Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Medicine and Health Sciences
Department of Circulation and Medical Imaging

Hedda Eidet

# Effects of high-intensity interval training on body composition and quality of life in women with lipedema

Master's thesis in Clinical health science
Supervisor: Anja Bye
Co-supervisor: Arnt-Erik Tjønna & Siren Nymo
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# Abstract

BACKGROUND: Lipedema is a chronic disease with pathological accumulation of subcutaneous adipose tissue in the arms and legs, sparing the hands, feet and trunk. The disease primarily affects women, and the prevalence is about 10% of the overall female population. Many women experience to be misdiagnosed with obesity or lymphedema. Lipedema patients report symptoms such as pain and reduced quality of life. Despite the lack of research on the field, lipedema tissue seems to be resistant to diet and exercise. The aim of this study was to examine if eight weeks of high-intensity interval training had positive effects on health-related quality of life and body composition. A secondary aim was to explore whether potential changes in body composition could improve health related quality of life.

METHODS: Women diagnosed with lipedema, age 18-65 with a BMI between 25-34.9 was invited to participate in the study. Twenty-two women were randomized to 8 weeks of high intensity interval training (4 x 4 intervals) or a control group. The exercise group were supervised twice a week and exercised once a week on their own. Anthropometric measurements were performed at both pre- and posttest. Blood pressure, standard blood tests, $Vo_{2peak}$ and lactate was also measured. The patients also answered questionnaires at pre- and posttest.

RESULTS: Eight weeks of high-intensity interval training improved self-reported energy-levels ($p=0.017$), social functioning ($p=0.048$), and general health ($p=0.026$) in women with lipedema. Reduction in body weight and fat mass in the legs correlated with increased physical and social functioning. HIIT did not seem to improve body composition, however, there were trends towards a reduction in body weight and hip circumference in the HIIT group.

CONCLUTION: High-intensity interval training seemed to have beneficial effects on some aspects related to health-related quality of life. No changes were seen in body composition probably due to a rather short exercise period and no restrictions in diet.

# Sammendrag

BAKGRUNN: Lipødem er en kronisk sykdom med fettansamlinger i det subkutane fettvevet i armer og ben, men ikke i hender, føtter eller abdomen. Sykdommen rammer i hovedsak kvinner, med en prevalens på 10% av alle kvinner. Mange opplever å bli misdiagnostisert med fedme eller Lymfødem. Vanlige symptomer blant lipødem pasienter er smerte og redusert livskvalitet. Til tross for mangel på forskning på feltet, ser det ut til at det syke fettvevet er resistent til trening og kosthold. Hovedmålet med prosjektet var å undersøke om åtte uker med høyintensitets intervalltrening hadde effekt på helse-relatert livskvalitet og kroppssammensetning. Sekundærmål var å se om potensiell endring i kroppssammensetning hadde en effekt på helse-relatert livskvalitet.

METODE: Kvinner diagnostisert med lipødem i alderen 18-65 med BMI mellom 25-34,9 var invitert til å delta i studien. Tjueto kvinner ble randomisert til åtte uker med høyintensitets intervalltrening (4 x 4), eller til kontrollgruppe. Treningsgruppen trente to ganger i uken på St. Olavs hospital med oppfølging og en dag på egenhånd. Antropometriske målinger ble tatt på pre- og posttest. Blodtrykk, blodprøver, laktat og $Vo_{2peak}$ ble også målt. Deltakerne svarte på spørreskjemaer på pretest og posttest.

RESULTATER: Åtte uker med høyintensitets-intervalltrening økte scoren underkategoriene energi/utmattelse ($p=0.017$), sosial funksjon ($p= 0.048$) og generell helse ($p=0.026$) for kvinner med lipødem. Reduksjon i vekt og fettmasse i bena korrelerte med økt fysisk og sosial funksjon. Det var ingen endringer i kroppssammensetning for treningsgruppen eller kontrollgruppen, men det var en trend i retning av vektreduksjon og reduksjon i hofteomkrets for treningsgruppen.

KONKLUSJON: Høyintensitets-intervalltrening så ut til å ha gunstige effekter på flere aspekter relatert til helse-relatert livskvalitet. Analysene viste ingen signifikante endringer i kroppssammensetning, sannsynligvis grunnet kort intervensjonsperiode og ingen restriksjoner i diett.

# Acknowledgement

This master thesis is a part of my master's degree in health science, obesity and health at det University of Science and Technology (NTNU) in Trondheim. The project took place at the Department for Circulation and Medical Imaging (ISB) at the faculty of Medicine, NTNU. My supervisors during the project period were Researcher Anja bye, Associate Professor Arnt-Erik Tjønna and Associate Professor Siren Nymo.

I'd like to thank all the participants in the study, who always met us with a big smile and was very patient with us students along the way. You were all so amazing and did a good job during the exercise classes and testing.

Thank you to Norwegian Lipedema and Lymphedema Association and user representative Sunniva Vikan for helping with the study design and recruitment of lipedema patients.

Furthermore, I'd like to thank my supervisors for guiding me through the project and writing process. For always being available for questions, and for everything I've learned the past year.

I would also like to thank Senior Engineer Ragnhild Røsbjørgen (ISB) for educating and helping us with blood testing, and for being there when we needed help.

My friends and family also deserve a big thank you. Thank you for always believing in me, for being so understanding and supporting. It has been crucial.

Finally, the biggest thank you goes to my fellow student at the project, Johanne Sæther. Thank you for all the fun times, the coffee breaks (a little too many of them maybe), for listening and for all your hard work. It's been a pleasure to work in a team with you.

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# Abbrevations

| | |
|---|---|
| BMI | Body Mass Index |
| BMP | Bone morphogenetic protein |
| CDT | Complete decongestive therapy |
| DPIA | Data Protection Impact Assessment |
| ER | Estrogen receptor |
| EQ-5D | EuroQol- 5 Dimension |
| HIIT | High intensity interval training |
| HRmax | Maximal heart rate |
| HRQOL | Health-related quality of life |
| IPCT | Intermittent pneumatic compression therapy |
| IQR | Inter quartile range |
| LCHF | Low carbohydrate high fat |
| NLLF | Norwegian Lymphedema and Lipedema Association |
| NTNU | Norwegian University of Science and Technology |
| QoL | Quality of life |
| SF-36 | Short-Form 36-item survey |
| Vo2max | Maximal oxygen uptake |
| Vo2-peak | Peak oxygen uptake |

# 1.0 Introduction

## 1.1 Epidemiology

Lipedema is a chronic fat disorder which primarily affects women, and the prevalence is about 10% of the overall female population, although it is also rarely seen in men with hormonal dysfunction (1, 2). The disease was first clinically diagnosed in the United States in 1940 (2). Lipedema is a chronic disease with pathological accumulation of subcutaneous adipose tissue particularly in the arms and legs, sparing the hands, feet and trunk (3). The condition is often unrecognized or misdiagnosed as obesity or lymphedema (1). The lipedema tissue can be very painful and can also severely impair mobility (4). From earlier studies, the patients report spontaneous pain, pain during pressure, feelings of tension, heaviness and burning (5). Lipedema patients report that the disease affects their mental health and quality of life (6). The lipedema tissue is difficult to reduce by lifestyle changes, and the potential inability to lose tissue mass can increase incidence of depression, anxiety or eating disorders (3, 4, 6). However, despite the high body mass index (BMI), the risk of developing several metabolic comorbidities seems to be quite low (3). Results from a study including 160 participants with lipedema showed a low prevalence of diabetes (6 ± 0.2%) (7). Women with lipedema often have a gynoid shape which means a greater amount of fat in the hips, buttocks and legs (3). The presence of gynoid body shape seems to lower the risk of cardiovascular disease compared to those who have android body shape (abdominal fat) (8).

*Table 1. Clinical criteria for the diagnosis of lipedema (1)*

| **Clinical criteria for the diagnosis of lipedema** |
|---|
| - **Bilateral, symmetrical disproportionate fatty tissue hypertrophy on the limbs**<br>- **The condition is not shown in feet and hands**<br>- **Approximately 30% involvement of the arms**<br>- **Feeling of heaviness and tension in the affected limbs**<br>- **Pain on pressure and touch**<br>- **Marked tendency to form hematomas**<br>- **Stable limb circumference with weight reduction or caloric restriction**<br>- **Worsening of symptoms over the course of the day**<br>- **Hypothermia of the skin** |

## 1.2 Lipedema pathophysiology

Today, the mechanisms behind the development of lipedema are unknown, but a few hypotheses have been proposed. The literature examines whether there are genetic, hormonal, disturbance in the lymphatic system or hyperplasia or hypertrophy in the cells (1, 9)

### 1.2.1 Genetic predisposition and familiar clusters

Women born into families with for example a mother diagnosed with lipedema, are more likely to develop the diagnosis themselves. Studies shows that 64% of women report a positive family history of lipedema (9). A study presented by Child AH et al. propose that lipedema is genetic with either autosomal dominant inheritance with sex limitation, or X-linked dominant inheritance (10). They examined the prevalence of lipedema in pedigrees and found that one family had six affected family members in three generations, two families had five affected members, two had four affected members and one family had three affected family members.

### 1.2.2 Hormonal changes and dysfunction

Lipedema often occurs along with hormonal changes, for example in puberty, after or during pregnancy and menopause (9). Therefore, there is a reason to believe that estrogen is playing a role in the development of the diagnosis. Through the estrogen receptors (ER), estrogen has a direct effect on the adipose tissue, and might also affect the tissue that have sex hormone receptors considering that the disease essentially affects women. A review written by Katzer K. et al. summarize the research based on the associations between estrogen and lipedema (11). They suggest that estrogen dysregulation can play a role in the development of lipedema. Estrogen contributes to regulate bone morphogenetic protein (BMP), and BMP can stimulate formation of fat cells (adipogenesis) (12).

### 1.2.3 Disturbance of lymph drainage and capillary damage

A review written by Kruppa P et al. suggest that there is a dysfunction in the lymphatic system and blood capillaries in women with lipedema (1). The dysfunction might have a connection to the excessive expansion of adipose tissue, which in addition can lead to endothelial dysfunction and increased angiogenesis. It is also suggested that there is a mechanical disturbance of lymph drainage and capillary damage among these women. Capillary damage may involve increased capillary permeability, capillary leak, and tissue edema (1).

## 1.3 Body composition in women with lipedema

Lipedema increases the risk of developing morbid obesity, and overweight and obesity worsens the lipedema. The disease occurs in different stages and classifications (1, 13). Stage 1 is characterized by smooth skin, small nodules and reversible edema. Stage 2 is characterized by walnut-sized nodule, the mass in the thighs becomes larger, and reversible or irreversible edema. When pulling the skin downwards, it feels like a mattress pattern. In stage 3, the skin becomes thinner, and the elasticity becomes worse. This is because the adipose tissue is growing in excess. Disfiguring of fat deposits, macronodular changes with accompanying lymphedema are also present (1). Schingale et al has categorized lipedema in to five different types (13). Type 1, the adipose tissue has increased in buttocks and thighs. Type 2, lipedema ranges to the knees, and it becomes fat pads on the inner side of the knees. Type 3 lipedema ranges from hips to ankle, and type 4 will involve both arms and legs. Type 5 will include lymphedema as well.

## 1.4 Quality of life

There are many factors that affect quality of life among the lipedema patients. Pain seems to be the major complaint among the diagnosed women, and is correlated with depression (14). The patients report overall deterioration in their quality of life and abnormal psychological status (13). Several possible reasons have been suggested, including the lack of a clear diagnosis and how to manage the disease. They may also experience rejection by medical personnel because they are seen as obese. This stigmatization and uncontrollable changes in weight and body composition will in several cases lead to self-stigmatization, depression, anxiety, stress, body dissatisfaction and feelings of guilt and shame. A study by Herbst KL et al. found that >75% of the participating women complained about fatigue (15). Difficulty sleeping and poor concentration was also reported as symptoms in the study. A survey from the United Kingdom (UK) with 250 responders revealed that 95% had difficulty in buying clothes, almost 50% reported eating disorders and restricted sex life, and 86% reported low self-esteem (16).

The complications of lipedema may be severe, and the patients may experience reduced joint mobility, hematoma and edema. Furthermore, the non-significant improvements in conservative treatment such as diet and exercise may influence on the patient's deterioration. Considering all these potential factors, lipedema may have a negative influence on the patient's life, and especially in the health-related quality of life (HRQOL).

A study conducted by Dudek et al. which included 120 women with lipedema found that the women who reported lower HRQOL had higher symptoms severity (13, 17). In addition, those who reported higher HRQOL had higher levels of psychological flexibility and social connectedness. They also found that 50% of the women reported severe pain and tenderness.

A study conducted by Romeijn JRM. et al explored the patient characteristics and quality of life in lipedema patients using RAND-36 and EuroQol- 5 Dimension (EQ-5D) (18). They compared the results with the Dutch average for females. Their findings were quite similar with Dudek et al. The mean score from EQ-5D-3L was 66.1 in women with lipedema, and 85 in the general Dutch population (range of RAND-36 goes from 0-100). Most of the responding women (64,8%) reported some problems with mobility, and usual activities like housework, study, and work. Psychological challenges were also represented in the survey, and 42% of the lipedema patients reported that they were struggling with anxiety and/or depression. The mean score of RAND-36 was 59.3 in lipedema patients compared to 74.9 in the average Dutch female population. The different dimensions are listed in the table below.

## 1.5 Lipedema treatment

### 1.5.1 Conservative treatment

As a part of the lipedema treatment, the health care providers are advising the patients to accept their condition (1). The aim of the conservative treatment is to relieve symptoms, and not to improve the appearance of lipedema in the extremities. Usual components in the conservative treatment are manual lymph drainage, compression therapy with compressive clothing, physiotherapy and exercise therapy, psychosocial therapy, dietary counseling and weight management (1, 19). Recommended exercises include swimming, aqua-jogging and aqua-gymnastic, such as walking or running (1). The reason for this recommendation is that water helps lessen edema and puts less stress on the joints in patients with overweight. Although this kind of treatment only involves a small reduction in tissue volume, it can still reduce feelings of pain on pressure and feelings of tightness in the limbs.

### 1.5.2 Weight control and dietary modification

Lipedema increases the risk of developing morbid obesity, and overweight and obesity worsens the lipedema (1). It seems that the subcutaneous fat in lipedema patients is resistant of exercise and diet, but weight managing can improve symptoms (4, 14, 20). Patients with lipedema are advised to have a hypocaloric diet to lower the body weight. A pilot study including nine women conducted by Sørlie V et al. assessed the impact of a ketogenic diet in women with lipedema (21). The aim was to explore if a diet low in carbohydrates and high in fat (LCHF) could be beneficial on pain and quality of life in the participants. They followed the diet for 7 weeks and followed the Nordic nutrition recommendations for 6 weeks after. The results showed a significant loss of weight, which was sustained after a period of 13 weeks. They also experienced changes in body composition, with a decrease in waist, hip and calf-circumference from baseline to week 7. No significant change was found in the thigh-circumference. The LCHF-diet caused a

significant reduction in pain the first seven weeks, but perceived pain returned to baseline levels at week 13. The results also showed an increase in general quality of life. The outcome from this study is in line with other existing literature and shows that lipedema tissue is resistant to diet and weight loss (4, 14). However, a ketogenic diet with slight exercise may reduce feelings of pain by reducing edema, hypoxia and inflammation (22). In addition, a healthy diet might prevent the development of obesity and cyclic weight loss-weight gain periods (20).

### 1.5.3 Liposuction

Studies show that surgery improves subjective symptoms as pain, feeling of tightness and quality of life in lipedema patients. (1). It is also shown that objective measured variables such as leg circumference are improved by liposuction surgery. In addition, the reported complication rates were low after the surgery in line with reported complication rates after liposuction in larger cohort of patients without lipedema. A study by Baumgartner A et al examined the long-term benefits of liposuction in 85 women with lipedema (23). The participants were asked to complete a questionnaire. Scale used for evaluation was 0; none, 1; minor, 2; medium, 3; strong and 4; very strong. The study had a follow-up after an average of 4 and 8 years. Postoperative changes in complaints showed that there was a decrease in spontaneous pain, sensitivity to pressure, oedema, bruising, restriction to movement, cosmetic impairment, reduction in QoL, and overall impairment. Based on the results from this study, and present data, liposuction seem to be the most effective treatment for lipedema with conservative treatment in addition.

## 1.6 Benefits of high intensity interval training (HIIT)

The positive effects of exercise on weight reduction and body composition are well documented in the literature. Considering the lack of literature in lipedema, literature assessing overweight and lifestyle diseases is included to understand the effects of HIIT on both body composition and quality of life.

A systematic review by Andreato LV et al. examined the influence of high-intensity interval training on body composition in adults with overweight and obesity (24). Their results showed that HIIT had a positive effect on several anthropometric measurements such as weight, BMI, waist circumference and body fat percentage. However, several studies have shown that exercise is not as effective as a hypocaloric diet when the goal is to reduce total body weight. Still, visceral adiposity seems to respond better to physical activity than a low calory diet (25). Previously, exercise with moderate intensity has been recommended for weight management, but HIIT has become a popular form of exercise because of its time efficiency, as lack of time is often the reason why people don't exercise. A systematic review revealed that the effects of HIIT compared with exercise with moderate intensity was quite similar, but the HIIT required 40% less time (25).

Martland R et al. conducted a meta review which examined the effects of HIIT on physical and mental health outcomes (26). The HIIT period ranged from one single session to a 12-month period in the included studies. They found significant improvements in symptom severity in people with depression and anxiety after HIIT. Molmen-Hansen HE et al. examined the effects of HIIT on blood pressure in hypertensive patients (>90% of maximal hearth rate, correlates to 85-90% of $VO_{2max}$) (27). They used the Short-Form 36-item survey (SF-36), to investigate the patient's quality of life. Quality of life was improved in three subcategories: general health, social functioning and physical functioning. In addition, Tous-Espelosín M et al. found that low volume HIIT (20 minutes exercise walking, jogging, cycling or swimming) had positive effects on social

functioning and mental health after 16 weeks of supervised exercise training in physically inactive adults with overweight and obesity (28).

## 1.7 Aim

The aim of this thesis is to examine if 8 weeks of HIIT can improve 1) quality of life, and 2) body composition in women with lipedema. The secondary aim is to investigate if changes in body composition correlates with improvements in health-related quality of life.

Hypothesis:
Eight weeks of HIIT improves quality of life and body composition in women with lipedema.

# 2.0 Materials and methods

## 2.1 Study design

Lipidex is a pilot single-center randomized-controlled trial that explores the effects of high intensity interval training in women with lipedema. The study was approved by the Regional Committee for Medical Research Ethics (461077) and performed in line with the Declaration of Helsinki and Good Clinical practice. Data Protection Impact Assessment (DPIA) was performed and approved by the Department of Circulation and Medical Imaging at the Norwegian University of Science and Technology (NTNU). The study was supported by the Norwegian Lymphedema and Lipedema Association (NLLF), and a user representative was involved in alle the steps of the research process.

## 2.2 Subjects

Women diagnosed with lipedema with an age of 18-65 and a BMI between 25-34,9 was invited to participate in the study (figure 1). Recruitment started in the early summer 2022. Initially, 43 women were interested in participating in the study, but a relatively low number was included due e.g., geographical and health related challenges. The women who signed informed consent and were included in the study, were randomized to (1:1) to 8 weeks of exercise training and a control group. Exclusion criteria included orthopedic limitations for exercise training and eating disorders. A compliance with the training program of 80% was set as a criterion for completing the study. Recruitment of participants was done through social media, physiotherapists, posters at GPs and through a user representative from the Norwegian Lymphedema and Lipedema Association (NLLF). Consent was obtained cf. GCP and the Health Research Act. The potential participants had at least a couple of days to consider their participation.

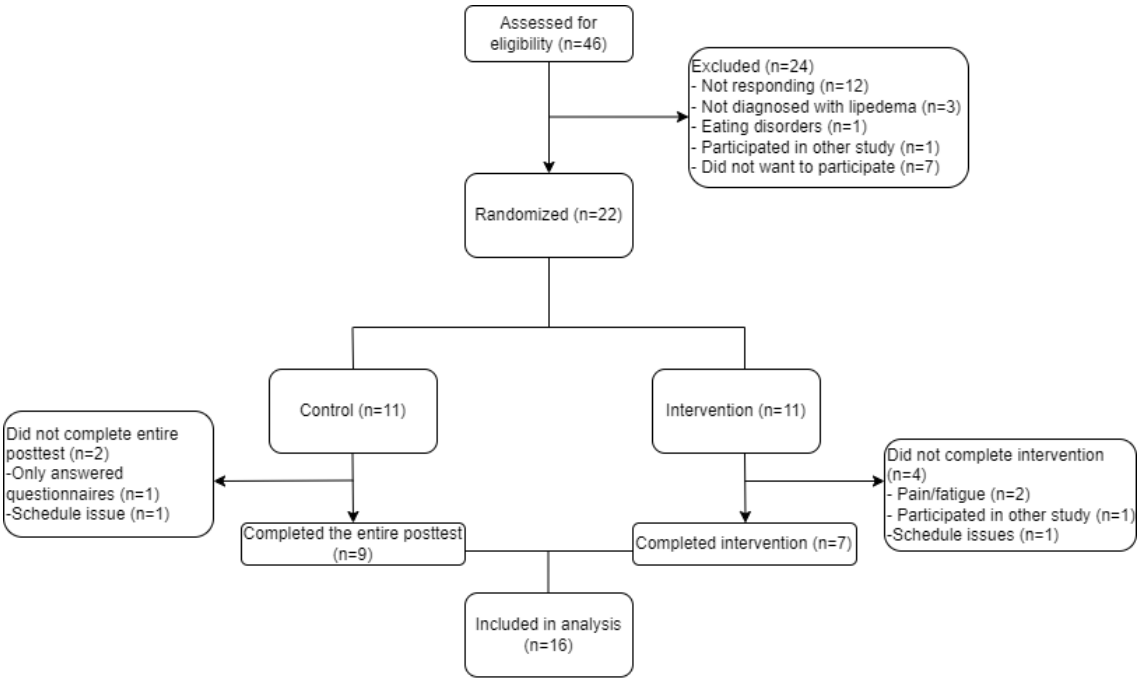


*Figure 1. Flowchart showing the study design.*

## 2.3 Intervention – Training protocol

The women were randomized (1:1) to 8 weeks of supervised high-intensity interval training (HIIT) that is 4×4 min intervals at 85-95% of maximal heart rate ($HR_{max}$), with 3-minute active breaks (~60 % $HR_{max}$) in between intervals, twice a week on treadmills at the NextMove core facility at NTNU, or to a control group. All participants were provided with

a pulse watch (Fitbit Charge 5) to keep after the study was completed. In addition, the participants in the intervention group performed exercise once a week on their own following the correct exercise intensity. Randomization was performed in eForsk. Body composition, blood pressure, $VO_{2max}$ (maximal oxygen uptake), questionnaire data and blood samples were measured and collected before and after the exercise intervention. The HIIT group wrote a diary for their physical activity to report BORG scale and heart rate during their exercise sessions.

## 2.4 Maximal oxygen uptake ($VO_{2max}$) and lactate

$VO_{2max}$ was measured during uphill treadmill walking or running based on the participants physical form (Woodway PPS 55 Med, Munich, Germany), using ergo spirometry Metalyzer ||, (Cortex Biophysik GmBH, Leipzig, Germany) (29). The participants warmed up for 10 minutes (~60% of $HR_{max}$) before starting the test. A levelling off of oxygen uptake ($VO_2$) despite increased workload and respiratory exchange ratio ≥1.05 was used as criteria for $VO_{2max}$. HR was measured continuously during the test (Polar, Polar Electro, Kempele, Finland), to define $HR_{max}$. As a part of the $VO_{2max}$ test, the women's lactate levels were measured using Biosen C-line (EKF diagnostics, Leipzig, Germany) The measurements were taken pre warm up, post warm up, and post $VO_{2max}$ test.

## 2.5 Anthropometric measurements

Body weight, BMI, leg and thigh circumference, and waist-to-hip ratio was measured. Body composition was measured by using InBody 770, (Biospace CO, Ltd, Seul, Korea). InBody 770 provides weight, muscle mass, fat percentage, metabolism, and mineral status non-invasively by sending weak electrical signals through the body. The whole test lasted for a couple of minutes. The analysis was done when the participants have been fasting for at least eight hours and have avoided strenuous exercise. The standard procedures at NextMove were used to measure the weight and height of participants. The height measurement was performed using a measuring tape attached to the wall. The height was measured without shoes or headwear and was done with equal weight on both legs. The distance between the legs was a foot. The height was measured with one decimal. The weight was measured without heavy clothes and shoes and was measured by the InBody. The weight was measured with one decimal. The participants stood upright when measuring of leg, thigh, waist and hip circumference. The leg and thigh measurements were performed using a measurement board to indicate exactly where the measurements were performed. All body measurements were performed by two students for quality assurance.

Blood pressure was measured while the patient was sitting down and had been resting for at least five minutes in a quiet room. The measurement was performed by one of the students, with a handheld sphygmomanometer (Tycos, 5098-02CB, USA). Blood pressure was measured at the same time of the day for each individual at pre- and post-test. The first reading was discarded and the mean of the next three consecutive readings with a coefficient of variation below 15% was used in the study, with additional readings if required. The sleeve was placed at heart level and customized with the size of the participant's arm.

## 2.6 Quality of life questionnaires

RAND-36 was used to track potential changes in quality of life. The questionnaire consists of eight scaled scores, which are the weighted sums of the questions in their section. Each scale is directly transformed into a 0-100 scale on the assumption that each question carries equal weight. The eight sections are vitality, physical functioning, bodily pain,

general health perceptions, physical role functioning, emotional role functioning, social role functioning, and mental health.

## 2.7 Physical activity index score

To analyze the participants physical activity level, we used a scoring method from the Trøndelag Health Study (HUNT1) which has a range from 0-15, to calculate the physical activity index score (PA index score) (table 2) (30). In our questionnaire, we ask the participants for frequency (1-7 days per week), duration (0-30 min, 30-60 min, 60 minutes or more) and intensity (low, medium, hard) of physical activity. One day equals score 1, 2-3 days equals a score of 2,5- and 4-7-days equals score 5. Intensity is scored low (1), medium (2) and hard (3). Duration is scored 0-30 min (0,38), 30-60 min (0,75) and 60 minutes or more (1). To calculate a total physical activity index score, each score is multiplied like for example (frequency score 2,5* intensity 2* duration 0,75), which results in a physical activity index score 3,75 of total 15.

*Table 2. Scoring method for physical activity index score.*

| | Original score | Index score |
|---|---|---|
| **Frequency** | 1 day | 1 |
| | 2-3 days | 2.5 |
| | 4-7 days | 5 |
| **Duration** | 0-30 | 0.38 |
| | 30-60 | 0.75 |
| | 60 or more | 1 |
| **Intensity** | Low | 1 |
| | Medium | 2 |
| | Hard | 3 |

## 2.8 Data analysis

Statistical analyses were performed using IBM SPSS Statistics. Statistical significance was assumed by using p-value 0,05, and trend levels was set to ≤0,1. The Kolmogorov-Smirnov test was used to test the normality of the data. The data is not normally distributed, therefore the results are described with median and inter quartile range (IQR) to describe the spread in the data. Data were analyzed using nonparametric tests with independent sample t-test (Mann-Whitney U and Wilcoxon sum ranked test). Spearman correlation was used to examine correlations between variables at baseline and after intervention period. Statistical power analyses were not performed, as this was regarded a pilot study, due to the spare literature on exercise training in lipedema patients.

# 3.0 Results

Twenty-two participants with median age of 43 (13.5) years met the inclusion criteria and was invited to pre-test. The participants were recruited through social media, physiotherapists, posters at GPs and through a user representative from the Norwegian Lymphedema and Lipedema Association (NLLF).

Median body weight at baseline was 80 kg (20.2), and median BMI was 29.4 (6.6). The HIIT group had a median PA index score of 1.9 at baseline, and the control group had 0.0. After 8 weeks of intervention, the HIIT group increased their PA index to 5.6 and the control group increased to 0.75 based on median values. More information about patients' characteristics is described in table 3 and 4. After randomization, four participants dropped out of the study due to work, pain, fatigue e.g. (figure 1). It is important to mention that the participants in the exercise group dropped out before the intervention started. Two participants did not show up for post-test due to work. Only participants who met to pre and posttest were included in the analysis.

## 3.1 Participant characteristics

Baseline characteristics and baseline RAND-36 scores are described in table 3 and 4. Most participants used compression garments on the lower body during the workout sessions, and the use of compression had to be consistent throughout the intervention period.

*Table 3. Baseline characteristics.*

| Baseline characteristics | Control (n= 9) | Exercise (n=7) | p-value |
|---|---|---|---|
| **Age** | 47 (14.5) | 36.0 (17.0) | 0.142 |
| **Weight (kg)** | 73.4 (18.8) | 86.4 (20.3) | 0.681 |
| **Height (cm)** | 167.5 (7.3) | 168.0 (9.0) | 0.351 |
| **BMI (kg/m2)** | 30.6 (8.6) | 29.2 (5.4) | 0.837 |
| **Body fat (%)** | 44.0 (15.5) | 41.0 (8.7) | 0.299 |
| **Fat mass right thigh (kg)** | 4.4 (2.4) | 4.6 (1.7) | 0.918 |
| **Vo2peak** | 32.8 (13.9) | 33.7 (10.8) | 0.536 |
| **PA index score** | 0.0 (3.75) | 1.9 (3.8) | 0.470 |
| **Waist circumference (cm)** | 86.0 (18.5) | 87.0 (21.0) | 1.000 |
| **Hip circumference (cm)** | 110.0 (20.0) | 104.0 (6.0) | 0.408 |
| **Thigh circumference (cm)** | 55.0 (6.8) | 56.0 (11.0) | 0.681 |
| **Calf circumference (cm)** | 40.0 (4.8) | 43.5 (5.0) | 0.408 |

*Table 4. RAND-36 baseline score*

| Baseline characteristics | All participants (n=16) |
|---|---|
| **Physical functioning** | 85.0 (28.8) |
| **Role limitations due to physical health** | 62.5 (93.8) |
| **Role limitations due to emotional problems** | 100.0 (66.7) |
| **Energy/fatigue** | 40.0 (22.5) |
| **Emotional wellbeing** | 72.0 (22.0) |
| **Social functioning** | 75.0 (50.0) |
| **Pain** | 51.3 (31.9) |
| **General health** | 45.0 (18.8) |
| **Total RAND-36 score** | 63.9 (22.7) |

## 3.2 Body composition

Changes in body weight and body composition after intervention period is described in table 5. As shown in the table, eight weeks of HIIT did not induce significant changes in weight or body composition. However, there was a trend of an exercise-induced reduction in body weight and hip circumference in the intervention group. Interestingly, there was a trend toward a reduced fat mass in the legs in the participants in the control group after the intervention period ($p=0.062$). There were no significant changes in BMI, body fat percentage or waist circumference in any of the groups.

*Table 5.Changes in body composition from baseline to week eight.*

| Characteristics | Control group (n=9) | | | HIIT group (n=7) | | | |
|---|---|---|---|---|---|---|---|
| | Baseline | 8 weeks | p-value | Baseline | 8 weeks | p-value | p-value between groups |
| **Weight (kg)** | 73.4 (18.8) | 72.9 (18.0) | 0.183 | 86.4 (20.3) | 84.3 (15.1) | 0.176 | 0.091 |
| **BMI (kg/m2)** | 30.6 (8.6) | 30.3 (8.7) | 0.292 | 29.2 (5.4) | 28.4 (4.0) | 0.176 | 0.142 |
| **Total body fat %** | 44.0 (15.5) | 43.4 (16.5) | 0.514 | 40.0 (8.7) | 37.7 (6.0) | 0.237 | 0.470 |
| **Fat mass right thigh (kg)** | 4.4 (2.4) | 4.4 (2.4) | 0.062 | 4.6 (1.7) | 4.2 (1.4) | 0.129 | 0.837 |
| **Waist circumference (cm)** | 86.0 (18.5) | 86.0 (20.3) | 0.833 | 87.0 (21.0) | 83.0 (17.0) | 0.141 | 0.408 |
| **Hip circumference (cm)** | 110.0 (20.0) | 107.0 (19.0) | 0.953 | 104.0 (6.0) | 103.0 (7.0) | 0.051 | 0.408 |
| **Thigh circumference (cm)** | 55.0 (6.8) | 54.0 (5.3) | 0.307 | 56.0 (11.0) | 56.0 (10.5) | 0.891 | 0.606 |
| **Calf circumference (cm)** | 40.0 (4.8) | 40.0 (4.0) | 0.518 | 43.5 (5.0) | 44.0 (5.5) | 0.273 | 0.918 |

### 3.3 Quality of life – RAND-36

Changes in health-related quality of life is described in table 6 and figure 2. There was no significant increase in total RAND-36 score in either of the groups, but the HIIT group had a strong trend of improved total RAND score after the exercise intervention (p=0.063). Significant improvements were seen in the subcategory energy/fatigue, which means that the participants experience less fatigue (table 6).

In addition, the participants in the intervention group improved their social function significantly after completing the exercise intervention (p=0.048). The exercise group also reported improvements in general health after completing the study (p=0.026). Furthermore, there was a trend toward improved emotional wellbeing in the control group (p=0.068).

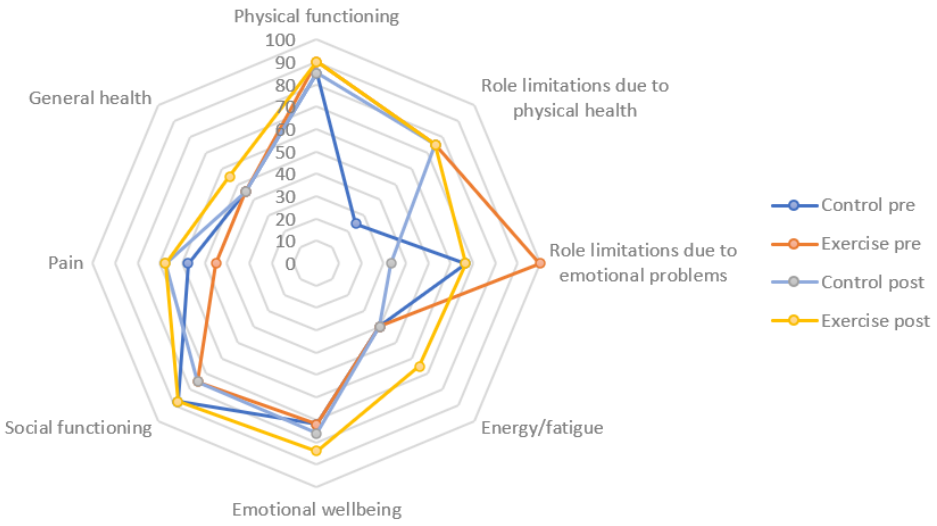


*Figure 2. Radar chart showing changes in QoL from baseline to week eight, based on the answers from RAND-36.*

*Table 6. QoL scores from RAND-36.*

| RAND-36 subcategories | Control group (n=9) | | | HIIT group (n=7) | | | |
|---|---|---|---|---|---|---|---|
| | Baseline | 8 weeks | p-value | Baseline | 8 weeks | p-value | p-value between groups |
| **Physical functioning** | 85.0 (35.0) | 85.0 (35.0) | 0.942 | 90.0 (35.0) | 90.0 (20.0) | 0.125 | 0.142 |
| **Role limitations due to physical health** | 25.0 (100.0) | 75.0 (87.5) | 0.059 | 75.0 (50.0) | 75.0 (25.5) | 0.496 | 0.837 |
| **Role limitations due to emotional problems** | 66.7 (83.3) | 33.3 (66.7) | 0.453 | 100.0 (66.7) | 66.7 (33.3) | 1.00 | 0.758 |
| **Energy / fatigue** | 40.0 (22.5) | 40.0 (17.5) | 0.891 | 40.0 (30.0) | 65.0 (25.0) | 0.017 | 0.002 |
| **Emotional wellbeing** | 72.0 (34.0) | 76.0 (28.0) | 0.068 | 72.0 (16.0) | 84.0 (12.0) | 0.115 | 0.758 |
| **Social functioning** | 87.5 (62.5) | 75.0 (43.8) | 0.258 | 75.0 (50.0) | 87.5 (12.5) | 0.048 | 0.252 |
| **Pain** | 57.5 (35.0) | 67.5 (35.0) | 0.581 | 45.0 (32.5) | 67.5 (22.5) | 0.141 | 0.408 |
| **General health** | 45.0 (20.0) | 45.0 (30.0) | 0.832 | 45.0 (15.0) | 55.0 (30.0) | 0.026 | 0.023 |
| **Total RAND-36 score** | 64.3 (41.1) | 61.1 (33.9) | 0.260 | 63.6 (14.2) | 73.1 (11.1) | 0.063 | 0.299 |

### 3.3.1 Energy fatigue

A significant increase in the subcategory energy/fatigue is seen in the HIIT group with an increase of 62.5%, (p=0.017). There is also a significant difference across groups (p=0.002)

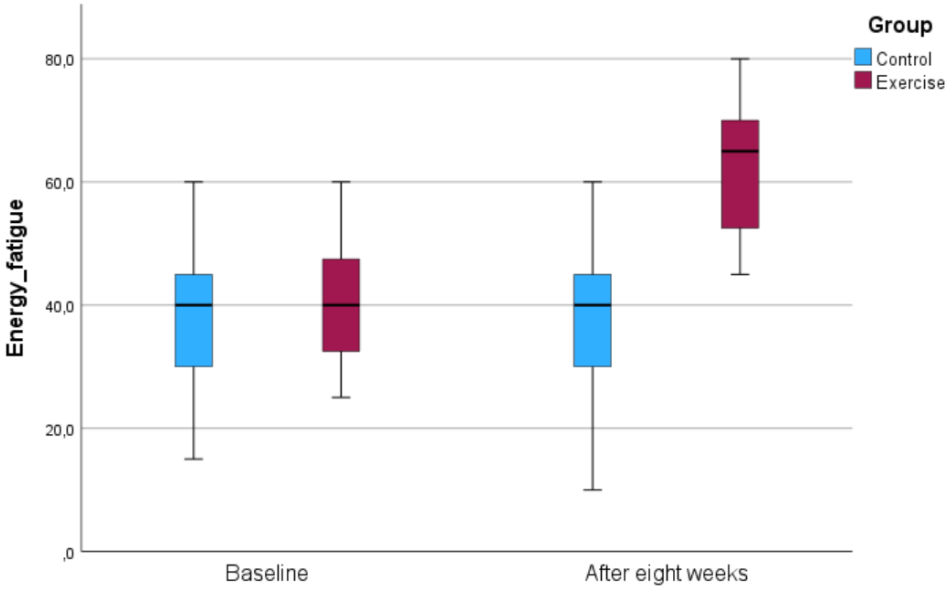


*Figure 3. Box plot showing changes in energy/fatigue in both groups.*

### 3.3.2 Social functioning

In the subcategory social functioning, the HIIT group had a significant increase of 16.7% from baseline to week 8 (p=0.048). There were no significant differences across groups.

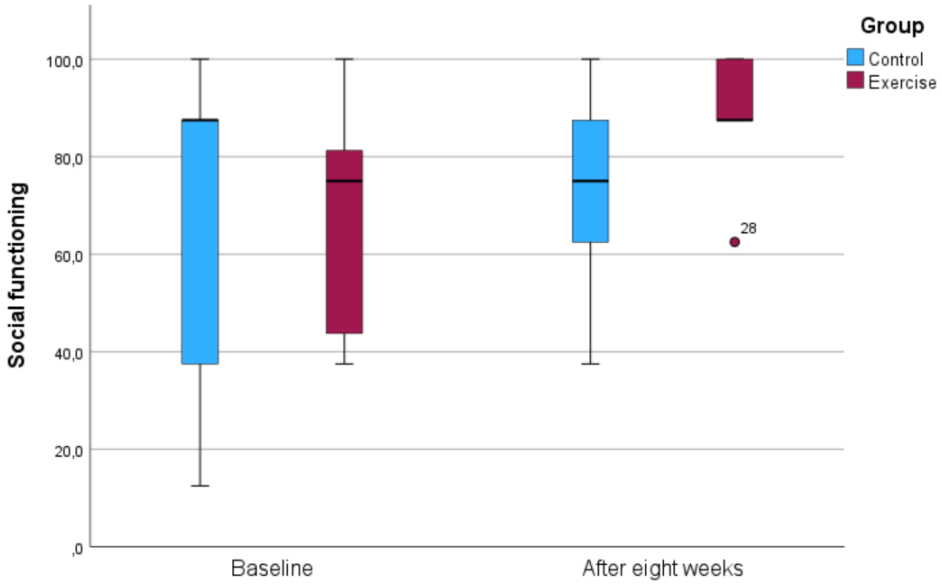


*Figure 4. Box plot showing changes in social function in both groups.*

### 3.3.3 General health

A significant increase of 22.2% was seen in the subcategory general health for the HIIT group (p=0.026). There was also a significant difference across the HIIT and control group (p=0.023).

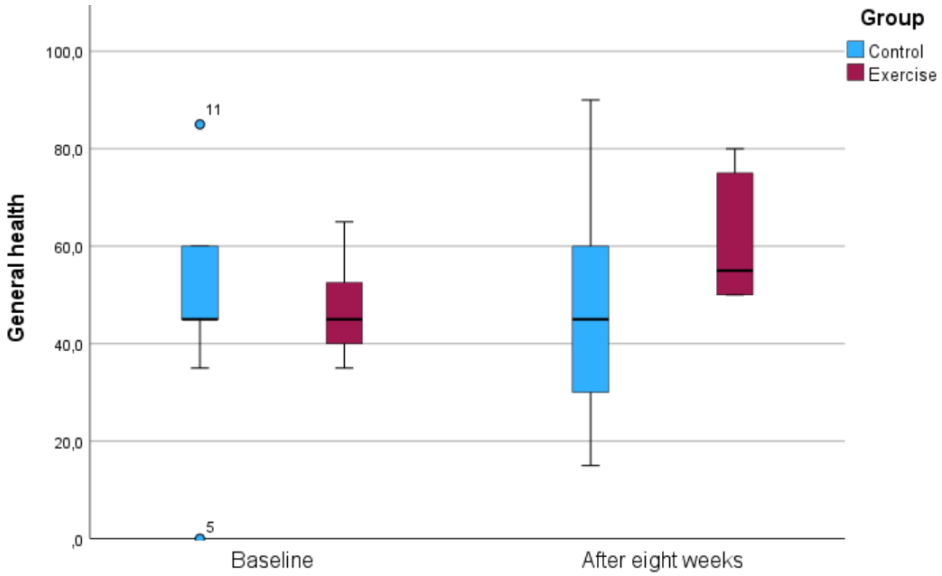


*Figure 5. Box plot showing changes in general health in both groups.*

## 3.4 Correlations

### 3.4.1 Baseline correlations

Spearman correlation analysis indicate several correlations between body composition at baseline and subcategories from RAND-36 (table 7). The analysis was based on both groups combined. There are strong indications that a higher hip circumference, and higher amount of fat mass in the thighs is associated with a lower score in general health for the participants in the study. Results also show that a higher weight and increased thigh circumference is strongly correlated with more pain.

*Table 7. Baseline QoL correlations for all the participants.*

| Variables | Physical functioning | | Energy/ fatigue | | Social functioning | | Pain | | General health | |
|---|---|---|---|---|---|---|---|---|---|---|
| | CC | P-value | CC | P-value | CC | P-value | CC | P-value | CC | P-value |
| **Waist (cm)** | -.561* | 0.024 | -.289 | 0.277 | -.030 | 0.912 | -.552* | 0.026 | -.398 | 0.127 |
| **Hip (cm)** | -.489 | 0.054 | -.520* | 0.039 | -.352 | 0.181 | -.556* | 0.025 | -.627** | 0.009 |
| **Weight** | -.393 | 0.132 | -.312 | 0.240 | -.123 | 0.649 | -.625** | 0.010 | -.483 | 0.058 |
| **Total body fat %** | -.328 | 0.215 | -.562* | 0.024 | -.176 | 0.514 | -.369 | 0.160 | -.480 | 0.060 |
| BMI | -.268 | 0.316 | -.464 | 0.070 | -.185 | 0.492 | -.487 | 0.056 | -.527* | 0.036 |
| Fat mass thigh (kg) | -.299 | 0.260 | -.541* | 0.031 | -.252 | 0.347 | -.606* | 0.013 | -.620* | 0.010 |
| Thigh (cm) | -.503* | 0.047 | -.528* | 0.036 | -.680** | 0.004 | -.743** | <0.001 | -.568* | 0.022 |

**** Correlation is significant at the 0,01 level (2-tailed).**
*** Correlation is significant at the 0,05 level (2-tailed).**

### 3.4.2 Correlations between body composition and QoL after 8 weeks.

Correlations are based on the changes in body composition and RAND-36 answers from pre to posttest (table 8). This chapter presents correlations in the HIIT group, as there were no significant correlations found in the control group.

*Table 8. Statistically significant correlations after eight weeks in the HIIT group.*

| Variables | Physical functioning | | Social functioning | |
|---|---|---|---|---|
| | CC | P-value | CC | P-value |
| **Weight** | -.954** | <0.001 | -.778* | 0.039 |
| **Fat mass thigh (kg)** | -.886** | 0.008 | -.849* | 0.016 |
| **** Correlation is significant at the 0,01 level (2-tailed).**<br>*** Correlation is significant at the 0,05 level (2-tailed).** | | | | |

### *3.4.2.1 Weight*

There was a significant correlation between decreased weight and a higher score in the subcategories physical and social functioning (figure 6 and 7)

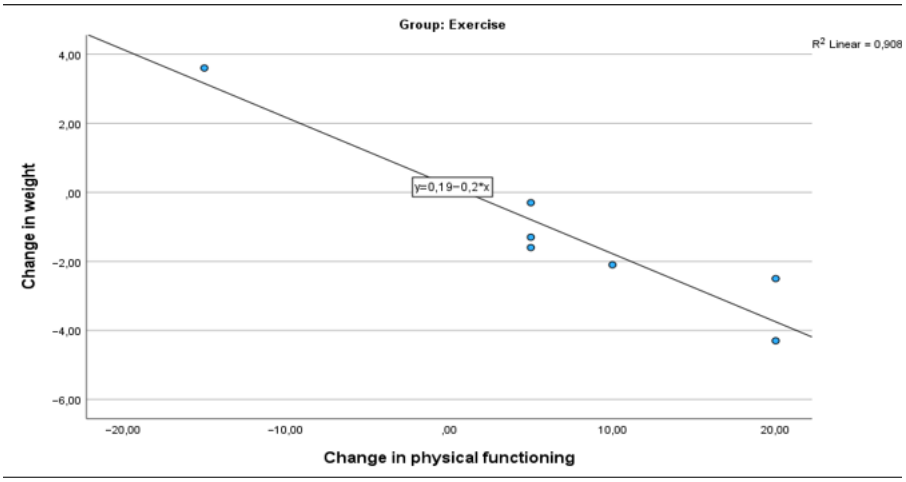


*Figure 6. Scatter plot showing correlations between weight reduction and improvements in physical function.*

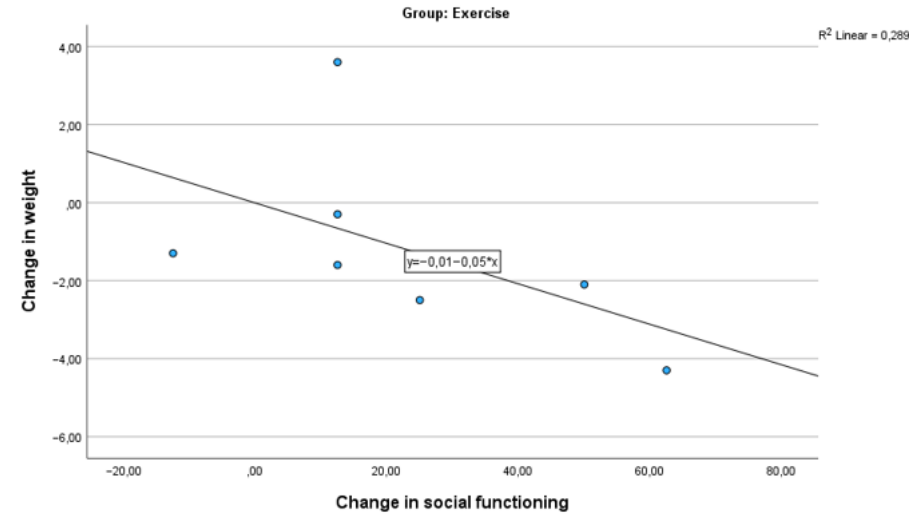


*Figure 7. Scatter plot showing correlations between weight reduction and improvements in social functioning.*

### *3.4.2.2 Fat mass thigh*

There was a significant correlation between decreased fat mass in the thighs and a higher score in the subcategories physical and social functioning (figure 8 and 9)

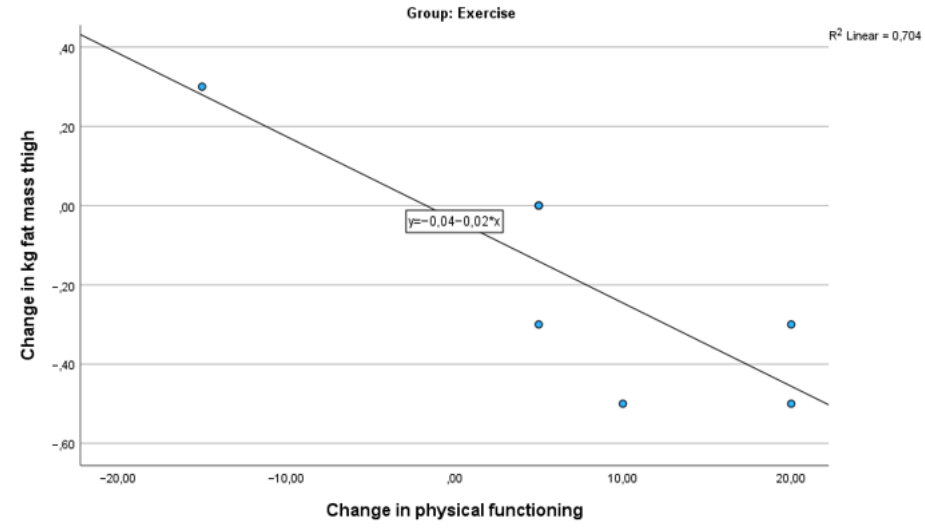


*Figure 8. Scatter plot showing correlations between reduction in fat mass in the legs and improvements in physical functioning.*

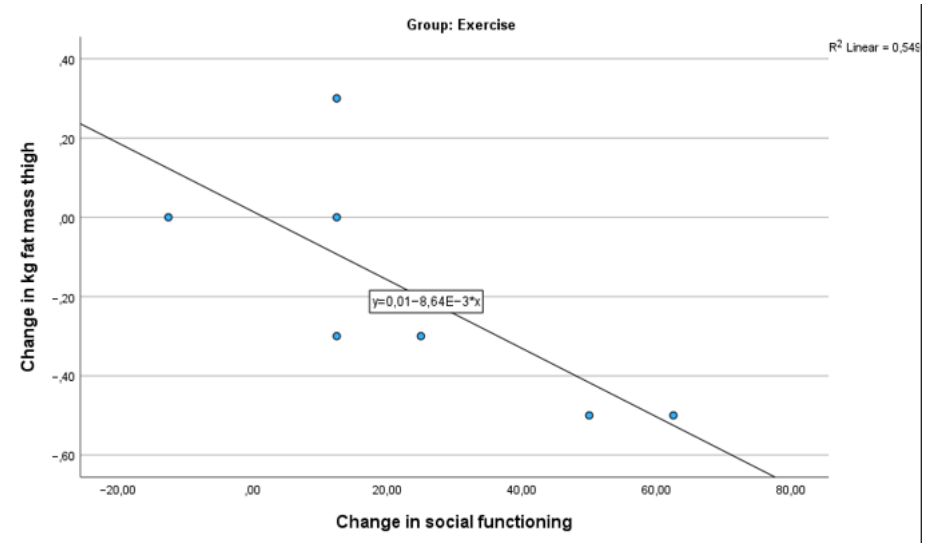


*Figure 9. Scatter plot showing correlations between reduction in fat mass in the legs and social functioning.*

# 4.0 Discussion

The main finding of this study was that long-term high-intensity interval training resulted in significant improvements in quality of life in women with lipedema. Furthermore, exercise-induced decrease in weight and fat mass in legs were strongly correlated with improvements in physiological and social function. In addition, there was a trend toward reduction in body weight in the exercise group. Interestingly, there was a trend toward a reduced fat mass in the legs in the participants in the control group after the intervention period ($p=0.062$). A possible explanation might be that participants in control groups can be motivated to initiate lifestyle-related changes after joining a research project. The participants in the HIIT group had a positive trend of reduced waist circumference after the intervention period ($p=0.051$), and this variable might have been significant with more participants in the study. Based on the RAND-36 scores, it seems like the participants tolerate the training quite well as they report less fatigue and did not report more pain after the intervention period compared to baseline data.

## 4.1 Quality of life

Several subcategories of health-related quality of life were improved by 8-weeks of high intensity interval training. Furthermore, changes in body composition seems to be correlated with increased score in physical and social functioning. In addition, participants in the control group achieved a positive trend in the subcategory role limitations due to physical health ($p=0.056$). Considering that the control group did not register their physical activity level during the intervention period, it is difficult to determine if their physical activity level had an impact on that variable. However, their physical activity index score increased from a median of 0.0 to 0.75 meaning the control group might have been more active during the intervention period. Waters L et al. conducted a systematic review which examined control group improvements in physical activity in intervention studies, and possible explanatory factors (31). The review mentions the Hawthorne effect, which is when the participants achieve improvements because they are aware of being observed. In addition, exercise intervention studies often have participants that are motivated to initiate behavioral change.

### 4.1.1 Energy/fatigue

Baseline values showed a median score of 40 points, which is quite similar to the Romeijn JRM et al. study, where the participants had a mean vitality score of 49.1 (18). The results of this present HIIT study are also showing baseline correlations between body composition and vitality. Participants with higher hip circumference and higher body fat percentage report more fatigue. The same goes for those who had higher amount of fat mass in the legs, and higher thigh circumference.

After 8 weeks of intervention, the results are showing an increase in the energy/fatigue score in the HIIT group ($p=0.017$), which means less feelings of fatigue. In line with our findings, Puetz TW et al. found that six weeks of low and moderate exercise training performed by sedentary adults resulted in beneficial effects on feelings of energy (32). Although the Puetz TW et al study is a low to moderate intensity study, our study may show that high intensity interval training also might have a beneficial effect on energy levels among adults, and also in lipedema patients.

### 4.1.2 Social functioning

The social functioning category describes the participants ability to interact with for example family and friends. Baseline values is showing a median RAND score of 75 points, which is slightly higher than the Romeijn JRM et al. study with a mean score of 67.3 points (18). It may seem that the participants from our HIIT study is quite comfortable in social settings compared to the Romeijn JRM et al. study. However, correlation analysis conducted at baseline also show that participants with a higher thigh

circumference had a lower social functioning score. A possible explanation to this finding might be how many women with lipedema experience stigmatization from, for example, health personnel, which in addition might lead to a self-stigmatization and a lack of self-confidence (13).

However, after 8-weeks of HIIT, the exercise group achieved a significantly higher social functioning score, with a median score of 87.5 (p=0.048), but no significant difference is seen across groups. These findings are similar to Molmen-Hansen HE et al. (27). The participants in that study had a higher baseline score (93 ±10 points), but the increase was quite similar to our study. Tous-Espelosín M et al. also found positive effect of HIIT in social functioning, but in low volume HIIT in adults with overweight and obesity (28). Low volume HIIT might be a good alternative for women with lipedema considering the short duration of the exercise, and their feelings of tension and pressure in the legs. However, it is important to mention that the Tous-Espelosín M et al. study had a 16-week intervention which is twice as much as this pilot study. Maybe, with a longer intervention period, the patients of this present study could achieve greater impairments in the domain social functioning. In addition, post intervention correlations are showing that a reduction in body weight and kg fat mass in the legs resulted in a higher social functioning score in the intervention group.

### 4.1.3 General health

The participants in this present study reported a general health score of 45 points at baseline, which is slightly lower compared to the Romeijn JMR et al. study, where the participants scored a mean of 51.6 points (18). The general health category correlates with several body composition variables at baseline such as hip and thigh circumference and BMI. The results from this current study are showing that participants with higher hip and thigh circumference had a lower general health score. A higher BMI is also correlated with lower general health score at baseline.

After 8 weeks of HIIT, the intervention group achieved a significantly higher score (55 points) compared to the baseline values (45 points) (p=0.026). There was also a significant difference across groups (p=0.023). No correlation is seen between changes in body composition and general health.

## 4.2 Body composition

There were no changes in body composition after an 8-week HIIT intervention, which is in line with existing literature (4). However, almost all participants in the exercise group achieved weight loss, but the results did not reach statistically significance, which might be explained by one participant who gained 3,6 kilos during the intervention period. The HIIT group had a strong trend in reduction in hip circumference, which might have been significant with more participants. There were no significant changes in thigh circumference or amount of fat mass in the legs, which was expected (4, 14).

As there are very few exercise training studies performed on lipedema patients, it was most appropriate to compare the results from this present study with studies who examines overweight and obesity, as the median BMI in our participants is 29.4 and the obesity threshold is BMI>30. It is important to mention that the women who participated in the study did not have any caloric restrictions, and there was no focus on energy balance which is quite important in weight loss and weight management. However, the systematic review by Andreato LV et al. which also did not include any diet, mentioned several positive effects of exercise training in patients with overweight and obesity (24). They found that HIIT is quite effective on decreasing body weight, BMI, waist circumference and body fat percentage. These results did not match our findings, which may indicate that the lipedema tissue is resistant to high-intensity interval-training. However, Atan T and Bahar-Özdemir Y. found some promising results when examining

the effects of exercise-based rehabilitation with 1) complete decongestive therapy (CDT), or 2) intermittent pneumatic compression therapy (IPCT), or 3) exercise alone (control group) in women with severe lipedema (> stage 3) (33). Limb measurements was the primary outcome, but they also examined anthropometric measurements, pain, fatigue, depression and quality of life. The groups received 30 exercise sessions of combined aerobic, strengthening and stretching. All groups achieved improvements in outcome measurements, but CDT in addition to exercise provided significant improvements in reducing limb volume, pain and increase social function. These results may indicate that lipedema patients might benefit from an interdisciplinary treatment program.

## 4.3 Strengths and Limitations

### 4.3.1 Strengths

Even though the present study was underpowered to make strong conclusions, there are some strengths. As there is little research on lipedema and exercise, it is useful to examine the effects of HIIT on both body composition and QoL, and to investigate if the lipedema patients tolerate exercise with high intensity. Furthermore, this was a randomized controlled trial that included randomization to an intervention or control group. That makes it possible to compare the results of the intervention with those who did not receive the intervention. In addition, there were always two or more students present during the data collection.

### 4.3.2 Limitations

This study includes several limitations. One of them is the small number of participants in the study. There are multiple reasons for this. First, there are few women diagnosed with lipedema which may be because of the limited awareness around the disease. Second, considering that this was a pilot study, it was difficult to predict the required number of participants to obtain sufficient statistical power. Third, even though there were many who expressed their interest, very few of them met to pretest, and some of them who met to pretest, did not meet to posttest and is therefore not included in the analysis. Several of the measured variables almost met the criteria for statistical significance, and inclusion of more participants might have provided more clear results.

Furthermore, there are little information about the physical activity levels in the control group except for the PA index. It could also have been a closer follow-up in the training classes for the HIIT group. Another limitation is the measurement of maximal heart rate. This was measured during the $Vo_{2max}$ test, and that is not the best way to measure maximal heart rate. Manual adjustments of maximal heart rate were made after the vo2max test. In addition, some of the participants did not reach the desired heart rate zone due to pain and tenderness in the legs.

Anthropometric measurements were conducted by unexperienced students, which might have led to mismeasurements in some cases, although there were always two students who completed the measurements.

Another limitation is the short intervention period. It had been desirable with a longer intervention but due to the limited time of a master assignment, it was not possible to implement a longer intervention.

# 5.0 Conclusion

The present study showed that HIIT seemed to have beneficial effects on some aspects related to health-related quality of life such as more energy in the daily life, better general health and more socially functioning. No changes were seen in body composition after the exercise intervention, probably due to a rather short exercise period and no restrictions in diet. There were, however, trends towards a reduction in weight and hip circumference in the exercise-training group. In addition, there was an association between reduction in body weight and composition and improvements in QoL. Eventually, according to the results from RAND-36, it seemed like females with lipedema tolerate long-term high-intensity interval training and did not report more pain after the intervention period.

## 5.1 Future directions

The present study investigated the effects of long-term high-intensity interval training in women with lipedema over an 8-week period. Since there are very few exercise training studies investigating this disease, it would be interesting to examine the effects of low and moderate intensity training with longer duration and a larger sample size. In addition, including low volume HIIT in an intervention would be interesting considering their feeling of tension and pressure. A shorter duration might be better for them. Future research should also investigate the effects of diet and exercise in the same intervention.

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# 7.0 Appendix

## 7.1 Appendix 1 – Information material


*Versjon 3*

*(26.05.22)*

Vil du delta i forskningsprosjektet LipidEx

Formålet med prosjektet og hvorfor du blir spurt

Dette er et spørsmål til deg om å delta i et forskningsprosjekt for å undersøke effekt av 8 uker med intervalltrening på lipødem. Vi ønsker å finne ut om denne treningstypen kan føre til mindre smerter, bedre livskvalitet, samt en endret blodprofil og kroppssammensetning. Vi spør om du vil delta siden du tidligere har fått diagnosen lipødem, og ikke driver med regelmessig intervalltrening.

Hva innebærer prosjektet for deg?

Prosjektet involverer to testdager før og etter en 8-uker lange intervensjonsperioden hvor vi på begge testdagene vil måle kroppssammensetning, blodtrykk, kondisjon og blodprøver. Alle deltakere må komme fastende til disse testdagene pga. blodprøvene som skal tas, men vil få mulighet til å spise før videre målinger blir gjennomført. Deltakeren vil bli tilfeldig trukket ut til å delta enten i en treningsgruppe eller i en kontrollgruppe. Det er altså like stor sannsynlighet for at man havner i kontrollgruppen som i treningsgruppen. Alle deltakerne skal fylle ut en aktivitetsdagbok i hele intervensjonsperioden. De som havner i treningsgruppen, trener to ganger i uken ved NTNU sine treningsfasiliteter NextMove på Øya i Trondheim i til sammen 8 uker. Det vil da være intervalltrening med høy intensitet som gjennomføres fortrinnsvis på tredemølle (gange eller løping), men sykkel vil også være et alternativ. Treningen tilpasses til hvert enkelt. I tillegg gjennomfører alle i treningsgruppen en treningsøkt selv hver uke. Deltakerne i treningsgruppen vil få en aktivitetsklokke som skal brukes i løpet av treningsperioden og kan beholdes etter studien er slutt. Deltakerne som havner i kontrollgruppen skal fortsette sitt vanlige liv som før de 8 ukene, men delta på de to testdagene. Disse deltakeren vil få tilbud om treningsopplæring ved NextMove i etterkant av siste test, samt også få sin egen aktivitetsklokke som de kan beholde etter studiens slutt. Alle deltakerne vil bli spurt om å fylle ut spørreskjema på de to testdagene, samt underveis i studien. Etter at resultatene er behandlet vil alle deltakerne bli invitert til en presentasjon av resultater ved NTNU sine lokaler på Øya. Deltakelse i denne studien skal ikke innebære avvik fra ordinær behandling, men man kan ikke delta på andre kliniske intervensjonsstudier i løpet av de 8 ukene. I prosjektet vil vi innhente og registrere opplysninger om deg på de målingene som blir gjennomført på testdagene, samt de svarene som gis på spørreskjema i løpet av studien, og aktivitetsdagboken.

Mulige fordeler og ulemper

Det er ikke forventet særlig risiko relatert til denne studien annet en typiske ubehag som stølhet etter trening. Dersom vi ser at treningen gir uventet ubehag, vil vi forsøke å endre belastningen ved å justere treningen og apparatene som brukes til treningen. Blodprøvene kan i enkelte tilfeller føre til en forbigående bloduttredelse.

Frivillig deltakelse og mulighet for å trekke ditt samtykke

Det er frivillig å delta i prosjektet. Dersom du ønsker å delta, undertegner du samtykkeerklæringen på siste side. Du kan når som helst og uten å oppgi noen grunn trekke ditt samtykke. Det vil ikke ha noen negative konsekvenser for deg eller din behandling hvis du ikke vil delta eller senere velger å trekke deg. Dersom du trekker tilbake samtykket, vil det ikke forskes videre på dine opplysninger og ditt biologiske materiale. Du kan kreve innsyn i opplysningene som er lagret om deg, og disse vil da utleveres innen 30 dager. Du kan også kreve at dine opplysninger i prosjektet slettes og at det biologiske materialet destrueres. Adgangen til å kreve destruksjon, sletting eller utlevering gjelder ikke dersom materialet eller opplysningene er anonymisert eller publisert. Denne adgangen kan også begrenses dersom opplysningene er inngått i utførte analyser, eller dersom materialet er bearbeidet og inngår i et annet biologisk produkt. Dersom du senere ønsker å trekke deg eller har spørsmål til prosjektet, kan du kontakte prosjektleder (se kontaktinformasjon på siste side).

Hva skjer med opplysningene om deg?

Opplysningene som registreres om deg skal kun brukes slik som beskrevet under formålet med prosjektet, og planlegges brukt til 2025. Eventuelle utvidelser i bruk og oppbevaringstid kan kun skje etter godkjenning fra REK og andre relevante myndigheter. Du har rett til innsyn i hvilke opplysninger som er registrert om deg og rett til å få korrigert eventuelle feil i de opplysningene som er registrert. Du har også rett til å få innsyn i sikkerhetstiltakene ved behandling av opplysningene. Du kan klage på behandlingen av dine opplysninger til Datatilsynet og institusjonen sitt personvernombud. Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger (=kodede opplysninger). En kode knytter deg til dine opplysninger gjennom en navneliste. Det er kun prosjektleder som har tilgang til denne listen. Etter at forskningsprosjektet er ferdig, vil opplysningene om deg bli oppbevart i fem år av kontrollhensyn.

Deling av opplysninger og overføring til utlandet

Som en del av gjennomføringen av prosjektet kan det bli aktuelt å overføre innsamlede opplysninger om deg til andre land. Dette vil i så fall kun anonymiserte blodprøver som blir analysert av et laboratorium i utlandet. NTNU er ansvarlig for at overføringen av opplysninger skjer i samsvar med norsk rett og EU sin personvernlovgivning (GDPR). Koden som knytter deg til dine personidentifiserbare opplysninger vil ikke bli utlevert.

Hva skjer med prøver som blir tatt av deg?

Blodprøvene som tas av deg skal oppbevares i en forskningsbiobank tilknyttet prosjektet. Biobanken heter LipidEx, er lokalisert på Akutten og Hjerte-lungesentret ved NTNU. Ansvarshavende for biobanken er prosjektleder Anja Bye. Biobanken opphører ved prosjektslutt. Dersom det blir aktuelt å bruke et laboratorium i utlandet for analyse av blodprøvene, vil kun EØS-land være aktuelt. Blodprøver vil bli sendt komplett anonymisert, og laboratoriet vil destruere eller returnere blodprøvene til NTNU etter avsluttet analyse.

Forsikring

Du er dekket av forsikring gjennom universitetet når du deltar i dette prosjektet.

Oppfølgingsprosjekt

Dersom det blir aktuelt med et oppfølgingsprosjekt til LipidEx, så kan det hende vi tar kontakt med deg igjen.

Godkjenninger

Regional komité for medisinsk og helsefaglig forskningsetikk har gjort en forskningsetisk vurdering og godkjent prosjektet (461077). NTNU er ansvarlig institusjon, og prosjektleder Anja Bye er ansvarlig for personvernet i prosjektet. Vi behandler opplysningene basert på ditt samtykke i henhold til GDPR.

Kontaktopplysninger

Dersom du har spørsmål til prosjektet eller ønsker å trekke deg fra deltakelse, kan du kontakte Anja Bye, 932 32 057, Anja.Bye@ntnu.no. Dersom du har spørsmål om personvernet i prosjektet, kan du kontakte personvernombudet ved institusjonen: thomas.helgesen@ntnu.no.

Ved andre spørsmål i forbindelse med prosjektet, ta kontakt med masterstudentene som står for daglig drift. Hedda Aasland Eidet heddae@stud.ntnu.no (mobil: 45440067), Sara Knudsen Sarahkn@stud.ntnu.no (mobil: 99422831) eller Johanne Sæther johasaet@stud.ntnu.no (mobil: 9360041).

| | |
|---|---|
| Sted og dato | Deltakers signatur |

## 7.2 Appendix 2 - Recruitment Booklet

# Kvinner med lipødem ønskes til treningsstudie

**Er du mellom 18-65 år, har en BMI på 25-35 og har lipødem?**
**Da kan dette være noe for deg!**

**Mål med studien:** Finne ut om kondisjonstrening kan føre til mindre smerter, bedre livskvalitet, samt endret blodprofil og kroppssammensetning hos kvinner med lipødem.

**Studien innebærer:**

- Halvparten av deltakerne vil bli tilfeldig trukket ut til å følge et treningsopplegg med **utholdenhetstrening** mens resten skal leve som normalt.
- Deltakerne i treningsgruppen må møte til trening **2 ganger i uken i 8 uker**, og i tillegg gjennomføre en treningsøkt i uka på egenhånd.
- Deltakere i kontrollgruppen vil få tilbud om treningsveiledning etter at studien er avsluttet.
- Alle deltaker vil svare på spørreskjema om livskvalitet og smerte, føre treningsdagbok, og få målt kroppssammensetning, blodtrykk, kondisjon og blodmarkører to ganger i løpet av studien.
- Alle deltakere vil motta en aktivitetsklokke som takk for innsatsen.

**Hvor:** Testing og trening foregår ved NTNU sine lokaler ved St.Olavs hospital.

Du kan ikke delta i studien dersom du driver med mye kondisjonstrening fra før, dersom du har alvorlige spiseforstyrrelser eller ikke kan verken sykle eller gå på tredemølle. Det kan også være andre årsaker til at noen ikke kan delta, men dette vil avklares ved første undersøkelse.

**For påmelding eller mer informasjon vennligst kontakt**
Johanne Sæther johasaet@stud.ntnu.no (mobil: 936 00 741)
Hedda Aasland Eidet heddae@stud.ntnu.no (mobil: 454 40 067)
Sara Knudsen sarahkn@stud.ntnu.no (mobil: 994 22 831)

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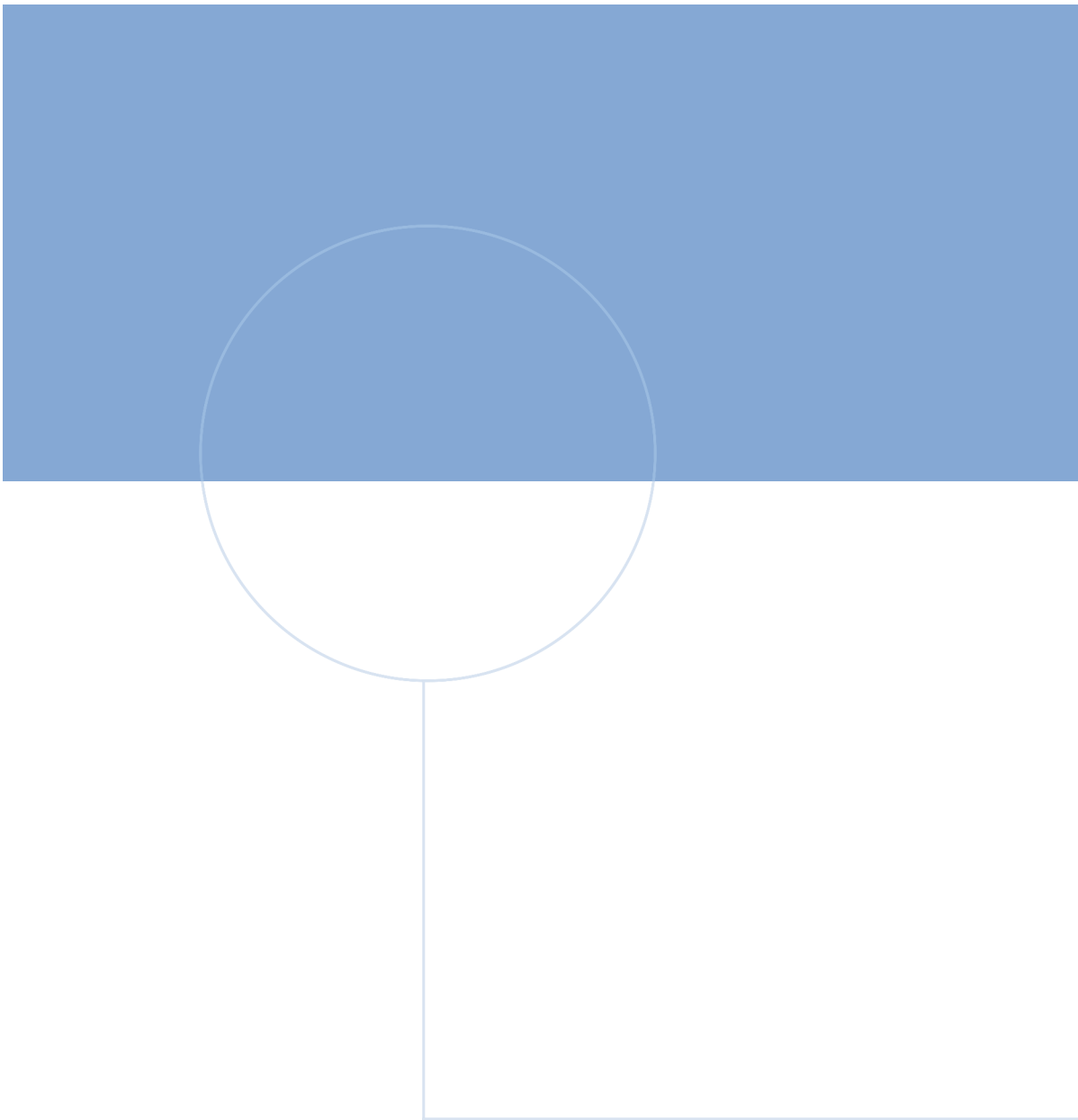

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