SAHLGRENSKA AKADEMIN

CHANGES IN FOOD CHOICE DURING A WEIGHT LOSS TRIAL WITH DIETARY TREATMENT IN POSTPARTUM WOMEN WITH OVERWEIGHT OR OBESITY

Results from a randomized controlled trial

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Abstract

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Background: Overweight and obesity are an escalating problem worldwide and are major risk factors of diseases like cardiovascular disease and diabetes mellitus type 2. Pregnancy can cause overweight as substantial weight might be gained during pregnancy or retained after delivery. Interventions including diet and/or exercise to achieve weight loss in postpartum women have been tried, with various results. The diet is the key component of weight loss and diet quality and food choice could be an important part of the diet.

Objective: The aim of this study was to investigate food choice at baseline in postpartum women with overweight or obesity and changes in food choice after a 12 week diet intervention and at 1 year follow-up.

Methods: In Sweden, 110 postpartum women with overweight or obesity were randomized to either Diet group or Control group at 6-15 weeks postpartum. The Diet group received a 12-week diet intervention focusing on 4 dietary principles, based on the Nordic Nutrition Recommendations, 2012, to produce weight loss and was provided by a face to face meeting with a dietitian and also addressed behavioral strategies. The dietary intake of both study groups was assessed with a 24-h recall at the 3 occasions; baseline, 12 weeks and 1 year follow-up. The dietary intake was categorized into 10 different food groups and the changes in intake were analyzed and compared between the two groups.

Results: At baseline, potatoes/grains, dairy products and sweets/salty snacks were the major contributors to the energy intake of the women. At the end of the diet intervention the Diet group had increased the intake of vegetables ($P = 0.046$) and decreased the intake of sweets/salty snacks ($P = 0.024$) significantly more than the control group. After 1 year, no differences in changes in food choice were observed between the groups, however both groups had significantly decreased the intake of sweets/salty snacks compared to baseline.

Conclusion: The results of this study indicates that a 12 week diet intervention can produce changes in food choice in line with the diet treatment in the short term, but are difficult to maintain after 1 year.

Sammanfattning

Titel:	Förändringar i livsmedelsval under en viktminskningsstudie med kostbehandling bland kvinnor med övervikt eller fetma efter graviditet
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Bakgrund: Övervikt och fetma är ett växande problem i världen och är riskfaktorer för sjukdomar såsom hjärt- kärlsjukdomar och diabetes typ 2. Graviditet kan orsaka övervikt eftersom en del kvinnor har stor viktökning under graviditeten och behåller viktökningen efter förlossning. Interventioner som inkluderar kost och/eller fysisk aktivitet har testats för att åstadkomma viktminskning efter graviditet, med varierande resultat. Kosten är den viktigaste komponenten för viktminskning och kostkvalitet och val av livsmedel kan vara en viktig del av kosten.

Syfte: Syftet med den här studien var att undersöka intaget av olika livsmedel hos kvinnor med övervikt eller fetma efter graviditet och analysera förändringar i livsmedelsval efter en 12 veckor kostintervention samt 1 års uppföljning.

Metod: 110 kvinnor i Sverige med övervikt eller fetma efter graviditet randomiserades till en kostinterventiongrupp eller kontrollgrupp. Kostgruppen fick en 12 veckor lång intervention som fokuserade på fyra kostråd, baserade på Nordiska Närings-rekommendationerna 2012, som ämnade åstadkomma viktminskning och innefattade även strategier för beteendeförändring och genomfördes via ett möte med en dietist. Kostintaget hos båda grupperna uppskattades med hjälp av en 24-h intervju vid de tre tillfällena baslinje, 12 veckor och ett år. Kostintaget kategoriserades sedan i tio livsmedelsgrupper samt förändringar i intaget analyserades och jämfördes mellan grupperna.

Resultat: Vid baslinjen bidrog potatis/spannmål, mjölkprodukter samt sötsaker och salta snacks med den största andelen energi av det totala dagliga energiintaget. Vid interventionens slut hade kostgruppen ökat sitt intag av grönsaker ($P = 0,046$) samt minskat sitt intag av sötsaker och salta snacks ($P = 0,024$) signifikant mer än kontrollgruppen. Vid uppföljningen efter ett år observerades inga skillnader i förändringar av livsmedelsval mellan grupperna, dock hade båda grupperna ett signifikant minskat intag av sötsaker och salta snacks jämfört med baslinjen.

Konklusion: Resultatet i den här studien pekar på att en 12-veckors kostintervention kan åstadkomma förändring på kort sikt i livsmedelsval som stämmer överens med interventionens kostråd, men förändringarna är svåra att upprätthålla efter 1 år.

Abbreviations

BMI	Body Mass Index
C-group	Control group
D-group	Diet group
E%	Percentage of total energy intake
HEI	Healthy Eating Index
FFQ	Food Frequency Questionnaire
IOM	Institute of medicin
LEVA	Swedish: Livsstil vid Effektiv Viktminskning under Amning
	English: Lifestyle for Effective Weight loss during Lactation
NNR	Nordic Nutrition Recommendations
US	United States
WHO	World Health Organization

Dictionary in short

Gestation	The time between conception and delivery
Gestational weight gain	Mean weight change from preconception to postpartum
Parity	Number of pregnancies carries to a viable gestational age
Postpartum	Period after delivery, sometimes considered up to 1 year after delivery
Postpartum Weight retention	Weight gained during pregnancy not lost postpartum
Pre-eclampsia	Pregnancy complication characterized by hypertension and swelling and is a serious condition, even fatal, for both mother and fetus, if not treated
Visceral body fat	Fat located in the abdomen

Content

Background

During pregnancy most women will gain weight due to natural causes. Some have problem losing the weight after delivery and therefore pregnancy is considered a risk factor of overweight and obesity. Overweight is a risk factor of medical conditions that might lead to morbidity and mortality later in life (1).

Overweight and obesity

Overweight and obesity is an escalating problem in the world. According to the World Health Organization (WHO) the definition of overweight is a body mass index (BMI) of 25-29.9 kg/m^2 and ≥30 kg/m^2 for obesity (2). However, the distribution of body fat seems to be of more importance than the body weight. Visceral body fat is connected to morbidities, therefore waist circumference and/or waist-to-hip ratio is preferable measurements (3, 4). In 2012, 70% of the population in the US was overweight with the highest prevalence among non-Hispanic black women (80%) (5). A recent survey in Sweden indicates that half of the adult population (16-84y) is overweight or obese (57% of men and 43% of women) of which 28% of women are classified as overweight and 15% as obese (6). WHO estimates that the prevalence of obesity worldwide in 2016 were 11% in men and 15% in women (7) with the highest prevalence in the Pacific islands, where over 50% are obese (8).

The most common cause of death globally is cardiovascular disease (CVD) and obesity is an independent risk factor (9). Being overweight is also an important predictor of type 2 diabetes and insulin resistance (10). The incidence of low back pain and knee osteoarthritis seems to be higher in obese people than in non-obese. Obesity is strongly related to some forms of cancer such as endometrial and postmenopausal breast cancer. Furthermore obesity affects the reproduction by decreased fertility, due to alterations in endocrine mechanisms (11, 12). Obesity is also linked to several risk factors associated with pregnancy, such as an increased risk of gestational diabetes, cesarean delivery, pre-eclampsia, neonatal deaths and fetal anomalies (13).

Pregnancy

Pregnancy is considered a risk factor of overweight and obesity, were a high pre-pregnancy BMI, excessive gestational weight gain and postpartum weight retention are the most important pregnancy related factors (14). In 2009, an estimate of 25% of women in the US who gave birth were overweight (but not obese) just before pregnancy and 22% were obese. Pre-pregnancy weight increased with age and varied between different ethnic groups, with non-Hispanic black women having the highest prevalence of pre-pregnancy obesity (15) . In 2014, 25% of women were overweight and 13% were obese in early pregnancy in Sweden (16).

Gestational weight gain

Gaining weight during pregnancy is a natural outcome of the pregnancy with the placenta, amniotic water and the growing fetus causing an increased weight (17). Further, many physiological changes occur in the female body, e.g reduced insulin sensitivity, increased respiratory tidal volume and an increased plasma volume which is a major contributor to an increase of total body water as well as larger cardiac output. Other metabolic and endocrine functions might alter the basal metabolic rate and energy expenditure (18). The total gestational weight gained is very diverse among women and influenced by numerous factors. The increase in fat mass is causing the most variability between women's weight gain. Socioeconomic status, ethnicity, psychological factors such as stress or attitudes towards gestational weight change and many factors in the surroundings, like support from family or health care and access to healthy food have impact on the variability in the weight gained (17).

Mean gestational weight gain range from 10 kg to 16.7 kg in normal weight adults in the US and obese adults gain slightly less. The Institute of medicine (US) has established recommendations (table 1) based on associations from numerous studies, between gestational weight gain and negative consequences in the mother or fetus. There is an inverse relationship between pre-pregnancy BMI and gestational weight gain, although overweight or obese women are more likely to exceed the recommendations of weight gain during pregnancy (17).

Table 1. *Institute of Medicine guidelines for weight gain during pregnancy, 2009.*

Pre-pregnancy BMI	Total weight gain Range in kg	Rates of weight gain 2nd and 3rd trimester Mean (range) in kg/week
Underweight (<18.5 kg/m^2)	12.5-18	0.51 (0.44 – 0.58)
Normal weight (18.5-24.9 kg/m^2)	11.5-16	0.42 (0.35 – 0.50)
Overweight (25.0-29.9 kg/m^2)	7-11.5	0.28 (0.23 – 0.33)
Obese (≥30.0 kg/m^2)	5-9	0.22 (0.17 – 0.27)

Modified from Institute of Medicine, Weight gain during pregnancy: reexamining the guidelines (17).

Postpartum Weight Retention

Excessive gestational weight gain is the main predictor of postpartum weight retention. After the delivery the body is expected to return to its pre-pregnancy state. The postpartum period has previously been defined as the time from delivery until the reproductive organs return to the pre-pregnancy state and usually last 6-8 weeks. However, it has been suggested that the postpartum period could proceed for one year after delivery because of the duration of other pregnancy related physiological changes, such as lactation and increased body weight. The average weight retention is quite modest at 0,5kg - 4kg (1), however at one year postpartum 15-20% of women have retained more than 5 kg (19).

Apart from gestational weight gain, diet, exercise and lactation influence postpartum weight retention. Since lactating increases the energy expenditure it can theoretically reduce weight, although the evidence is inconclusive. Other factors that impact postpartum weight retention are low socio-economic status, multiparity or a high pre-pregnancy BMI (1).

Regarding the association between diets and postpartum weight retention, a recent study examined the relation between Diet quality and postpartum weight retention in 100 US women with the majority being normal weight. Diet quality was determined as meeting the recommended intake of bread, meat, fruit, vegetables and milk in the Food Guide Pyramid as well as the intake of sweet and salty snacks. Diet quality was not related to weight retention, however gestational weight gain and weight-related distress were (20).

Further, the association between postpartum weight retention and two different diets was studied by Boghossian et al. A scoring system for a modified Mediterranean diet and the Alternative Healthy Eating Index (AHEI-2010) was used on 1136 US postpartum women. The original HEI score consist of the following twelve components; total fruit, whole fruit, total vegetables, dark green or orange vegetables, total grains, whole grains, milk, meat, oils, sodium, saturated fat and energy from solid fat, alcohol and added sugar. AHEI-2010 pays more attention to different types of fat than the original HEI and alcohol was excluded from both original diet scores. None of the diets were associated with postpartum weight loss at 14 months postpartum, instead total energy intake was associated with postpartum weight retention (21).

Another study (n = 47 011) investigated the association between adherence to Norwegian dietary guidelines and postpartum weight retention at 6 months postpartum. Adherence to the quantitative recommendations of the following food groups was calculated with an index inspired by the HEI-2005; a minimum intake of fresh fruit, vegetables, whole grain products, a range of fish, fatty fish and limitations of red meat, processed meat as well as salt and added sugar. They found that a higher adherence to the recommendations was related to a reduced weight retention (22).

Finally, the Active Mothers Postpartum trial, found an association between a limited intake of junk food (e.g. sweetened drinks and fast food) and a larger postpartum weight loss in US women (n = 450) with overweight or obesity (23).

It has been proposed that the pre-pregnancy weight should be reached by 6 months postpartum, since retained weight at 6 months seems to be associated with long term obesity (24). In Sweden, the recommendations are to return to the pre-pregnancy weight within a year and not to lose more than 0.5 kg per week to not negatively impact lactation performance or infant growth (25).

Weight loss

General weight loss

Weight loss can be achieved by either reducing energy intake and/or increasing energy expenditure. A deficit of 500 – 1000 kcal / day is generally recommended (26). To increase energy expenditure with 500 kcal, one hour of vigorous exercise is needed every day (27). There is strong evidence that adding physical exercise to diet has little effect on weight loss in people with obesity (26).

There is a great variety in how to compose a weight loss diet. It could be altered combinations in the proportion of the macronutrients, such as low fat, low carbohydrate or high protein or more attention to food quality by different dietary patterns, for example the Mediterranean diet. Previous research has shown that a diet with a reduced proportion of carbohydrates is more efficient in the short term (6 months), but there seems to be no difference in weight loss between the different diets in the long term (12 months). On the other hand, the diets could have different effects on co-morbidities, for instance diabetes type 2 or CVD (26).

In the previous decades nutrition recommendations have focused on specific nutrients such as saturated fatty acids, sucrose and fiber (28, 29). Since our food intake is very complex with food items containing a mix of different nutrients and a lot of food items are eaten together, the most recent Nordic Nutrition recommendations 2012 (30) have introduced food-based dietary guidelines. The guidelines are based on present knowledge on the influence of food on health and/or risk of disease. Food groups that have been associated with weight gain or an increase in waist circumference are meat and processed meat, refined grains and sugar-rich foods and beverages. In contrast, whole grains, fruit, nuts and dairy products appear to have a protective role (30).

The general advices from the European guidelines for Obesity Management in Adults are: “1) decrease energy density of food and drinks 2) decrease the size of food portions 3) avoid snacking between meals 4) do not skip breakfast and avoid eating at night time 5) manage and reduce episodes of loss of control or binge eating” (31). They also suggest an increased intake of vegetables, beans, legumes, lentils, grain, unsweetened cereal and seafood and a reduced intake of foods and beverages with added sugar as well as substitution of low-fat products regarding meat and dairy products (31).

According to the American Guidelines for the Management of Overweight and Obesity in Adults, there is strong evidence that a lifestyle intervention should include a combination of moderately reduced calorie intake, increased physical activity and behavior therapy including self-monitoring of food intake, physical activity and weight. They put emphasis on a calorie reduction and that the choice of diet should reflect the preferences and health status of the individual (32).

Weight loss postpartum

According to a review by Lim et al (33), there has been several studies (n = 22) using physical exercise as an intervention as well as studies (n = 21) combining physical exercise with diet regarding weight loss after pregnancy. Physical exercise alone seems to be insufficient as a weight loss tool and therefore a diet component seems to be of more importance. The interventions with exercise alone mostly included activities with low intensity, and thereby not sufficient increase in energy expenditure (33). Lack of time and childcare demands are two major barriers to exercise in the postpartum period in addition to tiredness (due to lack of sleep) or back/pelvic pain which could make it harder to exercise (34-36). The studies included in the review by Lim et al. who combined diet with physical exercise and showed a significant weight loss in the intervention compared to the control group had a variety of dietary approaches. Lovelady et al included an energy restriction of 500 kcal/day with the nutritional proportion of 25 E% fat, 20 E% protein and 55E% carbohydrates (37). Another study put emphasis on low glycemic index, high fiber and controlled portion sizes (38). O´Toole et al had individual dietary plans with an energy restriction of 350 kcal in conjunction with the participants preferences and dietary pattern (39).

Very few have studied diet alone compared to diet plus exercise. In the LEVA (Lifestyle for effective weight loss during lactation) trial, Bertz et al investigated the effect of diet and physical activity by a 2 by 2 factorial design by randomizing 68 lactating women into four treatment groups; usual care (control), dietary treatment, physical exercise or a combination of diet and physical exercise. There was a main effect of diet since both diet alone and the combined treatment showed significant weight loss compared to physical exercise and control (40). Another study compared diet and diet plus exercise with a control group, although with the aim to investigate the effects on lactation performance. As above, both diet alone and the combined treatment lead to significant weight loss compared to the control group, however the combined treatment seemed to have a greater reduction in percentage of body fat (41).

In Sweden, the dietary guidelines during lactation aim for a healthy diet with a variety of nutrients and consist of recommendations to eat according to the plate model, eat 500 g of fruit and vegetables/day, fish 2-3 times/week and mainly choose light/low fat and whole grain products when applicable (42).

Diet quality for weight loss

Some studies have focused on diet quality in the postpartum period using the Healthy Eating Index (HEI) or different compositions of diets with various results.

A study by Stendell-Hollins et al compared MyPyramid diet to a Mediterranean-style diet on weight-loss in 129 overweight (BMI 27.2 ± 4.9 kg/m^2) breastfeeding postpartum women, resulting in significant ($p < 0.001$) weight loss in both groups after 4 months, -3.1 ± 3.4 kg and -2.3 ± 3.4 kg respectively and with no difference between the study groups. At baseline the participants in both groups were given dietary advice (in line with either Mediterranean diet or MyPyramid diet) and behavioral counseling by a dietitian along with written materials. During the 4 months of intervention the participants met twice more with the dietitian and were counseled by telephone at five occasions. The Mediterranean diet intended to increase the intake of whole grains, fresh vegetables and fruit, legumes and nuts, fish and poultry, olive oil and low-fat dairy products with an emphasize on olive oil, walnuts, fruit and vegetables and limit the intake of red and processed meat. The other group was given general dietary advice based on MyPyramid diet for Pregnancy and breastfeeding, but deemphasizing the intake of oil, nuts, fruit and vegetables (43).

An US randomized control trial of 276 women used HEI (2005) to examine the effect of a behavioral intervention on postpartum weight loss. The intervention group (n = 131) received eight monthly educational kits via mail. Three of the kits focused on dietary advice, for instance suitable portion sizes, grocery lists and meal plans. They intervention group also received a phone call addressing motivation and barriers to change and to evaluate the content of the kits. The control group only

received monthly mailings, but with focus on the child. The study showed no significant differences in neither weight loss nor diet quality between the intervention and control group at 15 months postpartum (44).

Colleran et al (2012) used MyPyramid Menu Planner as a 16 week weight-loss intervention for postpartum women in a randomized controlled trial. MyPyramid Menu Planner is an internet based tool with recommended amount of servings for nine different food groups; vegetables, fruit, grains, meat and legumes, milk, oils, sweets, beverages and miscellaneous, however this study divided the food groups further. The intervention group (n=14) had lost significantly more weight than the control group (n=13), 5.8 ± 3.5 kg compared to 1.6 ± 5.4 kg ($p = 0.03$) at 20 weeks postpartum. The intervention group had a greater energy reduction most likely due to a higher intake of fruit and vegetables and lower intake of beverages and sweets than the control group (45).

In the above mentioned LEVA trial, changes in food choice were investigated after a 12-week diet intervention. Two groups receiving dietary treatment were compared to two groups not receiving dietary treatment. The intervention included two face to face counseling sessions with a dietitian as well as four dietary principles; decrease the intake of sweets, salty snacks and caloric drinks, choose low-fat and/or low-sugar products instead of the regular products, fill half the plate with vegetables at lunch and dinner and finally reduce portion size. Food choice was evaluated by the following food groups; vegetables, fruit, grain/potatoes, dairy, meat, caloric drinks and sweets/salty snacks. At twelve weeks postpartum the intervention group had increased the intake of vegetables and decreased the intake of sweets/salty snacks more than the non-diet groups. At the 1 year follow up the differences in intake of vegetables remained but both groups had a significant reduction in intake of sweets/salty snacks, with no between-group differences at 1 year (46).

The LEVA in Real Life trial

Based on the LEVA trial, the LEVA in Real Life trial was developed to test the previous diet intervention in clinical practice. In total, 110 postpartum women received similar treatment to the LEVA trial and the effect on weight loss and nutrient intake was examined after 12 weeks of diet intervention and at a 1 year follow-up. At the 12 week follow-up, the diet intervention group (n=54) had accomplished a larger weight reduction than the control group (n=56), median (1^{st}, 3^{rd} quartile) -6.1 kg (-8.4, -3.2 kg) versus -1.6 kg (-3.5, -0.4 kg) ($p < 0.001$). The diet group also decreased their total energy intake and energy percentage of fat and increased their intake of fiber and energy percentage of protein more than the control group (all $P \leq 0.05$). At the 1 year follow-up the larger weight reduction in the diet group remained, -10.0 kg (-11.7, -5.9 kg) versus -4.3 kg (-10.2 kg, -1.0 kg) ($P = 0.004$), but not the other differences apart from the increased energy percentage of protein. Changes in food choice have not yet been examined in this trial (47).

Aim

The aim of this study was to investigate changes in food choice after 12 weeks and one year during a weight loss trial with dietary treatment, in postpartum women with overweight or obesity. The aim was to be obtained through the following questions:

1) What food choices did the women report at baseline?
2) What changes in food choice were reported among women receiving dietary treatment and women not receiving dietary treatment in the LEVA in Real Life trial after 12 weeks and one year?

Methods

In this study, data from the previous LEVA in Real Life trial were used (47). The trial was conducted between 2011-2016 within the primary health care in Gothenburg, Sweden and aimed to investigate both the short term and long term effectiveness of a diet intervention to produce weight loss among postpartum women.

Study subjects

In total, 110 postpartum women with overweight or obesity (BMI≥27kg/m^2) at 6-15 weeks postpartum were recruited to a randomized controlled trial. Pregnant or early postpartum women were recruited at antenatal and childcare clinics around Gothenburg and by advertisement in web journals, shopping centers, newspapers and social networks between the years 2011-2014. Women or women with children with serious diseases were excluded. Furthermore women were not allowed to participate in other weight-loss trials and had to understand written Swedish. At baseline the women were randomized into either diet intervention group (D-group) or control group (C-group) at 6-15 weeks postpartum (47).

Intervention and follow-up

The diet intervention prolonged for 12 weeks with follow up 1 year after baseline. After the baseline visit, the dietary intake of the participants randomized to the D-group (n=54) was assess with a food record for 4 consecutive days and if possible one weekend day included. Within 1-2 weeks after the baseline visit, the participants in the D-group individually met with a dietitian to initiate a diet behavior modification treatment. During the 1.5 h meeting the women identified barriers to change and strategies to manage them together with the dietitian. Dietary advice of food and food groups to be consumed were given in a printed booklet. The composition of macronutrients in the dietary treatment was according to Nordic Nutrition Recommendations, 2004 (28) and aimed to accomplish a decrease in energy intake of 500kcal/day based on the baseline dietary intake assessed by the food record. The energy deficit should result in a weight loss rate of 0.5 kg/per week and a total of 6 kg at the end of the intervention. The following key dietary principles were given as four steps and were to be introduced one at a time as weight was lost.

1) Limit intake of salty snacks, sweets and caloric drinks to 100g/week

2) Exchange regular food items to items with low fat and/or low sugar

3) Fill half of the plate with vegetables at lunch and dinner according to the plate model

4) Decrease portion size.

The booklet also contained general advice of physical activity and instructions of self-weighing three times/week (47).

During the intervention the participants also received feedback biweekly through cell phone text messages except week 6 when the text message was replaced with a phone call. This permitted more thorough feedback and any questions to be answered. At the termination of the intervention the feedback continued, but with monthly standardized e-mails instead, until the 1 year follow up (47).

The C-group (n=56) only received a brochure at the baseline visit with general guidelines of a healthy diet and physical activity and no other treatment such as feedback or individual meeting with dietitian. The brochure contained suggestions and strategies of how to change habits, directives of self-weighing and measuring, suggested food items and meals and some similarities to the four dietary principles, such as the plate model (47).

Data collection

Dietary intake and anthropometric measures were assessed at three different occasions, baseline (6-15 weeks after postpartum), 12 weeks and one year after baseline. At the three visits the following measurements were assessed. Height was measured without shoes to the nearest 0.1 cm with a wall mounted stadiometer. A body composition monitor (Omron BF508) was used to measure weight to the nearest 0.1 kg and estimate percent body fat. The participants were dressed in light clothing with bare feet on the foot electrodes and estimation of body fat were conducted with bioelectric impedance through hands and feet with arms vertically holding the hand electrodes. Pre-pregnancy weight was obtained by self-report as was gestational weight gain. The weight (in kilograms) was divided by the height in square meters to calculate BMI at all occasions as well as a pre-pregnancy BMI.

The dietary intake of both groups was assessed with a 24-h recall prior to the three visits. The 24-h recalls were conducted by two study dietitians as unannounced telephone call and covered Monday to Thursday. The participants were asked to recall dietary intake in terms of food and beverages of the previous day (from midnight to midnight) by the study dietitians. Probing questions was used to obtain details of cooking methods, ingested items and meals. The intake was quantified by using weights, volumes, household measures or a booklet with photographed portion sizes (Portionsguiden) distributed to the participants prior to the call. Dietist XP (version 3.2) were then used to calculate intake of nutrients (48).

Food analysis

In this study the dietary intake of the 110 women at three occasions were divided and manually categorized into different food groups; 1) fruit/berries 2) vegetables (including root vegetables and legumes) 3) dairy products 4) potatoes/grains (including pasta, rice, cereals and bread) 5) dietary fats 6) meat/fish (including seafood) 7) sweets/salty snacks (including sugar, deserts, ice-cream and nuts) 8) caloric drinks (including juice) 9) low caloric drinks 10) mixed dishes (including fast food). Some food items were excluded e.g. egg, tap water, coffee and condiments. The excluded group comprises some foods that were consumed in very small amounts, such as condiments or was difficult to place in a food group, for example eggs. A specified list can be found in appendix A. The categorization is based on food-based dietary guidelines NNR-12 (30) and similarities in meal composition. It is also in line with the four key dietary principles and similar to food groups used in the previous LEVA trial. The contribution of energy from each food group was calculated as a percentage of total daily energy intake (E%) by dividing energy intake of the food group with the total daily energy intake. To evaluate the effect of second dietary principle, i.e. to exchange regular food items with low fat and/or low sugar products, energy density was calculated by dividing the intake of energy (kcal) of all food and beverages with the amount (grams) consumed for the food groups dairy products, dietary fats and meat/fish. (49).

Statistical analysis

All data were coded and summarized using Microsoft Excel 2010 and analyzed with IBM SPSS Statistics, version 24. First, tests for normal distribution were performed with One-sample Kolmogorov-Smirnov test for all variables. Comparisons of all continuous variables between D- and C-group were made using Students t-test or Mann Whitney U-test. Paired samples t-test or Wilcoxon signed rank was used to compare continuous variables within the groups. $P<0.05$ was considered statistically significant. The changes in food choice were calculated as the food intake obtained at 12 weeks and 1 year minus the baseline value, respectively. A negative number is equal to a decrease in intake and a positive number is equal to an increase in intake. Normally distributed variables are presented with mean ± SD values and non-normally distributed variables are presented with median (1^{st}; 3^{rd} quartile). At the two follow-ups women past 12 weeks of a new pregnancy were excluded.

Ethical considerations

Data from the study LEVA in Real Life were used. That study was approved by the regional ethics committee in Gothenburg. Written informed consent, with information on how the data would be used, was obtained from all participants. All the participants are coded with a number and the results can not be derived to a specific person. Furthermore, already existing data are more economical and time saving to use than generating data from a new study.

Results

Study subjects

In total, 100 women completed the intervention as a result of ten drop outs, seven in the D-group and three in the C-group. Another eleven participants where lost by the 1-year follow up due to seven drop outs of which two were in D and five in the C-group and four were excluded because of new pregnancies, one in D-group and three in C. Hence, 89 women were included in the analysis at 1 year.

At baseline, the women who were at 10 ± 2 weeks (mean ± SD) postpartum, had a mean age of 32.2 ± 4.6 years, 60% were highly educated and 84 % were breastfeeding to some extent. In addition, they had a median (1st, 3 rd quartile) pre-pregnancy BMI of 28.4 kg/m^2 (26.0, 32.4) and a baseline BMI of 31.0 kg/m^2 (28.8, 33.6) with no significant differences between the two groups regarding any of the mentioned characteristics. Characteristics in detail can be found in table 2.

Table 2: *Baseline characteristic for all women and divided by group in the LEVA in Real Life trial.*[1]

Variable	All women (*n* = 110)	Diet group (*n* = 54)	Control group (*n* = 56)
Age, years	32.2 ± 4.6	31.8 ± 4.5	32.6 ± 4.7
Parity, *n*	2.0 (1.0, 2.0)	2.0 (1.0, 2.3)	2.0 (1.0, 2.0)
Pre-pregnancy BMI, kg/m^2	28.4 (26.0, 32.4)	27.4 (25.4, 32.3)	28.8 (26.8, 33.0)
Baseline BMI, kg/m^2	31.0 (28.8, 33.6)	30.7 (28.6, 34.1)	31.2 (28.8, 33.5)
Gestational weight gain, kg	17.4 ± 7.4	18.2 ± 6.9	16.5 ± 7.7
Education, % (*n*)			
High school	0.9 (1)	1.9 (1)	0.0 (0)
≤3 y beyond high school	39.1 (43)	46.3 (25)	32.1 (18)
> 3 y beyond high school	60.0 (66)	51.9 (28)	67.9 (38)
Marital status, % (*n*)			
married or cohabitant	98.2 (108)	96.3 (52)	100.0 (56)
single	1.8 (2)	3.7 (2)	0.0 (0)
Lactation status, % (*n*)			
exclusive	57.3 (63)	46.3 (25)	67.9 (38)
partial	26.4 (29)	35.2 (19)	17.9 (10)
none	16.4 (18)	18.5 (10)	14.3 (8)

[1] Values are presented as means ± SDs for normally distributed variables, medians (1st, 3rd quartiles) for non-normally distributed variables and percentage (n) for categorical variables.

Food choice at baseline

At baseline, the women reported an average energy intake of 2250 ± 804 kcal/day with no significant difference between the two groups (P = 0.527).

Furthermore, regarding the intake of the different food groups, there were no significant differences between the D- and C-group at baseline (table 3). Of the total energy intake, grains were the major contributor (27 E%) followed by dairy products (17 E%) and sweets/salty snacks (16 E%) (figure 1).

The reported daily median intake of sweets/salty snacks was 80 (23, 163) grams. In comparison to the recommendation of 500 grams/day the median intake of fruit and vegetables was 278 (126, 459) grams (appendix B) where of 120 (30, 215) grams was vegetables and 125 (0, 233) grams was fruit.

Regarding the food groups dairy, fat and meat/fish the median energy density was 0.88 (0.59, 1.37) kcal/gram for dairy, 6.67 (5.37, 7.08) kcal/gram for fat and 1.72 (1.41, 2.44) kcal/gram for meat/fish with no significant differences between the D- and C-group.

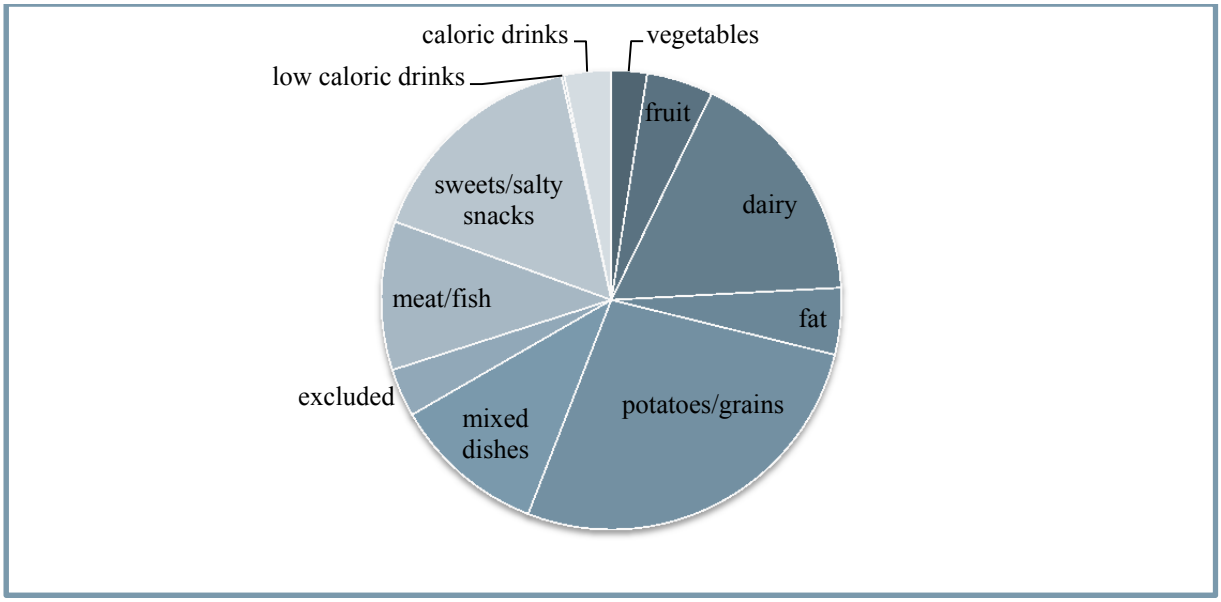

Figure 1. *Contributors of the reported daily energy intake (E%) at baseline divided by food groups (presented as means), based on the first 24-h recall.*

Food choice at 12 weeks and changes in food choice during the intervention

At the end of the intervention (12 weeks) there was a significant difference in the reported energy intake between the D-group and C-group, 1546 (1246, 1950) and 1717 (1488, 2490) kcal/day respectively (P=0.003) as a result of a greater reduction in energy intake in the D-group.

After 12 weeks the daily median intake of sweets/salty snacks was 20 (0, 43) grams in the D-group in comparison to 68 (27, 133) grams in the C-group. The intake of fruit and vegetables was 395 (258, 580) grams/day compared to an intake of 299 (85, 414) grams/day in the C-group (appendix B).

The reduced energy intake was mainly due to a decreased intake of sweets/salty snacks, but dairy products, grains, fat and caloric drinks had also decreased in the D-group (table 3). The C-group only decreased the intake of grains. When the changes in food choice were compared between the groups, there were only two statistically significant differences. The D-group had increased their median energy intake of vegetables (10 kcal/day vs -9 kcal/day, P = 0.046) and decreased their median energy intake of sweets/salty snacks (-94 kcal/day vs -19kcal/day, P = 0.024) more than the C-group. The food choice changes in energy intake were transferable to the changes in amount of intake. The D-group had significantly increased their median intake of fruit and vegetables by 60 (-34, 168) grams/day compared to -30 (-113, 68) in the C-group (P < 0.001). The reported intake of sweets/salty snacks had reduced in the D-group with -41 (-210, 0) grams/day as opposed to no change in the C-group (P = 0.005).

If the intake is put in relation to the total energy intake the median intake of vegetables (2 (0, 5) E% vs 0 (-2, 2) E%, P = 0.004) and meat/fish had increased (7 (0, 17) E% vs 2 (-9, 12) E%, P = 0.006) and the mean intake of caloric drinks had decreased more in the D-group (-2 ± 7) in comparison to the C-group (0 ± 5) (P = 0.044) (Figure 2). After 12 weeks mixed dishes contributed with a median intake of 8 (0, 17) E% and the excluded items with 1 (0, 5) E%..

In addition, the D-group had a significant decrease in energy density of fat (-1.6 (-2.7, -0.1) kcal/gram) compared to the C-group (P < 0.001), but with no changes in energy density of meat and dairy within or between groups.

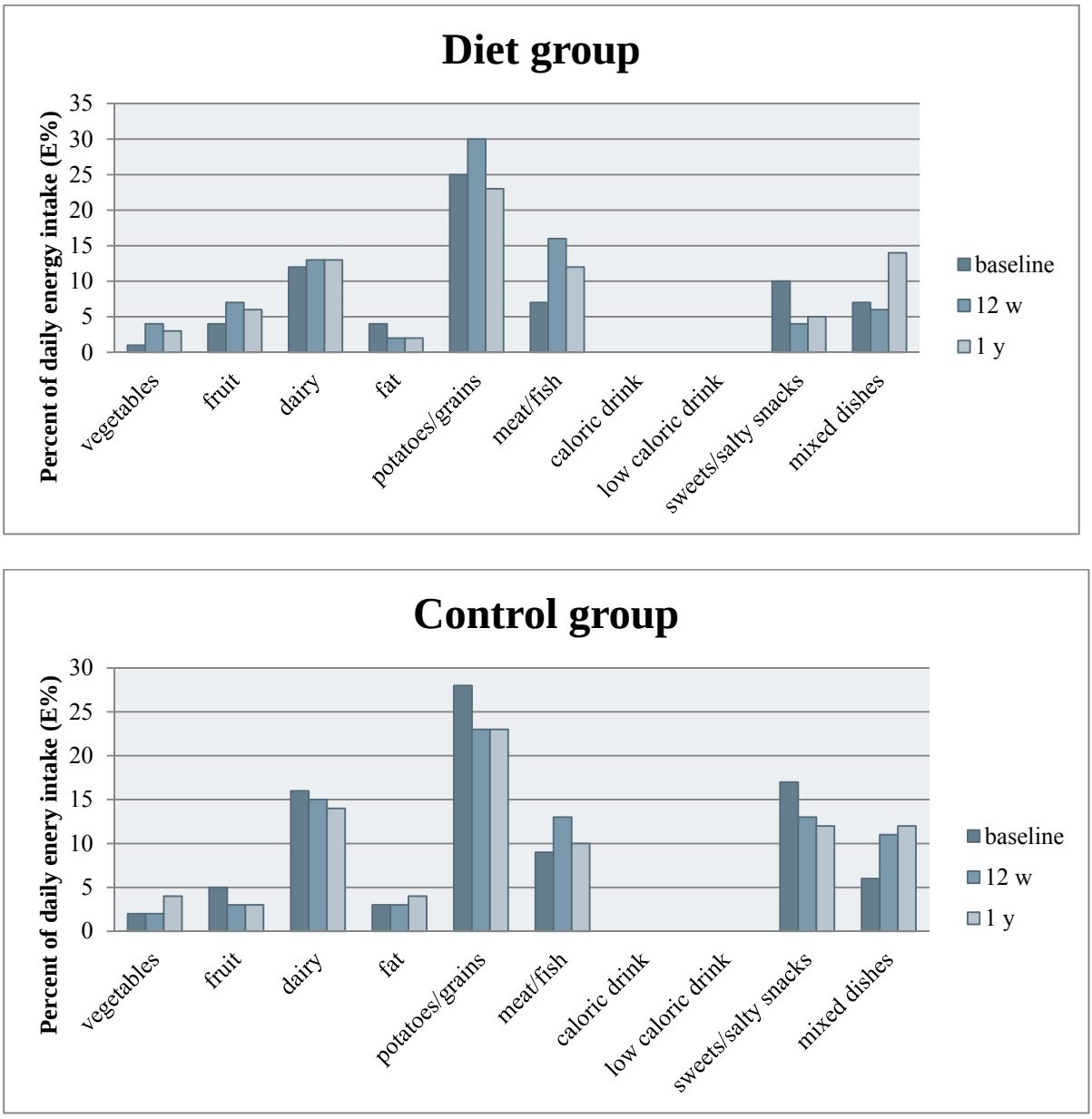

Figure 2. *Intake (energy percentage/day) of different food groups at baseline, after 12 weeks and 1 year divided by women receiving Dietary treatment and Control group (presented as median values) in the LEVA in Real Life trial. Based on the reported intake from a 24-h recall of 110, 100 and 89 women participating at baseline, 12 weeks and 1 year, respectively.*

Table 3. *Intake (kcal/day) of different food groups at baseline and changes in intake after 12 weeks (Δ 12 w) and 1 year (Δ 1 y) divided by women receiving Dietary treatment and Control group in the LEVA in Real Life trial.*[1]

	Diet group (n = 54)			Control group (n = 56)			
	Mean ± SD	Median (1st, 3rd quartile)	P-value Within[2]	Mean ± SD	Median (1st, 3rd quartile)	P-value Within[2]	P-value Between[3]
Vegetables							
Baseline*	56 ± 85	27 (4, 71)	-	57 ± 57	44 (9, 86)	-	0.259
Δ 12 w*	13 ± 85	10 (-16, 58)	0.068	-9 ± 62	-9 (-44, 29)	0.443	0.046
Δ 1 y	8 ± 93	14 (-40, -57)	0.522	17 ± 74	20 (-23, 68)	0.095	0.601
Fruit							
Baseline*	101 ± 105	96 (0, 157)	-	111 ± 104	104 (5, 156)	-	0.578
Δ 12 w*	7 ± 133	0 (-47, 90)	0.422	-7 ± 123	-18 (-63, 55)	0.424	0.243
Δ 1 y	-4 ± 122	-5 (-72, 68)	0.736	-28 ± 130	-3 (-114, 64)	0.291	0.369
Dairy							
Baseline*	323 ± 215	280 (178, 450)	-	361 ± 288	307 (168, 453)	-	0.763
Δ 12 w	-88 ± 279	-117 (-245, 128)	0.042	-42 ± 364	0 (-216, 209)	0.729	0.483
Δ 1 y	-44 ± 281	-66 (-239, 157)	0.294	-68 ± 370	-18 (-276, 108)	0.252	0.729
Fat							
Baseline*	109 ± 125	78 (0, 168)	-	102 ± 100	70 (36, 137)	-	0.789
Δ 12 w	-63 ± 129	-18 (-136, 21)	0.003	-21 ± 121	-17 (-100, 52)	0.206	0.141
Δ 1 y	-56 ± 122	-42 (-138, 3)	0.002	-21 ± 136	-10 (-61, 28)	0.186	0.177
Potatoes/grains							
baseline	620 ± 326	589 (395, 770)	-	610 ± 296	602 (414, 801)	-	0.871
Δ 12 w	-154 ± 249	-147 (-333, 34)	0.000	-136 ± 343	-153 (-330, 126)	0.009	0.760
Δ 1 y	-206 ± 326	-240 (-407, -2)	0.000	-181 ± 420	-212 (-453, 50)	0.006	0.757
Meat/fish							
Baseline*	218 ± 226	181 (13, 361)	-	258 ± 237	216 (71, 365)	-	0.365
Δ 12 w	70 ± 299	34 (-92, 212)	0.201	-7 ± 328	21 (-192, 202)	0.815	0.225
Δ 1 y*	-0.6 ± 221	38 (-83, 129)	0.530	-45 ± 266	0 (-188, 150)	0.469	0.436
Caloric drinks							
Baseline*	105 ± 195	0 (0, 125)	-	46 ± 78	0 (0, 84)	-	0.248
Δ 12 w*	-68 ± 171	0 (-123, 0)	0.012	7 ± 119	0 (-21, 35)	0.787	0.058
Δ 1 y*	-71 ± 181	0 (-130, 0)	0.009	-4 ± 89	0 (-45, 0)	0.639	0.217
Low caloric drinks							
Baseline*	0 ± 1	0 (0, 0)	-	1 ± 2	0 (0, 0)		0.955
Δ 12 w*	0 ± 3	0 (0, 0)	0.581	0 ± 2	0 (0, 0)	0.812	0.927
Δ 1 y*	0 ± 3	0 (0, 0)	0.282	0 ± 1	0 (0, 0)	0.916	0.257
Sweets/salty snacks [4]							
Baseline*	407 ± 515	183 (80, 535)	-	397 ± 355	369 (70, 595)	-	0.338
Δ 12 w*	-315 ± 542	-94 (-514, 0)	0.000	-55 ± 430	-19 (-308, 121)	0.320	0.024
Δ 1 y*	-267 ± 482	-113 (-493, -22)	0.000	-145 ± 360	0 (-437, 114)	0.047	0.110

[1] The analyzes are based on the numbers of women completing the intervention or not excluded, hence 110, 100 and 89 women were included at baseline, 12 weeks and 1 year, respectively.

[2] Differences within the groups were analyzed using paired samples t-test for normally distributed variables and Wilcoxon signed-rank test for non- normally distributed variables.

[3] Differences between the groups were analyzed using independent samples T-test for normally distributed variables and Mann Whitney U test for non- normally distributed variables.

[4] The baseline energy intake of sweets/salty snacks was adjusted for using linear regression. Since there was no significant difference between the groups, the unadjusted value is presented.

*non-normally distributed variables

Food choice at 1 year and changes in food choice from baseline to 1 year

The difference in the reported energy intake between the two groups at 12 weeks did not remain until the follow up at one year after baseline. Both groups had similar energy intake (1708 kcal/day in the D-group vs 1853 kcal/day in the C-group) (P = 0.298).

Furthermore, there was no significant difference between the D-group and the C-group regarding the reported intake of fruit and vegetables at 1 year follow-up with a median intake of 323 (142, 405) grams/day and 269 (142, 405) grams/day in the two groups respectively (P = 0.407). Both groups had decreased the intake of sweets and salty snacks, although the D-group had a lower intake at 18 (0, 58) grams/day vs 54 (11, 109) in the C-group (P = 0.045).

Consistent with changes after 12 weeks, the D-group had a decreased energy intake from sweets/salty snacks, potatoes/grains, fat and caloric drinks one year after baseline, but not from dairy products any longer (table 3). The C-group continued to have a significant increased intake of grains and like the D-group, also decreased the energy from sweets/salty snacks compared to baseline. After one year, the between group differences at 12 weeks, regarding changes in energy intake of vegetables and sweets/salty snacks did not remain (table 3).

Corresponding with the findings after 12 weeks there was no significant difference in change in energy density of dairy or meat/fish between the groups, however the difference at 12 weeks regarding energy density of fat, was not sustained (P = 0.244).

Discussion

The aim of this study was to examine food choices at baseline and changes in food choice in postpartum women who received dietary treatment to induce weight-loss, compared to women who did not receive any treatment. The first results found, were that the baseline intake of energy mainly came from grains, dairy products and sweets/salty snacks. The daily intake of fruit and vegetables was 278 grams and the intake of sweets/salty snacks – 80 grams. Secondly, findings after 12 weeks were that the intake of vegetables had increased more and the intake of sweets/salty snacks decreased more in the D- group than the C-group. After 1 year there was no difference between the two groups regarding changes in food choice in any food group. Finally, in the D- group a greater decrease in energy density of fat was observed after 12 weeks, but not after 1 year.

Food choice at baseline

Previous research shows a decline in diet quality during pregnancy and the postpartum period (50, 51) as well as a diet during the postpartum period not meeting the dietary guidelines (52, 53). The findings in this study regarding food choice at baseline are similar to the Swedish population in 2010, apart from that a higher intake of dairy products was observed in this study, according to Riksmaten (54), the most recent national dietary survey among men and women (non-pregnant and non-lactating) compared to Riksmaten. The major contributors of energy were potatoes/grains, 28 E%, dairy products, 17 E% and sweets/salty snacks, 16 E%, in comparison to the major contributors in Riksmaten which were grains (not including potatoes), 20E%, meat, fish and egg, 17 E%, sweets, caloric drinks and salty snacks, 15E%. An intake of vegetables of 120 grams and fruit of 125 grams were observed in this study, in comparison to Riksmaten with a daily intake of 189 grams and 135 grams respectively (among women 21-44 years of age). In the present study the intake of sweets/salty snacks was 80 grams which corresponds to the intake of 86 grams (by adding the data from the food groups: jam, nuts, salty snacks, ice cream, sweets, pastries, biscuits, cakes, desserts, sugar and others sweeteners) among Swedish women aged 31- 44 (54). Our results are also in line with findings from the LEVA trial, where the major contributors of energy at baseline were sweets/salty snacks and

potatoes/pasta/bread (46). However, the LEVA trial assessed the dietary intake by a 4-day food record and not 24-h recall as in the present study.

Changes in food choice

Sweets/salty snacks and caloric drinks

The first dietary principle was to reduce the intake of salty snacks and food and beverages with added sugar to 100 grams/week and at only one occasion. Since the dietary principles were to be implemented step by step and this was the first principle, this step was implemented by all participants in the D-group, which might not be the case with the other principles. At 12 weeks, a larger reduction of sweets/salty snacks in the D-group than in the C-group was observed, consistent with previous weight loss interventions in postpartum women with overweight. The previously mentioned study by Colleran et al (45) found a significantly decreased intake of added sugars in the Intervention group compared to minimal care group after a 16 week weight loss intervention. Likewise, Huseinovic et al (46) also found a decrease of sweets/salty snacks in the intervention group after 12 weeks of diet weight loss intervention in the LEVA trial. Lovelady et al, randomly assigned 48 US women (BMI 27.8 ± 2.4 kg/m^2) who were exclusively breastfeeding to a control group or a 10 weeks intervention from 4 weeks postpartum. They also found a decreased intake of sweets and snacks in the intervention group (55). Since this type of food is rich in calories and was a major part (16E%) of the energy intake at baseline in the present study, a reduction of this food group produced an initial energy deficit and thereby weight loss in the D-group.

Caloric drinks was part of the same principle as sweets/salty snacks, but was analyzed as a separate food group in this study. There was no difference in caloric drinks in either group at none of the follow-up assessments. a significant reduction might be impossible due to a very low intake of caloric drinks at baseline. The median intake was 0 (0, 97) kcal in both groups combined. In the LEVA trial, Huseinovic et al. (46) showed a decrease in the intake from caloric drinks after their diet intervention, however the LEVA trial showed a larger intake at baseline with a median intake in the Diet group of 3.9 E% at baseline, compared to the results in the present study with a median intake of 0 E%. The differences could be a consequence of weekends being included in the LEVA trial. In addition, Lovelady et al. (55) also found a decrease in intake from sweet drinks after their weight loss intervention among postpartum women with overweight. However, their intake was measured in numbers of servings and therefore more difficult to compare with the findings in the present study.

Dairy, fat and meat/fish

The second dietary principle was to exchange regular food items with low fat and/or low sugar alternatives. After 12 weeks the reported energy density of fat had decreased more in the D-group than the C-group, but with no differences in changes in energy density of meat or diary. This suggests a change from high fat products to lower fat products in the D-group. The food group fat contained cooking fat and spread. These are higher in fat content compared to meat and dairy products, commonly at 80-100% fat. The baseline median energy density of dairy products was 0.88 kcal/gram and 1.7 kcal/gram of meat/fish. Considering that an energy density under 1.5 is regarded as low, a low baseline energy density might impact the possibility to decrease the energy density of such food. Furthermore, energy density is commonly applied on specific food items or meals (mixed dishes), not food groups (49) and therefore difficult to compare to other research. There are also different methods to calculate energy density, for example with or without water content. Since water content can greatly change the weight of a food item and consequently the energy density, the energy density varies considerably if drinks are included (49), like milk was in our calculations of energy density in the dairy food group. Though, the energy density was calculated with the same method at all occasions and the results should therefore persist regardless of method chosen. One study, the LEVA trial (46), has used energy density on food groups, but only on the food group dairy. The participant in the LEVA trial in the D-group received the same dietary principles as in the present study. The result in

the LEVA trial was a decreased energy density of dairy in the D-group after 12 weeks, which is not corresponding with the results in this study.

Fruit and vegetables

The third dietary principle was to fill half the plate with vegetables, but there was no advice regarding fruit intake in this step. This advice also occurred in the brochure distributed to the C-group. At the end of the intervention the D-group reported a significant increase in intake from vegetables more compared with the C-group, and with no changes in fruit intake in either group. In the LEVA trial (46) the D-group increased the energy percentage from fruit as well as from vegetables, although the dietary principles were similar.

Other food groups

The fourth dietary principle was to decrease portion sizes. This could affect the intake of a variety of food groups, but most likely meat/fish and potatoes/grains. There were no significant changes in the reported intake of meat/fish after 12 weeks in either group. Instead of a reduced intake, the intake tended to increase in both groups. The intake of potatoes/grains decreased in the D-group after 12 weeks and this might be due to a reduced portion size. Another explanation could be that the trendy weight loss diets at this time are low in carbohydrates, which might have influenced the intake, especially since the intake of potatoes/grains decreased in the C-group as well. Since this dietary principle was the last step to be implemented, all participants might not have reached this step within 12 weeks. Most other studies focus on the intake of whole grain and not grains as a whole, which makes the results difficult to compare. The LEVA trial (46) examined the intake of potatoes/pasta/bread with an increased intake in the D-group, as opposed to the results in the present study.

1 year follow-up

At the 1 year follow up there were no significant differences between the D- and the C-group. However, in line with the result after 12 weeks, the D-group had a reduced intake from fat, grains, caloric drinks and sweets/salty snacks. The C-group also had a decreased intake from sweets/salty snacks after 1 year and this most likely erased the in-between differences. There are not many randomized controlled trials investigating weight loss or dietary changes in postpartum women in the long term.

Methodological considerations

Study subjects

The study subjects were a homogenous group. There were no significant differences between the D- and the C-group regarding background characteristics like age, BMI, level of education or breastfeeding status. Likewise the intake from the different food groups did not differ between the groups at baseline their eating habits correspond to the general Swedish population according to Riksmaten (54). People who participate in health related studies tend to be more interested in health than the general population and therefore the participants in this study might be more motivated to change their eating habits. Also, a majority were highly educated which is associated with healthier eating habits.

Further, previous research shows that women with overweight tend to underreport more than women with normal weight and therefore the results might be underestimated. A woman age 32 years and weighing 88 kg has an estimated daily energy requirement of 2400 kcal (with PAL 1.5) and an additional energy cost of 600 kcal/day for breastfeeding (NNR-12). The study subjects in the LEVA in Real Life trial reported a mean energy intake of 2250 kcal, which might be 750 kcal below estimated energy requirement for a breastfeeding woman. The discrepancy might be caused by underreporting, but also that some participants intentionally were trying to lose weight at baseline. In the LEVA in Real Life trial, the dietary intake of the D-group measured using both a 24-h recall and a 4-day food

record has been compared and showed a higher energy intake from the 4-day record than the 24-h recall. When the 24-h recall was compared with a 1-day record (weekday) instead, the result was reversed (48). The low energy intake in the participants could therefore be a result of weekends not being included in the present study, and in that way still be representative for weekdays.

24-h recall

The results from the LEVA in Real Life trial relied on a 24-h recall to assess dietary intake. Since this is a retrospective method, the dietary intake might be underestimated or altered due to recollection of the dietary intake the previous day (56). To limit this, the interviewers reviewed a multi-item list with easily forgotten food and beverages with the study subjects.

A single 24-h recall only provides the intake of one day and does not represent the usual dietary intake of an individual. However, a 24-h recall can provide dietary intake for a group (57) and consequently, all results in this study are analyzed and presented at group level only. Further, the 24-h recall in the trial did not include Friday, Saturday or Sunday and since the intake of sweets, desserts, salty snacks and caloric drinks might be greater on these days, the intake of these food groups might have been underestimated. For that reason the results are representative for weekdays, but not for weekends. However, the same days were assessed at all occasions and therefore changes in the dietary intake of weekdays should still appear. Another limitation with a 24-h recall is the estimation of portion sizes. Since the food consumed is not weighed an alternative method should be used to quantify the intake (56, 57). In the LEVA in Real Life trial a brochure with pictures of different portion sizes was used to quantify portion sizes as well as household measures.

Regarding dietary assessment methods in general, participants may withhold or modify information to be more in line with what they think is suitable behavior or change their eating behavior prior to the assessment (56). Since the 24-h recall was unannounced and retrospective it limited the study subjects' ability to alter their eating behavior. A 24-h recall was also selected because of a low burden on the participants as the focus of the trial was to evaluate the effectiveness on body weight, and not dietary changes (48).

Food groups

The selection of food groups and how the food items were categorized in the groups have most likely impacted the results of this study and the ability to compare the results to other research. At first, food items were divided into smaller subgroups and then merged into the 10 selected food groups. For example the sweets/salty snacks group consisted of 4 food subgroups at first; sweets, deserts/biscuits, nuts and salty snacks. Due to very low levels of intake in some subgroups and the risk of massignificance when many statistical tests are performed, the subgroups were combined into larger groups.

One of the key dietary principles was to exchange caloric drinks with low calorie alternatives, hence the creation of the food group low caloric drinks. Water, tea and coffee were not asked for in detail in the 24-h recall and thereby the intake of these items was missing for some participants. As a result of this, water, tea and coffee were part of the excluded items. If any of the participants replaced a caloric drink with tap water instead of a low caloric drink, this was not possible to detect. .

Smaller subgroups might be of more importance if the aim is to study the intake of specific nutrients. For example, the intake of whole grains separated from other grains to identify fiber intake or fish and nuts as separate groups from meat and salty snacks to detect intake of unsaturated fatty acids. The intention of this study was not to analyze the intake of nutrients and consequently larger food groups could be created and was based on dietary intake associated with overweight or obesity.

The mixed food group included all meals that could not be separated further or were not suitable in any other group, such as all fast food, soup, pancakes, casseroles and sauces. If separated into other groups the intake of some food groups would have increased. Of the daily intake of energy the mixed

food group contributed with 7 E% and the excluded items with 1E% at baseline and this results in that the analysis covers 92E% of the food intake at baseline and at the two follow-ups a minimum of 85% of the energy intake was covered.

Analysis

The entire dietary intake has been manually handled in Excel, like divide the food items in to the food groups and summarize the food groups. There is a possibility of human error when dealing with data manually.

Nutritional intake and diet quality has previously been analyzed with a variety of methods. Previously mentioned are, adherence to different guidelines either by using HEI or numbers of portions as well as intake of food groups, which are presented in different units, gram, calories or energy percentage. This makes it difficult to compare the results of this study to other research. In this study the results are mainly analyzed and presented in calories, with the intention of finding absolute changes. To examine if the changes remained in relation to energy intake, energy percentage of the food groups were analyzed as well. To be able to compare the results to the recommended intake of 500 grams fruit and vegetables (NNR-12) in addition to the principle of limiting sweets/salty snacks to 100 grams per week in the LEVA in Real Life trial, the intake of these two food groups are also presented in grams.

Strengths and limitations

One of the limitations of this study was that a single 24-h recall was used to assess dietary intake and only weekdays were represented. The results might be underestimated, but since the same method was used at baseline and the two follow-ups the results are representative for weekdays and changes in food choice during weekdays should still be observed. Another weakness is that the findings are not representative for the general population in Sweden. For example the majority of the participants were highly educated and living in an urban environment and the results can only be transferable to a similar population.

The strengths of the LEVA in Real Life trial were that the study subjects were randomized and the intervention was conducted in real life setting with minimal disruption of the participants normal life. Further, the trial was successful regarding weight loss and covers changes in weight and food choice both in short and long term. Another strength is that the trial had trained interviewers carrying out the 24-h recalls in a standardized way.

Conclusion

A weight loss trial with dietary treatment among postpartum women with overweight or obesity produced significant short term changes in food choice in line with dietary recommendations. The weight loss was most likely a result of changes in food choice. However, no differences in changes in food choice were observed between D- and C-group at 1 year. Future research should focus more on long term interventions with the aim to sustain dietary changes and weight loss.

My contribution

The research team behind the LEVA in Real Life trial have executed the intervention and provided me with all the data. My contribution included decide and create the food groups, divide and summarize the food intake from the 24-h recalls and statistically analyze the food choice at baseline and the changes in food choice according to the food groups, within and between the study groups.

Acknowledgement

Thank you Ena Huseinovic for all the feedback and useful advice you have given me. You have always been available to guide me in the right direction. Also, thanks to the research team behind the LEVA in Real Life trial who have provided me with data and for letting me use it in this thesis.

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Appendix A

Livsmedelsgrupp	Inkluderade	Exkluderade	Kommentar
Exkluderade	ketchup, senap, oliver, soltorkade tomater, bostongurka, saltgurka, kokosmjölk, ägg, måltidsersättning, sesamsås, sojasås, tofu, kaviar, buljong, kokosflingor, kakao, mandelmassa, sweet chilisås, teryiaki, rostad lök, ajvar, tuggummi, citronjuice, mjöl, falafel, kranvatten, mineralvatten, te, kaffe		Smaksättare Små mängder
Grönsaker/Rotfrukter	rotfrukter, baljväxter, konserverade, picklade, groddar, avokado	potatis	Ej potatis pga kunna jämföra m rek 500g
Frukt/bär	konserverad	juice torkad frukt	
Potatis/spannmål	bröd inkl rån, flingor, gryn, gröt, ris- o mannagrynsgröt, grötris , skorpor, pasta, ris, potatis, rösti, mos, tacoskal Korv-,hamburger-, tortillabröd, välling		Ingen större skillnad i energi mellan nyckelhål o vanliga
Kött/Chark Fisk/skaldjur inkl lätt/mager	Nöt, fläsk, kyckling, vilt, korv, köttbullar/-limpa, leverpastej, kebabkött, veg. ”kött” pastej, panerat	köttfärssås	Energidensitet visar val av magra produkter Veg.produkter som används som substitut
Mejeri inkl lätt/mager	dessertost , mjölk-ostsås, tzatziki, mildas+alpros ”grädd”-produkter, Soja-/havredryck,		Energidensitet visar val av magra produkter Veg.produkter som används som substitut
Matfett inkl lätt/mager	Olja, margarin, smör, alla lätt/magra		Energidensitet visar val av magra produkter
Utrymmesmat	Jordnötter, jordnötssmör, salta kex, chips, popcorn, salta pinnar, marmelad, sylt, fruktsoppor, efterrätter, glass, socker, honung, chokladsås, chokladboll, croissant, munkar, vetebröd, muslibar, milkshake, risifrutti, nutella, godis, choklad		

Energigivande dryck	saft inkl lättsockrad, alkohol, juice, chokladdryck		Väldigt lågt intag av alkohol
Energifattig dryck	Lightläsk		Max 4 kcal/100g Sötningsmedel i st f socker
Blandade	Soppa, stuvning, gratäng, gryta, sallad m dressing/vinägrett, köttfärsröror, pannkakor, våfflor, raggmunkar, pyttipanna, paj, pizza, lasagne, allt friterat (inkl pommes), omelett, sushi, kroppkakor, blodkorv, Alla såser (brun-, sötsur-, kebab-, lök-, jordnöt-, coleslaw, pesto-, dill-, ägg-, salsa, tomatsås,) hummersås, smoothie, skagenröra, dressing, majonnäs		

Appendix B

Intake (gram/day) of different food groups at baseline and changes in intake after 12 weeks (Δ 12 w) and 1 year (Δ 1 y) divided by women receiving Diet treatment and Control group in the LEVA in Real Life trial.[1]

	Diet group (n = 54)			Control group (n = 56)			
	Mean ± SD	Median (1st, 3rd quartile)	P-value within[2]	Mean ± SD	Median (1st, 3rd quartile)	P-value within[2]	P-value between[3]
Vegetables							
Baseline*	140 ± 183	105 (25, 190)	-	166 ± 143	140 (50, 237)	-	0.112
Δ 12 w*	74 ± 238	60 (-34, 168)	0.004	-32 ± 174	-30 (-113, 68)	0.148	0.001
Δ 1 y	15 ± 185	55 (-87, 129)	0.261	-11 ± 170	0 (-102, 121)	0.990	0.490
Fruit							
Baseline*	145 ± 146	105 (0, 230)	-	174 ± 165	143 (11, 257)	-	0.408
Δ 12 w*	32 ± 221	34 (-47, 119)	0.214	-13 ± 193	-8 (-122, 105)	0.449	0.136
Δ 1 y*	10 ± 175	0 (-104, 80)	0.798	-50 ± 200	-3 (-185, 79)	0.183	0.282
Dairy							
Baseline*	374 ± 325	336 (159, 467)	-	373 ± 284	355 (193, 511)	-	0.742
Δ 12 w*	-57 ± 457	-20 (-312, 186)	0.456	4 ± 340	10 (-128, 174)	0.672	0.470
Δ 1 y	-27 ± 322	-49 (-210, 201)	0.536	-72 ± 365	-46 (-262, 197)	0.349	0.536
Fat							
Baseline*	18 ± 20	12 (0, 25)	-	17 ± 15	14 (6, 21)	-	0.667
Δ 12 w	-8 ± 20	-6 (-19, 5)	0.012	-4 ± 19	-5 (-15, 6)	0.137	0.237
Δ 1 y*	-7 ± 20	-10 (-21, 4)	0.012	-4 ± 20	-3 (-13, 5)	0.185	0.304
Potatoes/grains							
Baseline*	325 ± 194	298 (195, 383)	-	307 ± 157	325 (178, 418)	-	0.891
Δ 12 w	-63 ± 157	-69 (-195, 36)	0.004	-65 ± 209	-65 (-229, 58)	0.015	0.973
Δ 1 y	-113 ± 198	-139 (-210, 9)	0.000	-71 ± 259	-120 (-260, 64)	0.040	0.393
Meat/fish							
Baseline*	112 ± 109	100 (11, 180)	-	135 ± 108	123 (53, 204)	-	0.226
Δ 12 w	44 ± 148	30 (-31, 126)	0.059	-10 ± 138	0 (-122, 70)	0.743	0.061
Δ 1 y*	13 ± 112	17 (-36, 65)	0.323	-13 ± 138	-36 (-94, 95)	0.595	0.236
Caloric drinks							
Baseline*	252 ± 444	0 (0, 272)	-	107 ± 171	0 (0, 200)	-	0.278
Δ 12 w*	-167 ± 422	0 (-300, 0)	0.012	9 ± 246	0 (-56, 0)	0.983	0.104
Δ 1 y*	-191 ± 423	0 (-300, 0)	0.006	-22 ± 178	0 (-38, 0)	0.354	0.177
Sweets/salty snacks							
Baseline*	117 ± 128	65 (23, 174)	-	112 ± 103	96 (19, 164)	-	0.827
Δ 12 w*	-88 ± 140	-41 (-210, 0)	0.000	0 ± 162	0 (-84, 54)	0.717	0.005
Δ 1 y*	-81 ± 117	-49 (-140, -14)	0.000	-38 ± 119	-30 (-117, 30)	0.018	0.132

[1] The analyzes are based on the numbers of women completing the intervention or not excluded, hence 110, 100 and 89 women were included at baseline, 12 weeks and one year.

[2] Differences within the groups were analyzed using paired samples t-test for normally distributed variables and Wilcoxon signed-rank test for non-normally distributed variables.

[3] Differences between the groups were analyzed using independent samples T-test for normally distributed variables and Mann Whitney U test for non-normally distributed variables.

*non-normally distributed variables