of the current study, one could speculate that suffering from anhedonia could drive an individual to seek other comforts, such as eating, which in turn could lead to weight gain (figure 9).

Those theories were: 1) the classic view of depression (that anger in a depressed person is specifically directed at the sense of self-worth and manifests itself through feelings of helplessness, shame, and humiliation, (American Psychoanalytic Association 2010), 2) the fact that depressed individuals are likely to experience problems with regulation of emotions, especially with respect to anger which may be over-controlled (Greenberg & Paivio 1997) and 3) psychosomatic theory of eating (an inability to differentiate between the need for food from other uncomfortable sensations and feelings like anger, fear, anxiety, might lead to excessive eating because of early learning processes (Bruch 1974, Ouwens *et al.* 2003, van Strien & Ouwens 2007). Thus, in the case of anhedonia, the disordered eating behaviour might be a consequence of anhedonia. Those with anhedonia had also poorer outcome in weight loss compared with those without this symptom emphasizes the relationship between anhedonia, eating behaviour and obesity.

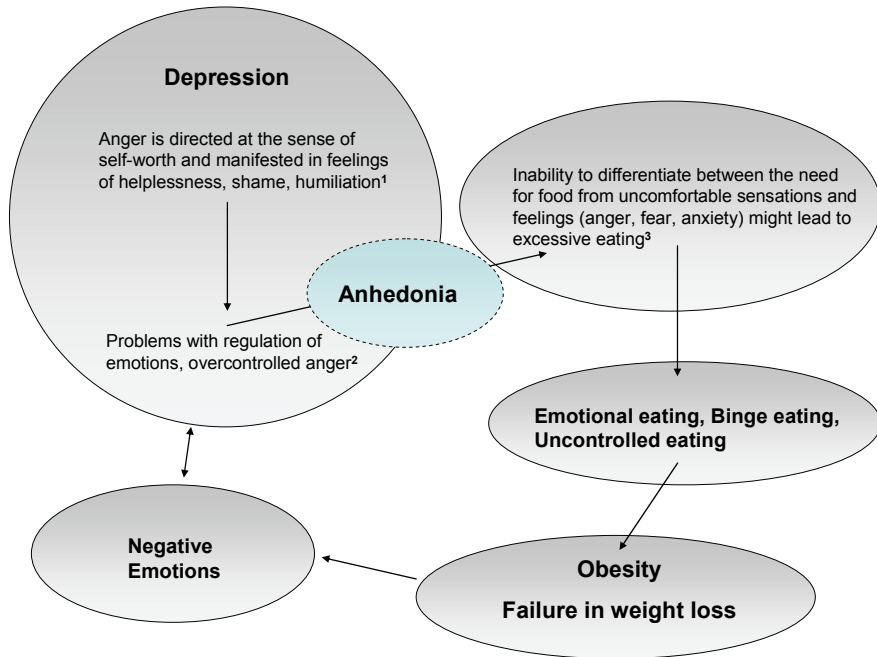


Fig. 9. The suggested relationship between anhedonia and obesity or failure in weight loss according to 1) Classical view of depression (American Psychoanalytic Association 2010), 2) Problems with regulation of emotions (Greenberg & Paivio 1997) and 3) Psychosomatic theory of eating (Bruch 1974, Ouwens *et al.* 2003, van Strien & Ouwens 2007).

The diminished individual enjoyment of normally rewarding behaviours and less frequent engagement in these activities is associated with a high BMI among women (Pagoto *et al.* 2006). The enhanced response to specific foods or the greater pleasure from eating is assumed to be one explanatory issue behind obesity and therefore food choices are a reflection of sensory hedonic responsiveness (Mela 2006). In addition, a difficulty in identifying and describing emotions, i.e. alexithymia, is a moderator of the relationship between food consumption and distress manipulation in normal weight women (van Strien & Ouwens 2007). Emotional eating may be a mediating mechanism linking depression and obesity (Ouwens *et al.* 2009). Moreover, (in normal weight subjects), emotional eating is associated with problems in emotional distress and relationship (anxiety, depression, phobias etc) (Van Strien *et al.* 1995). Binge

eating is more prevalent among those suffering from depression (Werrij *et al.* 2006), depression decreases the risk for binge eating in adolescents (Spoor *et al.* 2006) and major depressive disorder and binge eating disorder is associated with poorer weight loss outcomes (Pagoto *et al.* 2007). Weight regain has been associated with an increase in depressive symptoms, disinhibition and hunger (Wing *et al.* 2008).

Anhedonia was not assessed in these above studies and therefore it is not possible to evaluate exactly the same factor, anhedonia, which was examined in the LITE study, but in practice, the phenomenon is the same: emotions and their regulation affect eating behaviour and thus body weight. In clinical practice, depression is seldom assessed when patient is seeking help for weight loss. Furthermore, emotions and their regulation are rarely discussed in weight loss treatment. This is contradictory to the European guidelines of adult weight management (Tsigos *et al.* 2008). Moreover, subthreshold depression with symptoms of anhedonia might be more prevalent than depression itself because in clinical practice, the subthreshold eating disorders or abnormal eating behaviours are more prevalent than actual diagnosed eating disorders (Crow *et al.* 2002, Ricca *et al.* 2009, Stice *et al.* 2009). The fact that emotions affect eating and eating provides pleasure should be taken into account in developing weight loss counselling. Anhedonia should be assessed and treated as a part of weight loss management in order to improve eating behaviour and weight loss. Those subjects who are depressed or suffering anhedonia might need the counselling related to recognition and regulation of emotions and the correct management of depression.

6.5 Prevention of discontinuation

Discontinuation of a weight loss program is a complex process which is influenced by many factors. Previously, the reasons for discontinuation or factors affecting it have been studied, but this information has been used in clinical practise to a lesser degree. However, the prevention of discontinuation is essential in order to diminish waste of health care resources and to avoid the disappointing situation that subject may be influenced and lose confidence about the possibility of successful weight loss in the future.

In the LITE study, there were differences in unhealthy habits, eating control and psychosocial resources between the drop-outs and the completers. All healthy habits, eating behaviour factors or psychosocial factors were not associated with discontinuation, but age, use of alcohol, weight loss goal, cognitive restraint,

binge eating symptoms and free-time were significantly different in drop-outs than in completers. Independent factors of discontinuation were lack of free time and unrealistic weight loss goal, from which the unrealistically high weight loss goal has been also previously shown to be a risk factor for discontinuation (Dalle Grave *et al.* 2005, Teixeira *et al.* 2004) even though opposite findings exists (Fabricatore *et al.* 2007). A high body mass index and female gender have an influence on determining expectations (Fabricatore *et al.* 2008). More realistic weight loss expectations have been related to healthier eating behaviour (Provencher *et al.* 2007). However, the setting of a realistic weight loss goal was one aim of the first visit in the LITE-program in both counselling groups. Perhaps this kind of realistic goal setting was more suitable to those with a lower weight loss goal while those with a higher weight loss goal would have needed more intensive counselling to avoid disappointment. Even though it was not studied here, in order to avoid discontinuation, it would be very useful to assess the weight loss results at very early stage, because weekly weight loss during first 4 weeks is lower among drop-outs than in completers (Messier *et al.* 2010).

The lack of free time is an important finding because it might be an expression of wider problems in daily life. A reduction in psychological distress is associated with success in weight loss (Dalle Grave *et al.* 2010) and vice versa, chronic life stress is associated with weight gain, mainly in men (Torres & Nowson 2007). A lack of free time might lead to feelings of stress which often lies in the background of worsening the health habits needed for weight loss (healthy diet and sufficiently strenuous physical activity) (Stunkard *et al.* 2003). In addition, subjects feeling stressed are prone to eat too much (Nishitani & Sakakibara 2006). Elevated intake of alcohol in LITE study might be a consequence of stress related lack of free time. Those subjects who try to make themselves feeling better by eating or drinking in a stressful situation are likely to consume more alcohol than those without this behavior (Laitinen *et al.* 2002). The feelings generated by the subjective view of insufficiency of free-time might prevent the changes needed for weight loss and leads to the discontinuation. The subjective feeling that one has insufficient free time may lead to feeling of being incapable of maintaining the behavioural changes needed for weight loss. The perceived failure of treatment has previously been presented as a common reason for attrition of weight loss (Grossi *et al.* 2006).

Eating behaviour was associated also with discontinuation. Cognitive restraint and binge eating associated with discontinuation even though not as an independent factor in the regression analysis. This finding is important because

cognitive control of eating behaviour is needed in order to achieve weight loss (Westenhofer 2001) and the improvement of dietary restraint is associated with successful weight loss (Dalle Grave *et al.* 2009). Our results reflect the importance of eating behaviour with regard to discontinuation, and not only success in weight loss. From the point of view of discontinuation, eating psychopathology (measured by EDE-Q) is associated with discontinuation (Werrij *et al.* 2009) as well as binge eating (Gladis *et al.* 1998) but not with cognitive restraint (Dalle Grave *et al.* 2009). The above discussion about the failure in weight loss is relevant also to the association between discontinuation and eating behaviour. The low cognitive restraint and the high presence of binge eating symptoms among drop-outs might reflect the fact that the individuals with disordered eating behaviour would have required a different kind of counselling than that provided by LITE. Cognitive restraint and binge eating can easily be assessed by questionnaires before the beginning of weight loss program and the personalised counselling could be given according to the results obtained in personal eating behaviour in order to prevent discontinuation. Cognitive behavioural group therapy has been reported to reduce discontinuation more effectively compared with individual group counselling (Minniti *et al.* 2007) and thus, from the point of view of preventing discontinuation, then the benefits of incorporating cognitive strategies into weight loss counselling should be studied.

6.6 Suggestions for further studies

Further research is needed to understand the process involved in changes in eating behaviour in order to develop the best counselling methods to achieve permanent changes and for rectifying disordered eating behaviour. The causality relation between dietary intake and cognitive restraint needs to be validated. In addition, it would be interesting to determine the exact cut-off point for cognitive restraint that would achieve sustained weight loss or lead to the pursuance of a recommended diet. Moreover, the effect of rigid and flexible restraint should be studied i.e. if qualitative changes in cognitive restraint exist together with quantitative changes.

6.7 Practical implications

One of the most important practical implications of this study was the fact that effective weight loss counselling methods should be developed in order to

increase cognitive restraint, decrease emotional eating, uncontrolled eating and binge eating symptoms. The results emphasize the need for assessment of eating behaviour before and during weight loss counselling program and the development of counselling towards personal recognition; improvements are needed in cognitive restraint and management of emotional eating, uncontrolled eating and binge eating in order to achieve maintained weight loss. In addition, guidance about dietary issues should be developed in the direction of cognitive restraint. According to previous studies and theories, cognitive therapy approaches might be more effective than simply behavioural options in order to improve eating behaviour but the behavioural counselling would also be needed, so that the individual could practise control of impulses and goal setting. However, the counselling methods and programs used in the LITE study could both be used at least for preventing normal weight gain.

Weight loss counselling should also include the assessment of psychological factors or symptoms of depression, such as anhedonia in order to develop appropriate weight loss programs. The development of clinical practices and strategies for management of these factors as well as recognition and regulation of emotions are urgently needed. This will require the multidisciplinary co-operation from health care providers as is already recommended in the guidelines in the Finnish Current Care for Adult Obesity.

The assessment of eating behaviour and anhedonia and the development of the counselling content might prove useful also in preventing discontinuation. In addition, weight loss counselling should target a realistic weight loss. The life situation at work and during free time should be discussed in order to evaluate the realistic possibility to implement the planned changes in lifestyle. When selecting a suitable weight loss programme for an obese subject, it might be beneficial to describe the aims and timing of different programmes so that the individual can choose the one most suited to him or her. Naturally this means that primary and occupational health care offer different kinds of programmes, which would be an interesting but demanding challenge for health care providers.

In public health care, the development of weight loss programs should be promoted and the possibility to arrange education in counselling methods should be a matter of priority. It would be very important to improve the implementation of the evidence based weight loss settings into clinical practice.

7 Conclusions

These findings of LITE study emphasize the complexity of weight loss and weight loss counselling. Intensive counselling which was based on Finnish practical guidelines (Current Care for Adult obesity), did achieve the recommended weight loss in the short term, but failed to maintain the weight loss. Moreover, the changes occurring in dietary intake and eating behaviour were similar to those attained with short-term counselling. However, even though the weight loss was not maintained, it did not increase over the baseline body weight during the follow-up of 1.5 years. Therefore, one could conclude that intensive counselling as well as short term counselling were able to prevent the weight gain which normally occurs. In particular, short-term counselling could be useful in preventing weight gain because it was organized with a minimum of resources. It is noteworthy, that there were subjects with good success in maintaining the weight loss in both counselling groups. The development of different weight loss programs should be encouraged.

The association between eating behaviour with weight loss and dietary intake suggests that enhancing eating behaviour should be a target for improving weight loss. Moreover, the negative association of anhedonia with eating behaviour and weight loss suggests that assessment and management of this symptom should be included in weight loss counselling. The pleasure obtained from food and the effect of the emotions on eating should be taken into account and counselling methods should be developed for recognition and regulation of emotions. In cognitive therapy, obesity is considered to be a consequence of dysfunctional thoughts or misconceived beliefs and thus this might be a useful theory for improving eating behaviour. Further research is needed to understand the process of changes in eating behaviour to develop the best counselling methods in order to achieve permanent alterations and to rectify disordered eating behaviour.

Discontinuation was common in the LITE study. Lack of free time and an unrealistically high weight loss goal in baseline are understandable factors leading to discontinuation. These themes and factors affecting them should be discussed during the counselling sessions. The presence of low cognitive restraint and high binge eating symptoms among drop-outs might reflect the fact that this kind of disordered eating behaviour would have needed a different kind of counselling than that provided by LITE. To prevent discontinuation in weight loss programs counselling should focus early in the process on setting realistic weight loss

targets as well as emphasizing the fact that counselling visits and life style change are time consuming processes activities.

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- I Keränen AM, Savolainen MJ, Reponen AH, Kujari ML, Lindeman SM, Bloigu RS & Laitinen JH (2009) The effect of eating behavior on weight loss and maintenance during a lifestyle intervention. *Prev Med* 49: 32–38.
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