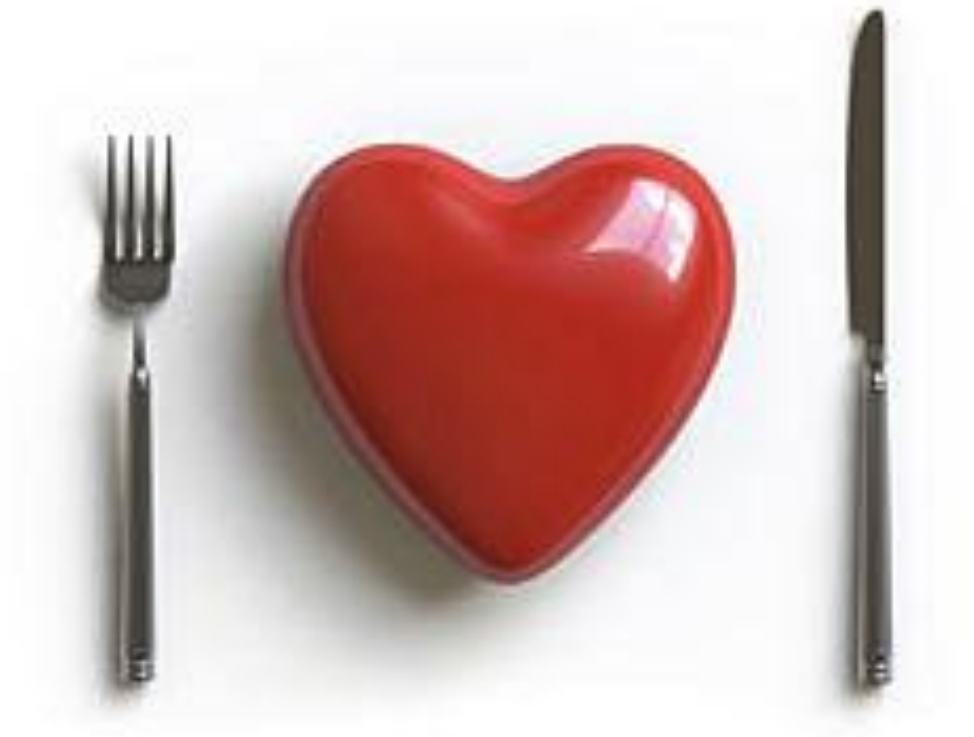
The effect of weight loss in obese patients with heart failure - a pilot study



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Foreword and acknowledgements

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Abbreviations and acronyms

6MWT	Six-minute walk test
BMI	Body mass index
CI	Confidence Interval
E%	Energy percentage
FM%	Fat mass percentage
HDL	High density lipoprotein
HF	Heart failure
HP	High protein
Kcal/d	Calories per day
LCD	Low calorie diet
LDL	Low density lipoprotein
Mmol	millimolar
NYHA	New York Heart Association
NT-proBNP	N-terminal brain natriuretic peptide
SE	Standard Error
TG	Triglycerides
VLDL	very low density protein

Abstract

Introduction: Dietary recommendations in heart failure management are contradictory to findings established by the obesity paradox. The objective of this study was to investigate if a weight reduction could reduce symptoms of heart failure; thus resulting in an improvement of body composition, plasma lipid profile and functional status and thereby positively affect cardiac function.
Methods: We enrolled 26 obese patients with heart failure and NYHA II or III. They were randomly assigned to adhere to a low calorie diet or a conventional diet for 12 weeks. During the study we assessed body weight and -composition, plasma lipid profile, NT-proBNP, functional status and quality of life.
Results: Of the 26 patients, 18 completed the study (11 in the intervention group and 7 in the control group). The mean weight loss with the low calorie diet (LCD) was 11.3% of initial body weight and the difference in mean weight loss between the low calorie diet group and conventional diet group was 11.7kg at the end of the study (95% CI: 6.8, 16.6, $p<0.0001$). Patients following the low calorie diet significantly reduced their body mass index ($p<0.0001$, 95% CI: 2.3, 5.3), waist circumference ($p<0.0001$, 95% CI: 5.9, 15.3) and hip circumference ($p<0.0010$, 95% CI: 5, 15.2,) compared to the patients following the conventional diet. The walking distance significantly improved between baseline and week 12, between-group difference amounted to 172m after 12 weeks $p<0.0005$. There was a significant mean difference for cholesterol- ($p<0.0006$), triglyceride- ($p<0.0100$) and low density lipoprotein ($p=0.0265$) concentrations between baseline and week 8. Mean differences in plasma lipid levels were not significant at week 12.
Conclusion: In this small pilot study a low calorie diet led to a significant improvement in body weight and -composition and functional status in patients with heart failure. Larger studies need to confirm these preliminary findings.

Introduction

The obesity paradox is interesting as it contradicts common advise for managing obesity (Curtis et al. 2005), (Kenchaiah et al. 2002), however, the obesity paradox encompasses another paradox; while numerous studies have documented an inverse association between body mass index and mortality in heart failure and therefore do not recommend weight loss the guidelines for managing heart failure from the European Society of Cardiology do recommend overweight and obese patients with heart failure to lose weight (Dickstein et al. 2008).

Heart failure is a common disease with a poor prognosis (Mosterd et al. 2001). The risk of developing heart failure at some point in life has been found to be one in five regardless of sex and age (Lloyd-Jones et al. 2002). In 2007 the prevalence of heart failure in Denmark was estimated to be 60,000 patients and just as many was thought to suffer from non-clinical heart failure. Mortality is estimated to be 20% just one year following diagnosis (Egstrup et al. 2007).
A reduced functionality of the heart causes added physical exertion to patients suffering from HF and thereby causes a decline in functional capacity. Left ventricular heart failure may cause dyspnoea and severe pulmonary oedema. Right ventricular heart failure is an independent risk factor off left ventricular heart failure but also causes fluid retention in legs and organs (Camm 2002). Heart failure is a great health risk and is a problem of great health concern.

Another considerable health issue is overweight and obesity, which is an independent risk factor for developing heart failure (Kenchaiah et al. 2002). In Denmark 47% (Body-mass index (BMI) $\geq$25) of the adult population are overweight and 13% are obese (BMI $\geq$ 30) (Christensen et al. 2011). People who are overweight or obese but otherwise healthy are strongly advised to lose weight to diminish adverse health affects (World Health Organization 2000), (Curtis et al. 2005), (Kenchaiah et al. 2002); however, in regards to heart failure recommendations are not definite. Observational studies have shown a negative association between degree of overweight and mortality in patients with heart failure (Curtis et al. 2005)(Kenchaiah et al. 2002), (Curtis et al. 2005), (Pocock et al. 2008), (Lissin et al. 2002) and that elevated BMI levels improved the chances of survival in heart failure patients (Horwich et al. 2001). These studies do not differ between intentional and unintentional weight loss. A deterioration of heart failure can cause an unintentional weight loss and thereby a loss of both fat mass and lean body mass. In addition, the measurement of left ventricular ejection fracture and hence the additional fat tissue may complicate the diagnosis of heart failure, so there is also a risk of the imprecision of the diagnostic tools.

Only a few clinical trials, with few participants have investigated the effect of intended weight reduction on heart failure. One study looked at the association of weight loss and quality of life (Mariotti et al. 2008), while another studied the effect of different diets and reduced body weight (Evangelista et al. 2009). However, it remains uncertain whether a weight reduction is advisable.

Thus the objective of this study was to investigate if a weight reduction could reduce symptoms of heart failure. We hypothesized that a 10-15 % weight loss induced by a low calorie diet (LCD) providing 800 kcal/day would reduce the symptoms of heart failure, thus resulting in an improvement of body composition, plasma lipid profile and functional status and thereby positively affect cardiac function.

Methods

Participant recruitment and characteristics

The study was designed as a non-blinded randomised parallel controlled trial. Patients were randomly assigned to a low calorie diet or a conventional diet. After the termination of the study, patients in the control group were invited to follow a similar programme as the intervention patients but these results do not appear in the final study.

All the patients were found in the database of Copenhagen University Hospital Gentofte using the search criteria; admitted to hospital within 2 years, BMI ≥ 30, diagnosed with New York Heart Association (NYHA) functional class II or III, 18-80 years, medically stable for the past three months, had not experienced any deterioration of their disease within the last six months e.g. operations/procedures or other factors that could be expected to affect the aim of the study and had not recently lost a considerably amount of weight. The local committee of ethics and the Danish Data Protection Agency has approved the study protocol. All patients were given information about the study and informed consent was obtained from all participants at the beginning of the trial. 53 patients were identified with being NYHA classification II or III, and having a BMI ≥ 30 kg/m^2 or being described as "heavy" or "adipose" in their patient chart or weighing > 100 kg and no height registered.

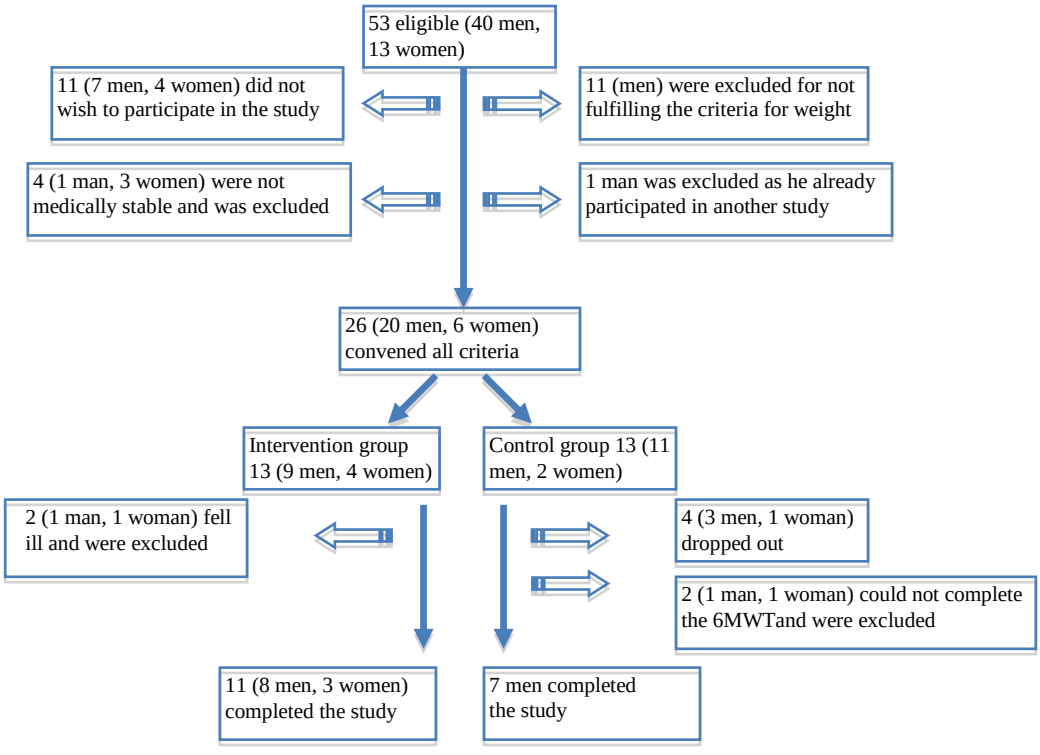

Figure 1: Flow chart

Figure 1 shows the outline of the study. Twenty men and six women (n=26) were randomised into two groups; intervention (n=13) and control (n=13).

Diet intervention

Patients in the intervention group underwent a 12-week nutrition programme consisting of a low calorie diet with high protein. Macronutrient energy percentages are given in table 1. The first eight weeks the diet provided 800 kcal/d. To easily control the dietary intake the diet consisted of Nupo products; six nutritional powder shakes or soups, where 100 kcal/d came from a snack bar or 200g of specific vegetables. The last four weeks patients were instructed to eat 1200 kcal/d, as a high protein diet can possibly help regulate appetite and body weight, making it less likely for patients to gain weight and more likely to reduce weight further (Larsen et al. 2010). Patients were given a diet plan of meal suggestions where each main meal was 300 kcal. In between meals consisted of a meal replacement bar or shake of approximately 200 kcal and a nutritional powder soup or shake of 100 kcal, accordingly in between meals were also 300 kcal. The diet consisted of approximately 30-40 E% protein a day.

The control group followed a similar course of action, though instead of the LCD they where guided to eat a conventional diet in accordance Danish dietary guidelines of the National Board of Health, Denmark (Astrup et al. 2005) and Nordic Nutrition Recommendations 2004(Nordic nutrition recommendations 2004) see table 1.

Both groups received nutrition counselling by a nutritionist in accordance to their diet and with the dietary guidelines for patients with heart failure (Dickstein et al. 2008)

Nupo A/S had no influence and was not involved in designing the study, selection of participants, analysing or interpreting data.

Table 1: The table show E% of macronutrients in the different diets.

Energy percentage of macronutrients in intervention and control diets			
	Intervention diet Week 0-8	Intervention diet Week 8-12	Control diet Week 0-12
Kcal/d	800	1200	2000-2500
Protein	35-40 E%	30-40 E%	10-20 E%
Carbohydrate	35-40 E%	no recommendations	50-60 E%
Fat	15-20 E%	no recommendations	25-35 E%
Dietary fibre	5-10 E%	no recommendations	25-35 g/d

Measures

Anthropometric measures

Anthropometric measures were collected at every visit. At the first visit patients' baseline height and weight were measured. Weight measurements were obtained using a calibrated scale. Participants were weighed in their underwear without shoes to obtain the most accurate measure. These measures were used to calculate BMI for each patient and each visit. BMI was used to assess total body weight in relation to height. Bio-impedance, which calculates percentage fat mass (FM %) and lean body mass, was used to determine body composition (Tanita BC-418 MA). In addition, body composition and fat distribution were measured from hip and waist circumference using a measuring tape. These methods were used because waist circumference and waist-hip ration are predicting factors of abdominal obesity, which is an influencing factor on heart (World Health Organization 2011). The same person performed all the measures at each visit to minimize measuring bias. The methods were used to compliment each other and give a more precise assessment of body composition.

Functional status – six-minute walk test

To asses functional status the patients performed a six minute walking test (6MWT), which is a measure used to reflect functional capacity and exertion, which are symptoms of heart failure. The test closely reflects the impact of everyday activities for HF patients (Guyatt et al. 1985) and is commonly used as it produces high reliability and validity (Demers et al. 2001). A track of 30 metres was measured and patients were asked to walk as far as possible when walking at their normal pace within six minutes. The test was performed at baseline and week 12 at the hospital. The ability to walk further at week 12 was considered to be positive.

Biochemical analysis

Biochemical analysis included potassium, glucose, triglycerides (TG), cholesterol, High density lipoprotein (HDL), low density lipoprotein (LDL), very low density lipoprotein (VLDL) and N-terminal brain natriuretic peptide (NT-proBNP). Fasting blood samples were collected at every visit from each patient.

Plasma lipids

Total cholesterol, high-density lipoprotein (HDL), and triglyceride levels were quantified in plasma by routine enzymatic methods (Ortho-Clinical Diagnostics, Johnson & Johnson, Birkeroed, Denmark) for the Vitros 5.1 FS analyzer. Very-low-density lipoprotein (VLDL) and low-density lipoprotein (LDL) were calculated from Friedwald's formular. That is; VLDL was calculated from the amount of triglyceride multiplied by 0.45 and low-density lipoprotein (LDL) from the amount of total cholesterol minus the amount of HDL and VLDL.

N- terminal brain natriuretic peptide (NT-proBNP)

NT-proBNP is a hormone reflecting cardiac function; in heart failure levels are elevated. NT-proBNP can detect the presence and severity of HF ((Baker 2002, Drury, Howlett 2002)) and is a useful tool in diagnosing heart failure. NT-proBNP samples were analysed by the Immulite 2500 Analyzer. NT-proBNP can be affected by several factors and thus show elevated levels in elderly and women among others, while lower level can occur in adiposity. NT-proBNP levels below 300 pg/ml exclude decompensate heart failure (Egstrup et al. 2007).

Quality of life

Quality of life was measured by asking the patients to answer a self-administered questionnaire (SF-36) about their physical and mental health. The questionnaire is a short form questionnaire, which was administered three; times at week 0, 8 and 12.

Statistical analysis

Unpaired t-test was used to test initial group differences. The effect of intervention on body weight, BMI, waist and hip circumference, waist-hip ratio, triglyceride, total, LDL, HDL, VLDL cholesterol, NT-proBNP and 6MWT was tested using analysis of covariance (ANCOVA). The MIXED procedure in the Statistical Analysis System (SAS) software package, version 9.2 was used (SAS Institute, Cary NC); with week 12 values as response and week 0 values as covariates and subjects as random factor. When adjusting for sex ANCOVA with week 12 values as response and week 0 values and sex as covariates was used. Repeated measures ANCOVA with the MIXED procedure in SAS were used to test interaction between groups (control and intervention) and time (1, 2, 4, 6,8,10 and 12 weeks). Week 0 values were included as covariates. When adjusting for sex, week 0 values and sex was used as covariates. Log transformation of data with skewed distributions was done when necessary.

Results

18 (15 men and 3 women) 11 in the intervention group and 7 in the control group completed the trial. In the intervention group two fell ill (one due to depression and one to a sore throat) and were not able to comply with the diet and was therefore excluded. In the control group four dropped out as they did not meet to the initial weighing and two were excluded, as they could not complete the 6MWT. Baseline characteristics include only the 18 individuals that completed the trial, as four patients dropped out before we obtained baseline data.

Table 2: The table illustrates baseline and end-point characteristics.

	Week 0		Week 12		p-value
	Intervention	Control	Intervention	Control	
	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)	
Age	57 ±3.8	65 ±1.54	-	-	0.1157
BMI (kg(/m2)	37.2 ±1.67	36.4 ±2.4	33 ±1.54	36 ±2.44	<0.0001
Weight (kg)	112.7 ±5.50	114 ±8.1	99.8 ±4.70	112.8 ±8.22	<0.0001
6MWT	406.3 ± 41.3	424.7 ±28.7	481.4 ±25.3	324.3 ±38.4	<0.0005
Cholesterol (mmol/L)	5.1 ±0.69	4.9 ±0.40	4.4 ±046	4.4 ±0.27	0.7633
Triglycerides (mmol/L)	2.01 ±0.30	2 ±0.31	1.62 ±0.31	1.9 ±0.29	0.6692
LDL (mmol/L)	3 ±0.61	2.9 ±0.37	2.6 ±0.36	2.4 ±0.23	0.5580
HDL (mmol/L)	3 ±0.61	1.11 ±0.10	1.11 ±0.06	1.12 ±0.11	0.1592
VLDL (mmol/L)	0.9 ±0.14	0.9 ±0.14	0.7 ±0.14	0.9 ±0.13	0.6282
NT-proBNP (pg/mL)	876.8 ±335.2	419.5 ±208.9	851.5 ±331.8	593.4 ±199.3	0.6024

Body weight and composition

Figure 2 show changes in weight between baseline and 12 weeks in patients randomized to the LCD and conventional diets respectively. The difference in mean weight loss between the two groups was 11.7kg (95% CI: 6.8, 16.6, p<0.0001). During the 12-week study period we found that the patients in intervention group lost an average 11.3% body weight compared to the control group who reduced their weight by 1.1%. Primary weight loss was achieved during the first eight weeks when the intervention group were following the LCD (10.5% (11.8kg)). A repeated measures analysis for changes in weight was significant at eight weeks (p<0.0001).

Over the course of the study the intervention group reduced their BMI significantly compared to the control group p<0.0001 (4.2 kg/m^2 vs. 0.4 kg/m^2, respectively). Thus the mean difference was 3.8 kg/m^2 (95% CI 2.3, 5.3). Figure 3 illustrates the changes in BMI between baseline and week 12 in the two groups. Patients following the LCD diet reduced their waist circumference significantly more than those following a conventional diet p<0.0001. At the end of the study the mean difference in waist circumference was 10.6 cm (95% CI: 5.9, 15.3). Figure 4 illustrates the change in waist circumference between baseline and week 12 in both groups.

The mean difference in hip circumference in the intervention group compared to the control group was 10.1cm (95% CI: 5, 15.2, p<0.0010) when the study ended. Waist-hip ratio did not reach significance.

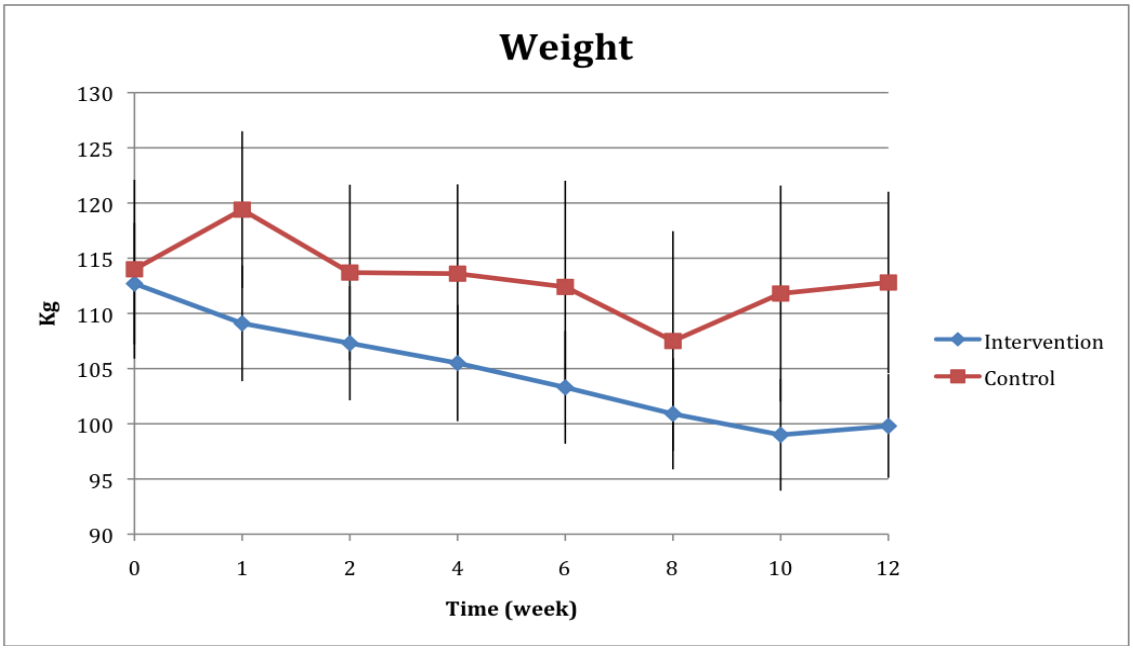

Figure 2: Weight changes between weeks 0-12. Error bars show SE.

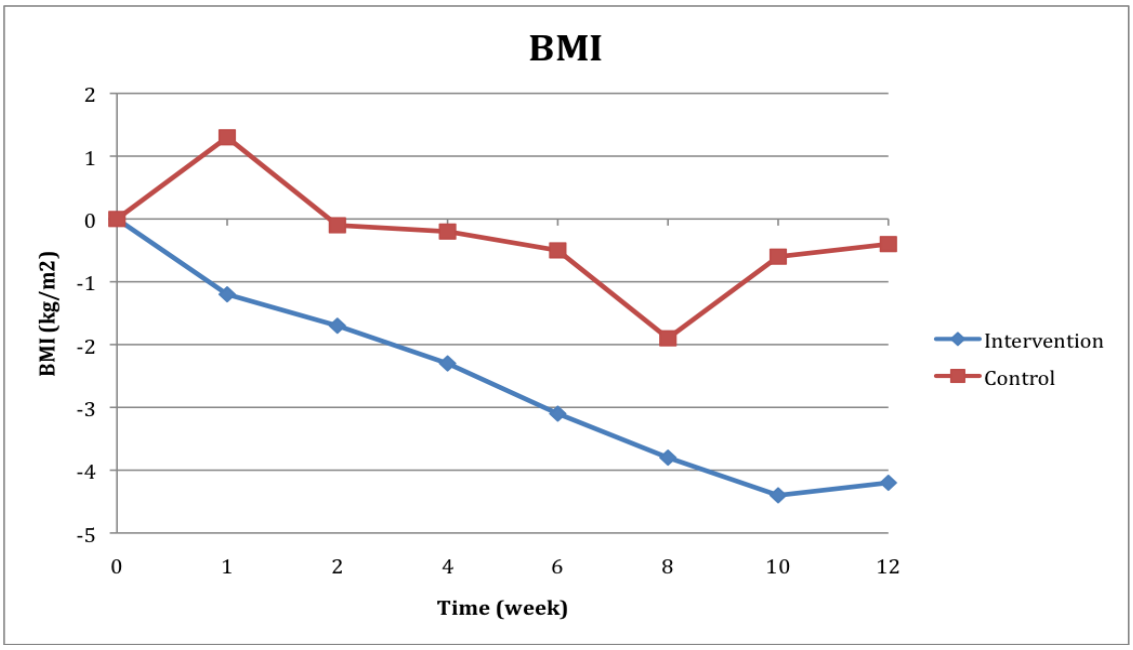

Figure 3: Changes in BMI between weeks 0-12.

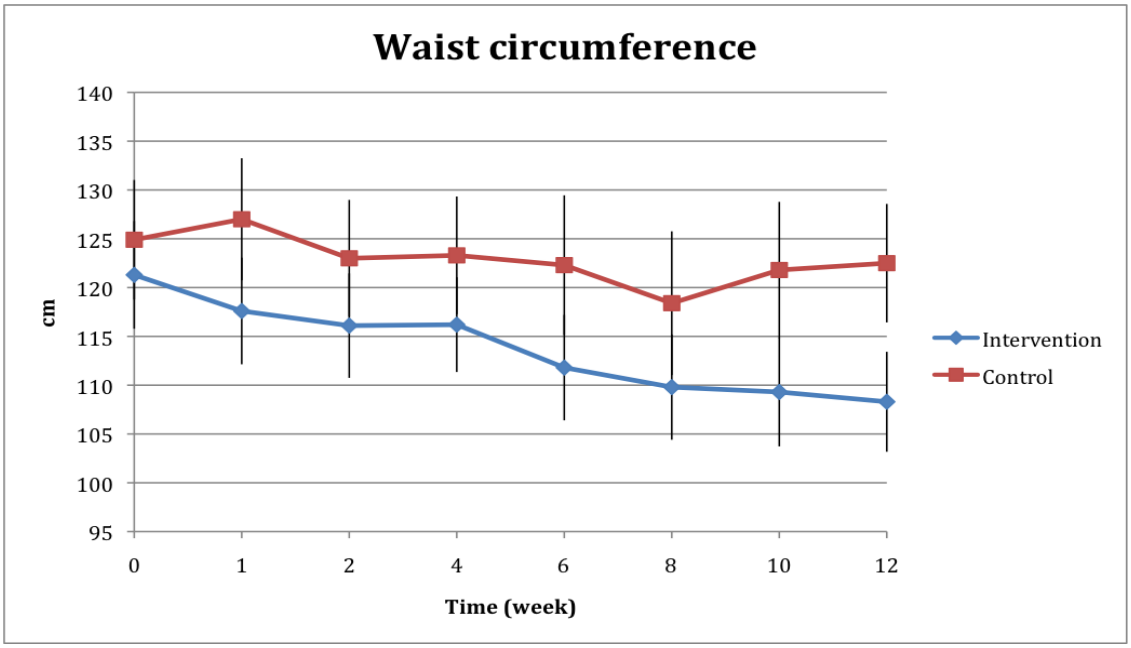

Figure 4: Changes in waist circumference between baseline and week 12. Error bars show SE.

Data for changes in fat mass percentage (FM %) were incomplete at baseline; therefore data did not capture the actual changes in FM% from week 0 to week 12 and data are therefore not shown. However, results did indicate a substantial loss of FM% in the intervention group.

Six-minute walk test

There were no complications during the test neither at baseline nor at week 12. The intervention group increased their walking distance between baseline and week 12, while the control decreased their walking distance within the same period of time, resulting in a between-group difference amounting to 172m (95% CI: 82.3, 261.7) after 12 weeks ($p<0.0005$, ANCOVA) (Table 2).

Plasma lipids

Changes in plasma lipid levels during the 12-week study period are shown in table 2. There were no significant differences in plasma lipid concentrations between the two groups. However, repeated measures analysis found that there was a significant mean difference for cholesterol- ($p<0.0006$), TG- ($p<0.0100$) and LDL ($p=0.0265$) concentrations between baseline and week eight.

There were no significant differences in HDL and VLDL concentrations between the intervention group and control group after 12 weeks.

NT-proBNP

The intervention had no effect on NT-proBNP levels and there were no significant change over time; mean difference was 40.2 pg/mL (95% CI: -167.4, 247.8, $p>0.6024$). Thus the diet had no adverse effect, nor did it improve NT-proBNP levels. We detected a large between subject variation and a small with-in subject variation in NT-proBNP levels. Values vary greatly between individuals regardless of group.

All data were adjusted for sex but it had no significant influence.

Quality of life

Regarding self-estimated quality of life, scores for physical function e.g. cleaning, walking distance and ability to climb stairs, and general well being improved slightly in the intervention group but not in the control group. The differences were strongest between baseline and week eight. However none of these results were significant.

Discussion

The study investigated the effect of a low calorie, high protein diet compared to a conventional diet in obese patients diagnosed with heart failure. We compared the effects of weight, body composition, functional status, lipid profile, NT-proBNP and quality of life in the two patient groups. Though this study is a pilot study with only relatively few participants; the results shows that dietary intervention significantly reduce weight, BMI and waist circumference and significantly improve functional status in patients following the LCD compared to the conventional diet. Furthermore patients in the intervention group improved their cholesterol-, triglyceride and LDL levels at week eight compared to the control group.

The data shows that patients reduced their weight by an average of 11.3%, 12.9kg, and their BMI by 4.2 kg/m^2 over the course of 12 weeks. This is a considerable and rapid weight reduction. The results of the study are similar to results by Evangelista et al. 2009, who investigated the effect of dietary interventions on fourteen heart failure patients with a BMI > 27 kg/m^2. They found that patients following a high protein, energy restrictive diet (40 E% carbohydrate, 30 E% protein, 30 E% fat) reduced their weight by 9.9kg over a 12 week period when following a high protein diet. Patients who were instructed to follow a standard protein diet (55 E% carbohydrate, 15 E% protein, 30 E%) or conventional diet (not specified) did not reduce their weight significantly.

Weight and BMI are independent predictors for heart failure and the risk of developing heart failure increase with increased BMI. Several studies have found an association of the severity of heart failure and BMI (He et al. 2001), (Kenchaiah et al. 2002). Additionally, Horwich et al. 2001 studied the association between obesity and heart failure in 1203 patients with heart failure. They found that obesity in heart failure patients had a protective effect; thus an elevated BMI reduce mortality risk and risk of adverse outcomes. Numerous studies have looked at this association; Oreopoulos et al. 2008 conducted a meta-analysis of 28,209 individuals and found the same inverse relationship. However, these studies are observational and do not differ between intended and unintended weight loss and therefore do not give any causal explanation; whether a worsening of the disease causes weight loss and increased mortality or if it is a reduction in weight that causes a deterioration of the disease and thereby increase mortality.

Only a few clinical trials have investigated the effect of weight loss in patients with heart failure, these studies have, however, found that a reduction in weight was associated with an improvement of the disease (Evangelista et al. 2009), (Mariotti et al. 2008) and (Evangelista et al. 2006). Evangelista et al. 2009 and Mariotti at al. 2008 investigated the effects of a weight reduction induced by a hypo caloric diet in 14 and 34 obese patients with heart failure, respectively. In accordance with the results in this study Evangelista et al. 2009 found significant improvements in weight, lipid profile, functional status and quality of life in heart failure patients when following a monitored weight loss programme. Mariotti et al. 2008 had patients follow a hypo caloric diet (55-60% carbohydrate, 25-30% fat, 15% protein) for six months where the objective was that patients reduced their daily calorie intake of 500 kcal/d. Patients who reduced their weight with 3kg or more was found to considerably improve cardiac function; significantly increasing left ventricular

ejection fracture and reduce mean NYHA functional class. As patients in this present study had a mean weight loss of 11.3% it is likely that these too would have improved these parameters for cardiac function had they been measured. Another study by Evangelista et al. 2006 analysing the effect of an exercise programme for 99 overweight and obese patients with heart failure found that the exercise group reduced their BMI significantly between baseline and endpoint and decreased the number of hospitalizations.

Another important aspect is how patients manage living with heart failure. Managing heart failure is difficult and requires a multiple approach such as dietary recommendations and pharmacological treatment. Heart failure patients who do not comply with these guidelines are at risk worsening heart failure symptoms and thereby a deterioration of disease. Further, only overweight and obese individuals are subjected to dietary interventions, as they are the ones potentially benefitting from this regimen and not the low and normal weight individuals. An unintended weight reduction may have an impaired effect on survival, whereas a managed intentional weight loss is beneficial to surviving and reducing symptoms of heart failure.

We also found that patients following the LCD reduced their waist circumference by 13cm indicating a loss of abdominal fat. This change in body composition was supported by the decrease in FM% documented by the bio-impedance (however not significant). Similarly Evangelista et al. 2009 found that heart failure patients following a high protein diet lost 5.9cm around their waist, the reduced adiposity was found to be associated with better functional status and plasma lipid profile. The high protein diet was intended to preserve or increase lean mass, while decreasing fat mass. The significant changes in body composition argue to this advantage. Contrary, Clark, Fonarow & Horwich 2011 found that high waist circumference was associated with better survival rates when analysing the effect of 344 patients with heart failure(Clark, Fonarow & Horwich 2011). However, this was only true for men. Waist circumference is a common measure used to determine the amount of abdominal fat tissue. The reduced waist circumference in addition to the significant 11.3% weight loss detected in our study indicates a loss of abdominal fat.

The relation between fat mass and lean mass undoubtedly plays a considerable role when assessing patients with heart failure. Increasing age is associated with a decrease in skeletal muscle mass. This can lead to sarcopenia, which is a state of depleted muscle mass. In chronic illnesses such as heart failure, deficient muscle mass can cause an inadequate response to the stress imposed by the disease. Patients in the present study were categorised as obese and could thus be sarcopenic obese. In a condition of sarcopenic obesity it is particularly important to be aware of body composition. To control this we monitored body composition by screening patients with bio-impedance. Initial screening took place at week zero or one and then at every visit. Results (not shown) showed nothing abnormal, and in combination with the high protein diet we consider it unlikely that any patients suffered from sarcopenia.

Another condition that can be present with heart failure is Cachexia. A symptom is progressive weight loss due to wasting (von Haehling et al. 2009), (Anker, and Sharma 2002) and it is therefore important to be aware of this when managing a dietary intervention with the objective to lose weight. However, as with sarcopenia, it is unlikely that any if the patients in the present study had cachexia, as body composition was monitored at each visit (bio-impedance). Further, one inclusion criteria was that patients had not lost considerable amounts of weight recently, which also makes it unlikely that patients in this study suffered from cachexia.

The 6MWT showed a significant improvement between baseline and week 12 in patients in the intervention group compared to patients in the control group. A final cut-off point for when an individual performs poorly at a 6MWT is not defined. Similar to other studies the distance covered by the patients at baseline was quite poor when comparing to the endpoint (Evangelista et al. 2009). Patients in the intervention group walked significantly further at week 12, this increase in walking distance as seen in the intervention group is an indicator of improved functional status. It is likely that the reduced weight is associated with the improvements functional status however, it is difficult to determine as there was no correlation between the 6MWT, BMI or NT-proBNP (data not shown). The control decreased their walking distance, likely because they did not lose weight. Age, overweight and heart failure are all known to negatively affect walking distance (Guyatt et al. 1985). In accordance with this study, Evangelista et al. 2009 also found that patients following a high protein diet, who also displayed the greatest weight reduction, were able to walk 90m further in week 12 than at baseline. Studies investigating the effect on functional capacity in obese individuals after bariatric surgery, found that individuals walked significantly further after the operation when reducing their weight considerably (de Souza, Shirley Aparecida Fabris, Ph.D. et al. 2009, Maniscalco et al. 2006). These results further verify that a significant weight reduction can improve functional capacity considerably. The 6MWT was however not standardised in the present study. Bias could have inflicted the results as we did not ask the patients to keep from being physically active the day prior to the test, though patients were considered unlikely to be performing moderate to severe physical activity, as this was likely to cause shortness of breath. Furthermore, patients were not asked to wear the same shoes at week 12 as they did at week 0. However, there is no evidence suggesting that these things have had a negative effect on the outcome. The test was performed by the same personnel at the same time of day and patients were informed when they were halfway through the test and when one minute remained. This improvement in functional status reflects that patients endure daily activities better.

Plasma lipid concentrations did not differ significantly between baseline and week 12 in the two groups. However, between-group difference was significant for cholesterol, TG and LDL at week 8. (Evangelista et al. 2009) found that total cholesterol-, TG- and LDL concentrations decreased and HDL concentrations increased between baseline and week 12 when obese patients with heart failure complied with a high protein, energy restrictive diet. The increase in plasma lipid levels between week eight and 12 in the present study can be ascribed to the shift from the 800 kcal/d diet to the 1200 kcal/d diet (see table x). The 800 kcal/d LCD was high in protein and dietary fibre and relatively low in fat, whereas in the last four weeks patients were encouraged to keep eating a high protein diet but there were no exact recommendations for other nutrients as patients could combine whichever meals they preferred. Thus the latter diet is likely to be containing more fat, as a high protein diet commonly is also a diet relatively high in fat, as animal sources typically contain high amounts of both protein and fat. Cholesterol is a steroid found in animal sources, which was very limited during the first eight weeks, thus the diet eaten by the intervention group between week 8-12 contained more E% from fat, which would have caused plasma lipids to. To overcome this the meal plan encompassed meals with both plant and animal based protein sources. After 12 weeks cholesterol-, TG- and LDL concentrations were still within recommendations (Nordic nutrition recommendations 2004). A high protein diet can have a satiating effect and thus naturally decrease food intake, further, such a diet reduce the risk of possible weight gain and may even promote an additional weight loss (Larsen et al. 2010).

NT-proBNP is used to diagnose left ventricular heart failure; consequently, NT-proBNP can not be used to diagnose patients who are diagnosed with non-systolic heart failure (Egstrup et al. 2007). In this study NT-proBNP levels remained stable in both groups (table 2). Consequently results showed no improvement in NT-proBNP. Levels showed a great between-subject variation and small within-subject variation, which indicates that there was no effect of the diet neither positive nor negative. Horwich, Hamilton & Fonarow 2006 investigated the association between elevated BMI and B-type natriuretic peptides (BNP) in 316 patients with heart failure. They found that high BNP levels were an independent predictor of impaired survival, regardless of BMI (Horwich, Hamilton & Fonarow 2006). Thus elevated BNP levels were associated with increased mortality. However, BNP may be a less reliable measurement than NT-proBNP (Clerico et al. 2011). Even though, this makes you consider if BNP and NT-proBNP are stronger predictors of heart failure and subsequent mortality than BMI and weight. High baseline BNP/NT-proBNP levels that increase or remain stable throughout intervention are independent predictors for all cause mortality risk in patients with heart failure (Clerico et al. 2011). However, this encompasses a dilemma, as some patients in our study may have an increased mortality risk due to high, stable NT-proBNP levels and a reduced risk if maintaining a high BMI. Yet, patients in the control group who maintained their weight throughout the study was also found to decrease their walking distance between baseline and endpoint and thereby displayed symptoms of impaired functional status. Heart failure can be difficult to diagnose and difficult to determine which parameters decide the outcome. Shortness of breath as defined by NYHA class is used as tool to diagnose heart failure (Egstrup et al. 2007). However, it is important to take into consideration that shortness of breath also is a key symptom in obesity, thus the display of impaired breathing may be a symptom of obesity and not heart failure.

Patients in either group did not increase scores for quality of life significantly, whether this was due to poor understanding of the questionnaire or that patients did not feel better is unknown. However, both Mariotti et al. 2008 and Evangelista et al. 2009 found an inverse association between weight reduction and quality of life scores when conducting similar studies.

Conclusion

Conclusively, in this pilot study with only few participants the aim was to improve symptoms of heart failure by reducing initial body weight. Our results show that a dietary intervention in obese patients with heart failure reduced symptoms of heart failure by reducing body weight and improved body composition and functional status. Patients following the low calorie diet showed positive changes in plasma lipid profile. The results in this study gives reason to further explore the benefits of dietary intervention and weight loss in obese patients with heart failure to improve symptoms of heart failure. There is a need for larger studies to conclude long term effects of dietary interventions and assess long term effects.

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