# Effects of a low-frequency sound wave therapy program on functional capacity, blood circulation, and bone metabolism in frail old men and women

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# Background

- Aging reduces muscle strength and balance leading to problems in the activities of daily living and increasing risk of falling and fractures.
- Exercise, strength training and balance training have proved to be effective and useful ways of maintaining or improving muscle strength and balance in the elderly.
- Unfortunately, it can be difficult to apply such approaches in frail or disabled old people.
- Therefore, it is necessary to explore alternative, more widely-applicable methods for maintaining and improving at least some aspects of functional capacity and well-being in frail elderly subjects.

# Background

Physioacoustic method has been used for several health purposes, such as muscle relaxation and enhancing blood circulation. Some positive effects have been shown, for example in neurological patients (San Vicente et al. 1997, Wigram 1997).

The purpose of this randomized controlled trial was to evaluate the effects of a low-frequency sound wave therapy program on functional capacity, blood circulation, and bone metabolism in frail old men and women

# Study design

Recruitment of subjects

Over 60 year-old men and women from two senior service centres as well as other older persons living near the centres

Exclusion criteria were

1) under 60 years of age,
2) impaired mental status that prevented giving informed consent,
3) history of severe or progressive disease or any illness that might confound the results of the study or pose additional risks to the subject,
4) diseases or posttraumatic disorders that would inhibit participation in tests (e.g. inability to stand without assistance).
5) In addition, pacemaker patients were excluded from the intervention group.

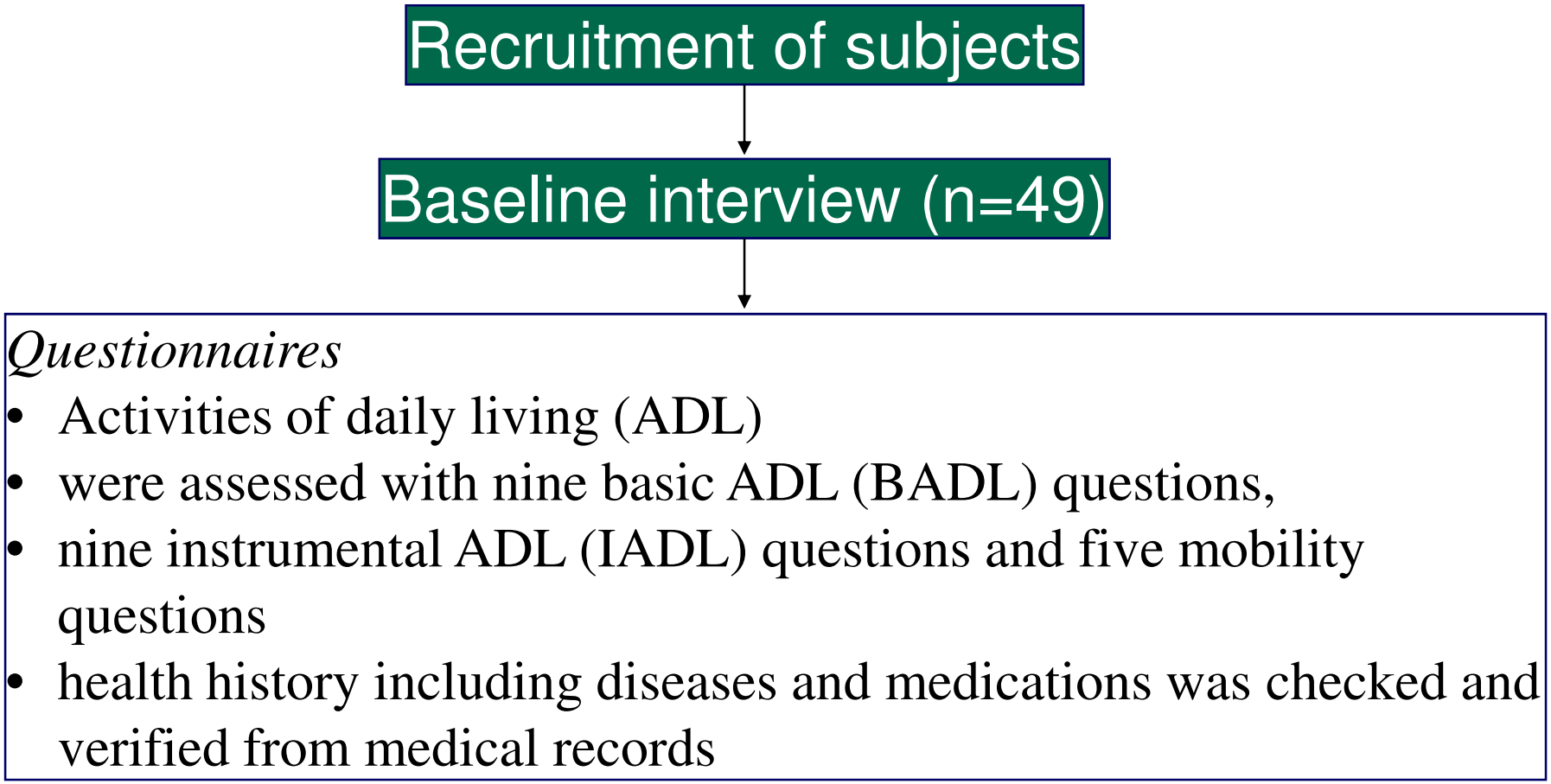
# Flow chart of the study

Recruitment of subjects

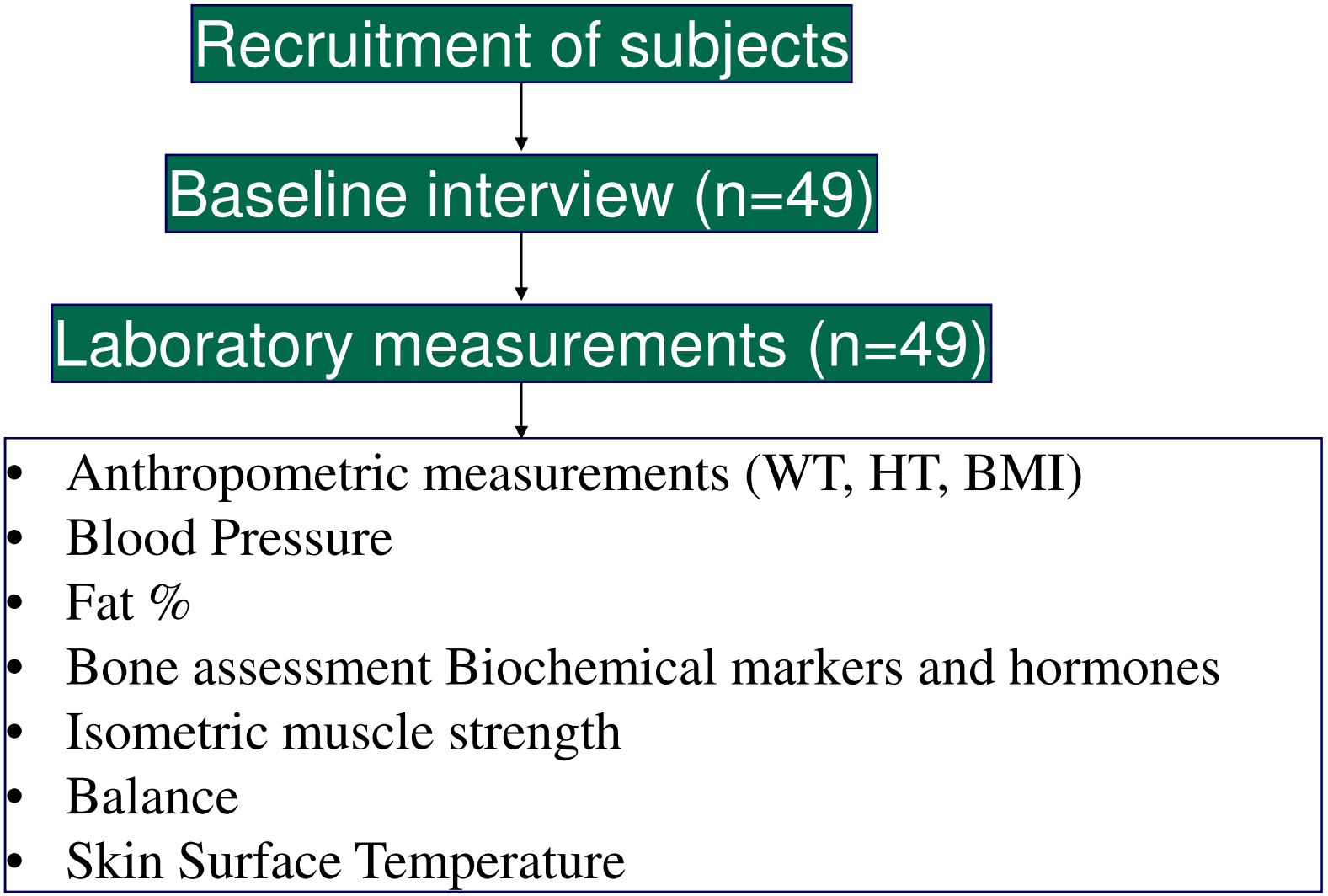
Finally, 49 men (n=14) and women (n=35) aged 62-93 years who gave their informed consent.

- On the average, subjects had 6 chronic diseases (range 0 - 12) and used 9 different prescription drugs (range 0 - 22).
- 72% of them used walking aids indoors and 55% outdoors, most often walkers and canes. One subject used a wheelchair but also a walker for shorter distances.

# Flow chart of the study



# Flow chart of the study



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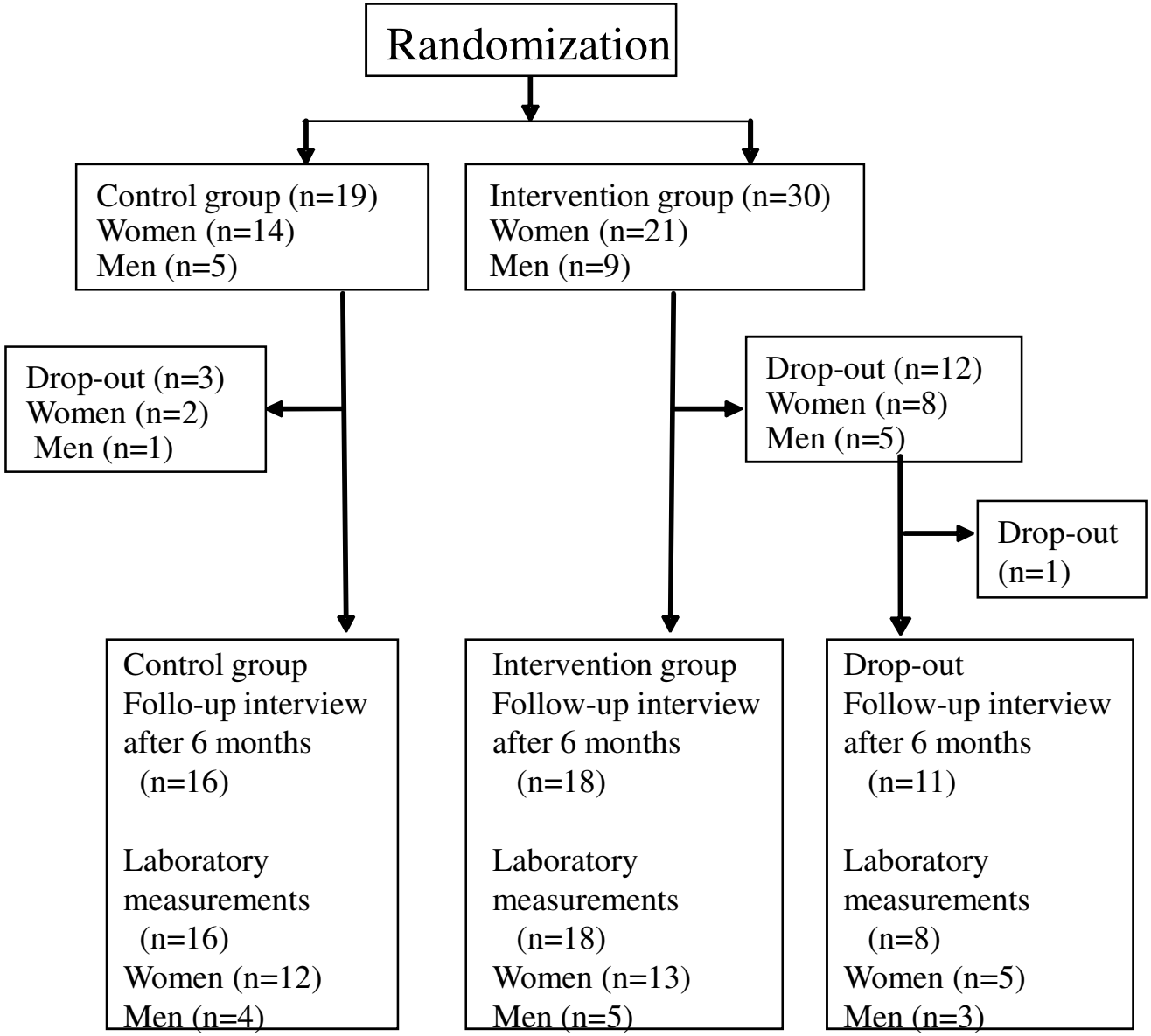


# INTERVENTION

- Intervention group undergo 6-month theraphy using Physioacoustic Sound Wave Therapy chair.
- The other group serves as a control keeping their daily routines
- Intervention at Service Home Telkänpesä and Lutako with 3-5 weekly 30 min session for 6 months

| Month | 1 | | | | 2 | | | | 3 | | | | 4 | | | | 5 | | | | 6 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Week | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 2 |
| Tests | x | x | | | | | | | | | | | | | | | | | | | | | | | |
| Treatment | 5 | 3 | 5 | 3 | 3 | 5 | 3 | 3 | 5 | 3 | 3 | 5 | 3 | 3 | 5 | 3 | 3 | 5 | 3 | 3 | 5 | 3 | 3 | 5 | 3 |
| (times/wk) | | | | | | | | | | | | | | | | | | | | | | | | | St |

# Intervention program

The compute controlled programs used in this study were progressive.

- During the first 2 weeks, we used frequencies from 27 to 50 Hz with very slow rhythm (from 2 to 5 minutes, overall time 30 minutes) for subject's to get used to the treatment.
- From the 3rd week to following 9 weeks, we used series programs during a week and change in each session as follows:

# Intervention program

day 1: frequencies from 27 to 67 Hz with 22 minutes very slow rhythm, 8 minutes maintaining rhythm;

day 2: frequencies from 27 to 45 Hz with 27 minutes maintaining or stimulating rhythm, 3 minutes of very slow rhythm;

day 3: frequencies from 29 to 71 Hz with slow rhythm, but stimulating continuously for 20 minutes;

day 4: frequencies from 27 to 91 Hz, mainly over 55 Hz and at the end 2 minutes from 27 to 29 Hz;

day 5: repeated from the first grogram.

# Intervention program

From week 10-25 weeks, the following programs were used:

1. Frequencies from 27 to 75 Hz, 14 minutes over 50 Hz, 16 minutes under 50 Hz. First 10 minutes very slow rhythm then 20 minutes of maintaining rhythm;
2. Frequencies from 27 to 50 Hz;
3. Frequencies from 28 to 66 Hz. 9 minutes of relaxation, 21 minutes of maintaining or fast rhythm; and
4. Frequencies from 27 to 54 Hz with slow rhythm.

# Feedback from intervention group

- **Intermediate measurement**
  - **How do you feel sitting in the chair?**
  - **Very pleasant 3**
  - **Pleasant 13**
  - **Not pleasant nor unpleasant 1**
  - **Unpleasant 0**
  - **Very unpleasant 0**

# Feedback

- **Final measurement**
  - **1. How did you feel sitting in the chair?**

| | Intervention | Drop-outs |
|---|---|---|
| – Very pleasant | 3 | 1 |
| – Pleasant | 13 | 6 |
| – Not pleasant nor unpleasant | 2 | 2 |
| – Unpleasant | 0 | 1 |
| – Very unpleasant | 0 | 0 |

# Results

- The subjects in the intervention group (6.8 ± 2.6, p=0.040) and those who dropped out (7.6 ± 2.0 p=0.013) had more chronic diseases than those in the control group (4.6 ± 2.6).
- Twelve persons from the intervention group dropped out during the intervention, which was expected due to natural changes in health during six months in old, frail subjects.

# Results – No changes

When comparing the intervention and the control groups, no significant effect of the intervention was found in:

- weight, BMI, waistline, fat,
- systolic and diastolic blood pressure,
- chair stand time,
- maximal isometric knee extension strength or grip strength,
- muscle CSA,
- balance,
- 10 meters' walking speed,
- the scores of BADL or IADL

# Results – positive changes

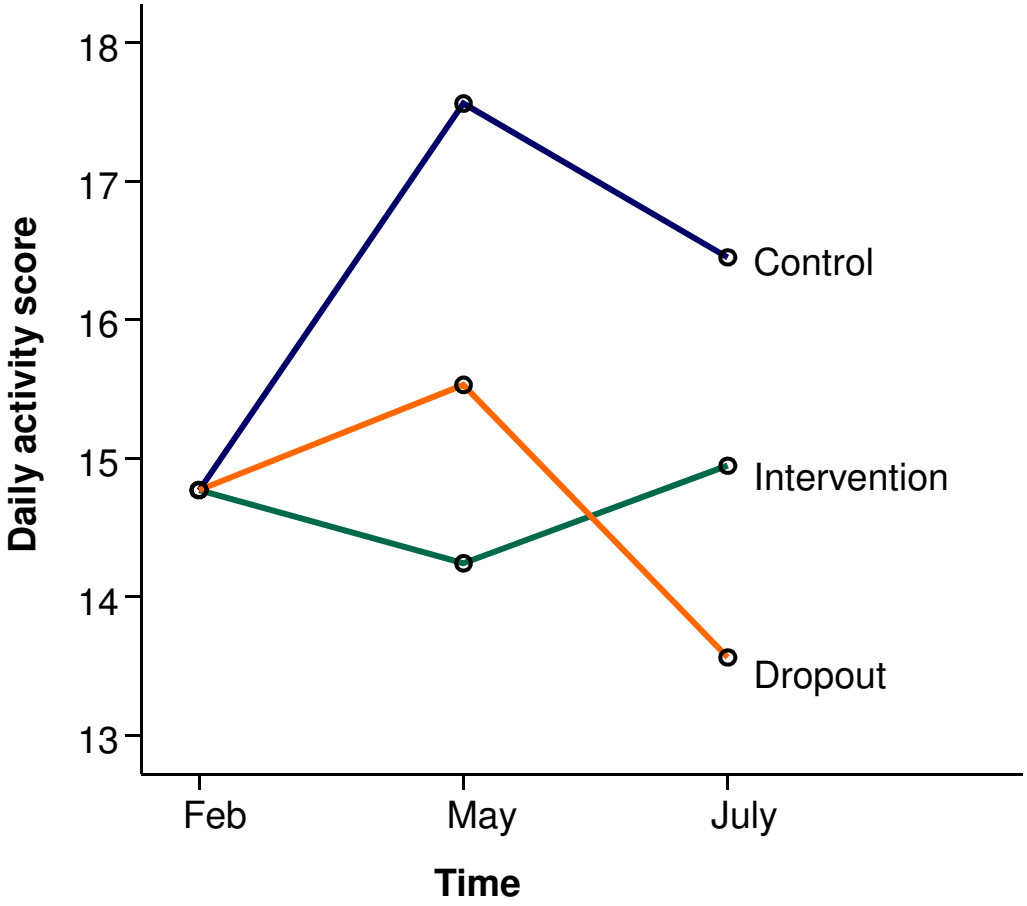
- The first positive impact for the intervention group was that most (89%) of the subjects have enjoyed sitting in the chair and thus the acceptance of the intervention was good.
- Placing the chairs at the senior service center made the treatment accessible both for the residents of the residential home as well as all the persons who lived independently, but were used to visit the center and use its services.
- The positive effects caused by increased social activity among those who participated in the intervention cannot be separated from the total effects of the program.

# Results

After the intervention

- 8 persons (44%) reported positive effects in their daily life that they connected to the chair sessions (e.g. disappearing of overnight foot pain, feet feeling lighter, feeling refreshed, better daily functioning, decreased blood pressure and increased social interaction).
- 4 persons (22%) reported that the intervention had not obviously affected their daily life.
- 5 persons (28%) reported negative effects which concerned mostly the difficulties and restrictions in planning weekly routines because of the sessions.
- 1 person reported excessive tiredness which prevented certain exercise activities.

# Daily activity

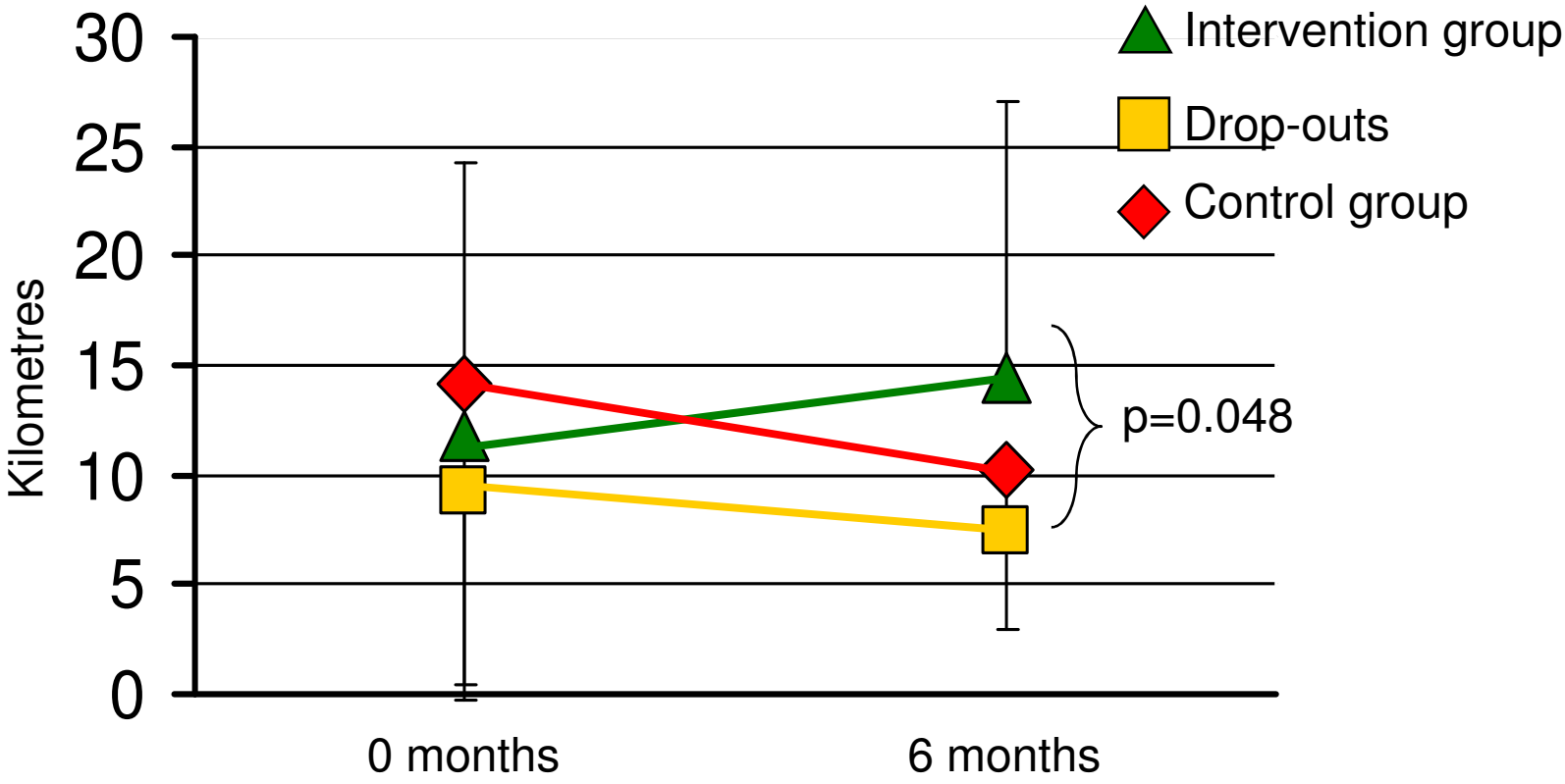



Activity score was computed by sum of Eating, Washing up, Toileting, Transferring in and out of bed, Transferring in and out of bed, Dressing, Walking indoors, Walking outdoors, Climbing stairs, Cutting toe nails, Taking care of own medicine, Use of telephone, Cooking, Light household tasks, Handling finances, Laundry, Cleaning, use of public transportation, Shopping, get up from chair without using hands, Squat down and get up, Sit down and get up from the floor, Bend down and pick up an item and Climb stairs without resting at least one flight.

Form low-score no difficulties to high-score can't do even with assistance.

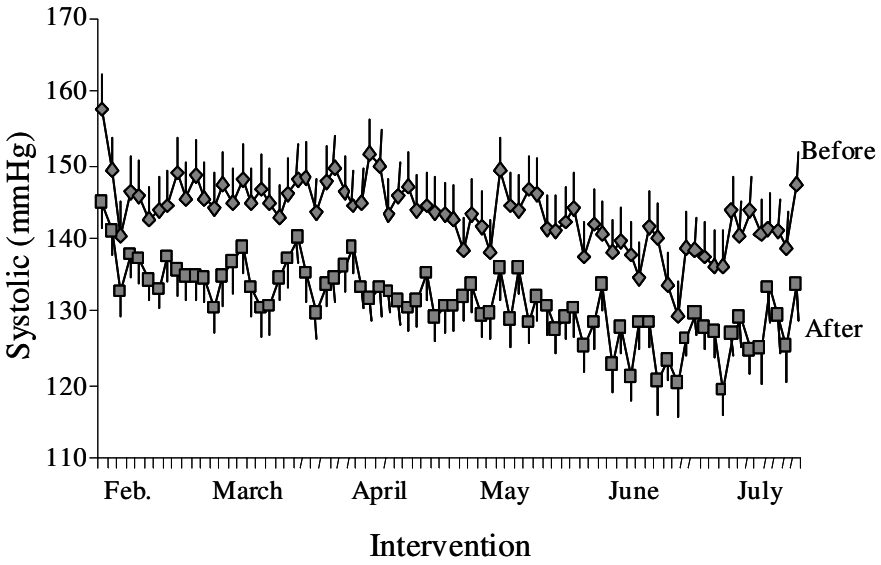
Compared to the control group, the intervention group maintained their daily activity capacity

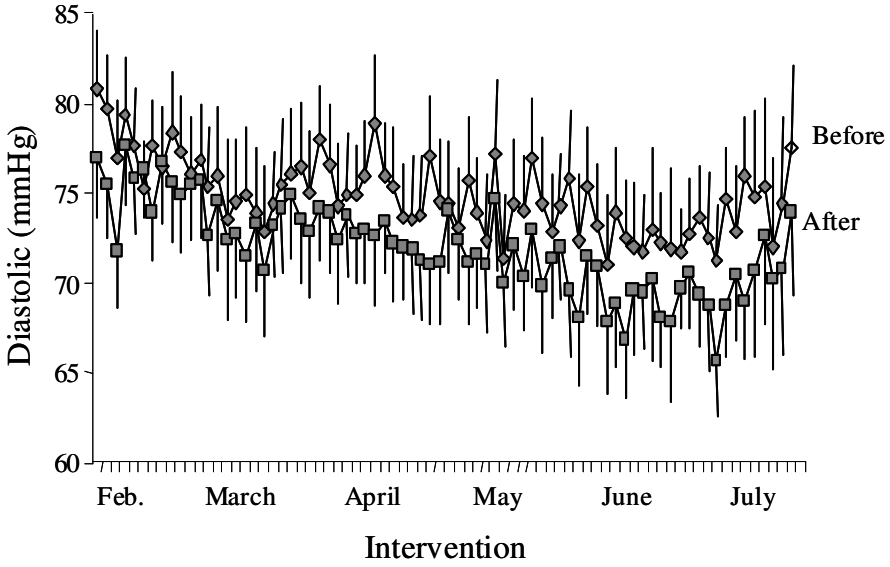
# Change in self-reported walking kilometres per week




The amount of kilometers walked per week was increased about 3 km in the intervention group

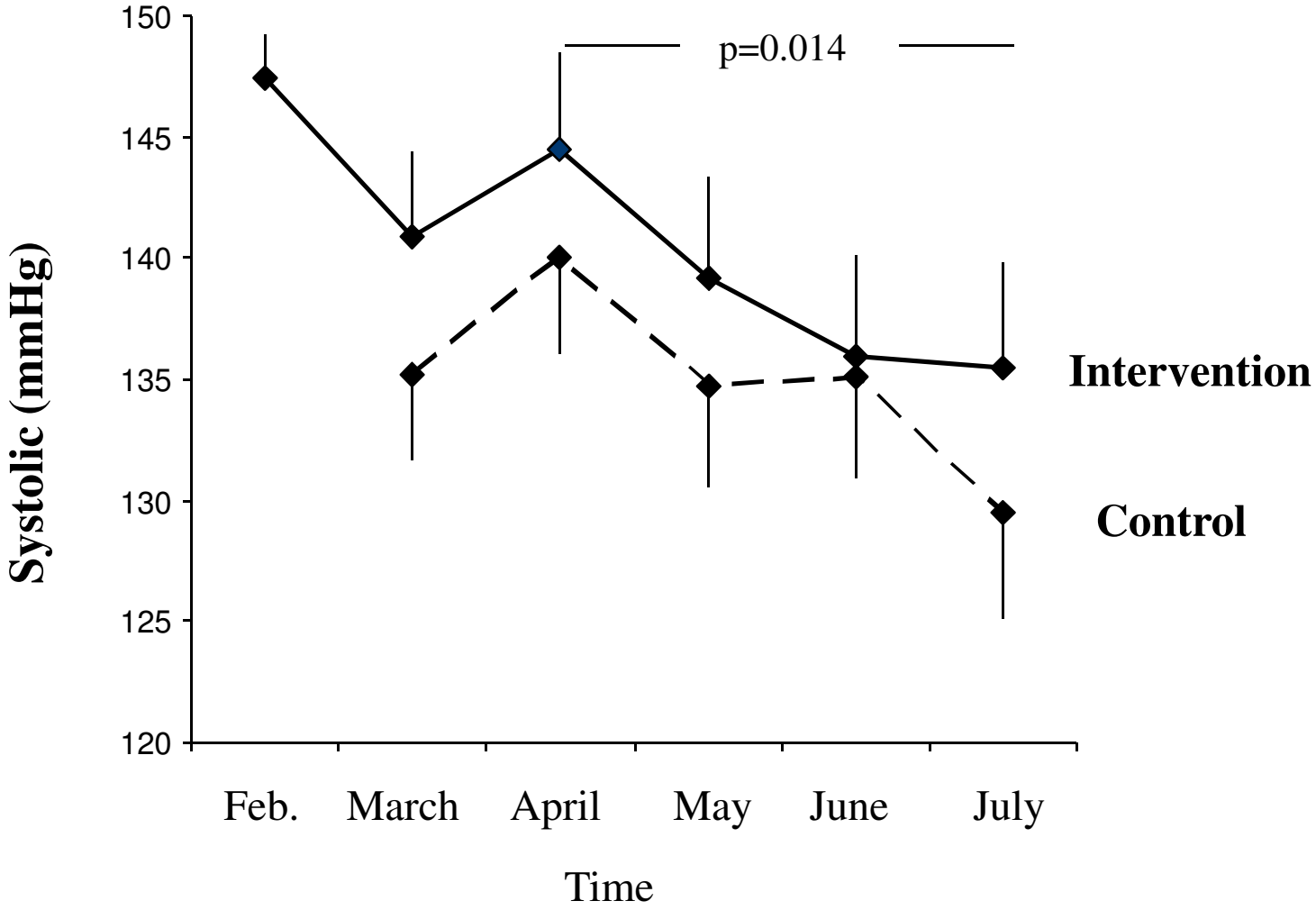
# Change in blood pressure



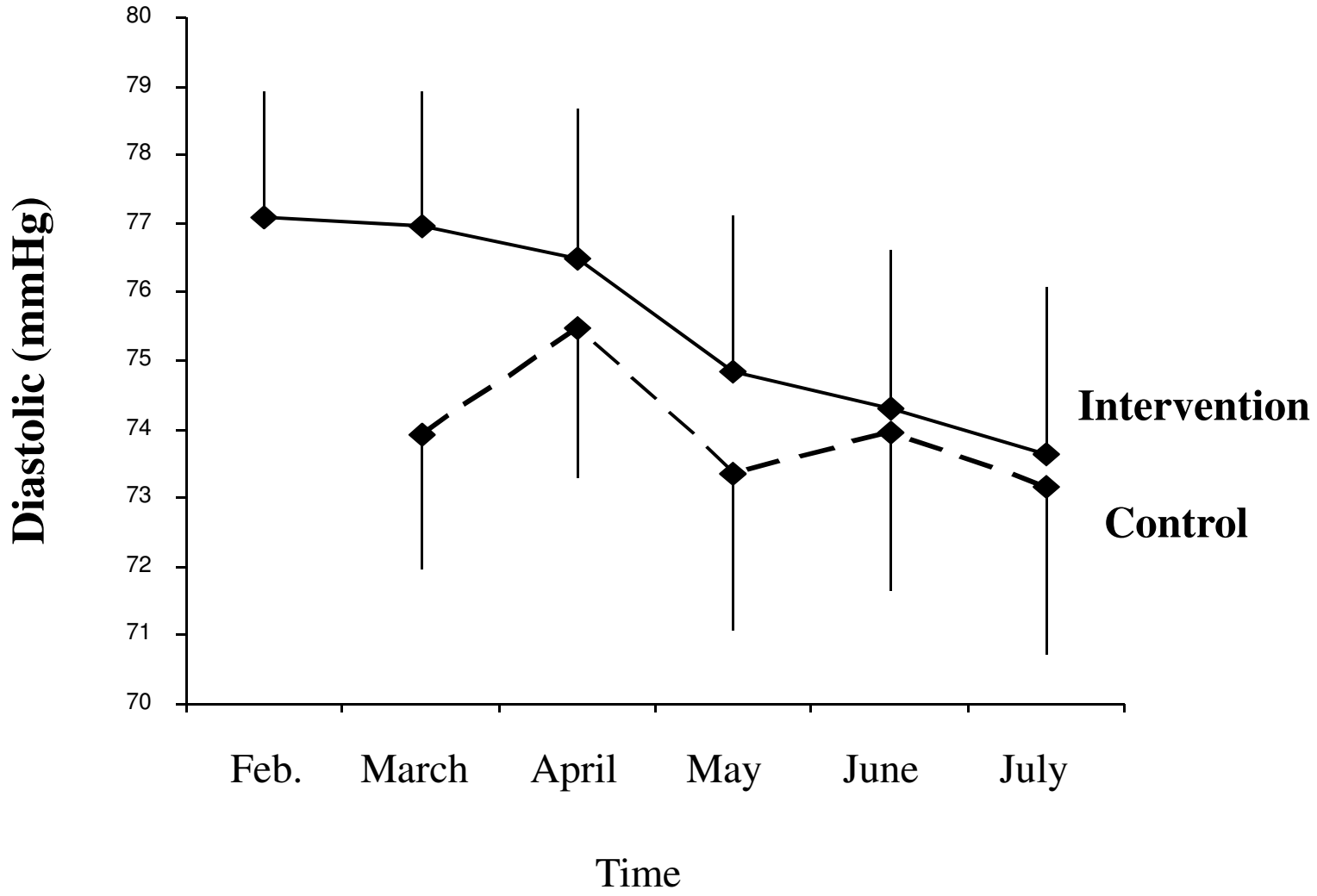




The blood pressure decreased significantly in each session during the entire intervention. On the average the systolic pressure decreased by 12 mmHg (9.2%), and the diastolic pressure by 2.9 mmHg, (4%). The decrease in blood pressure was seen after placebo sessions as well.

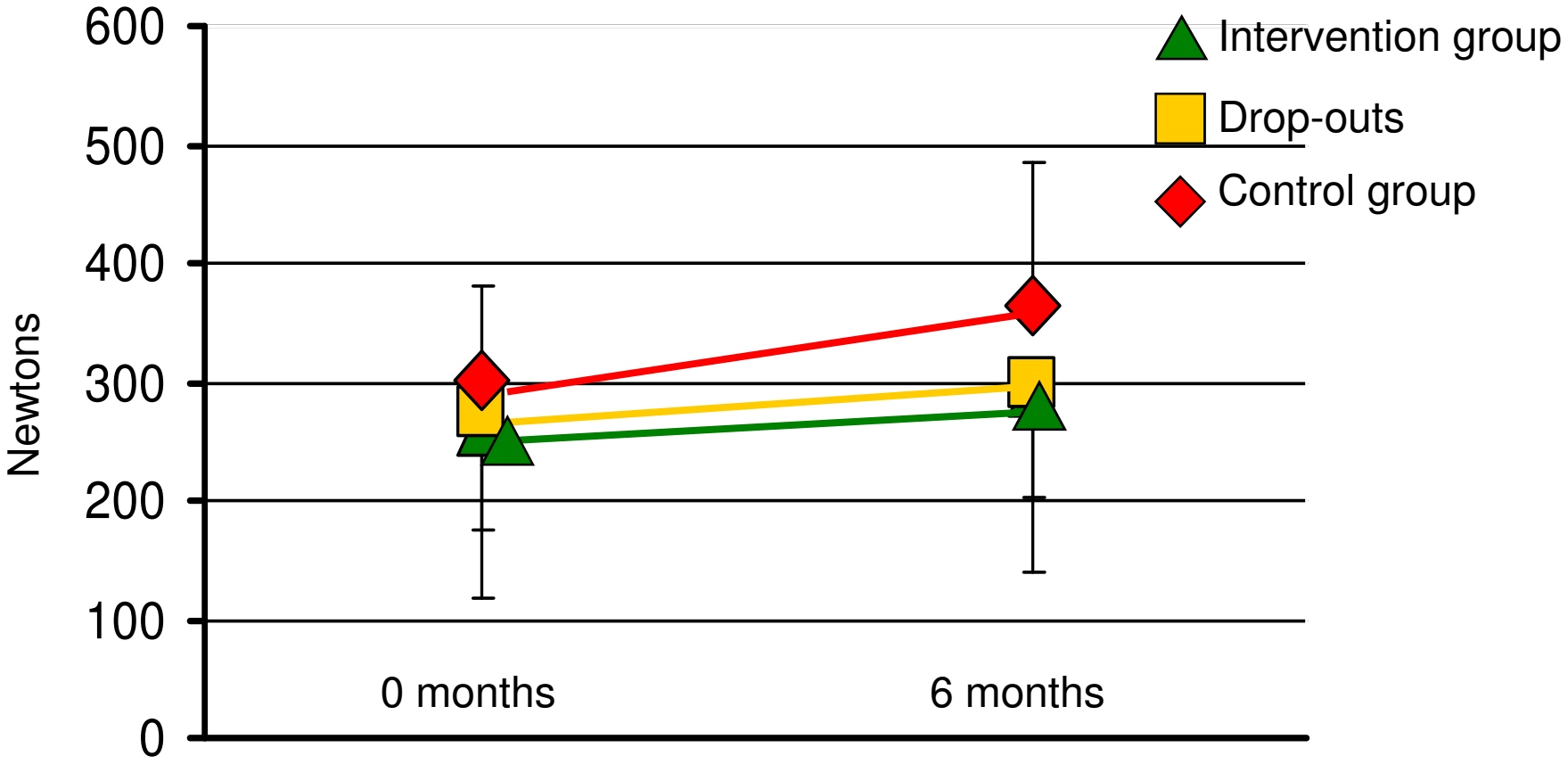
# Blood pressure



# Blood pressure

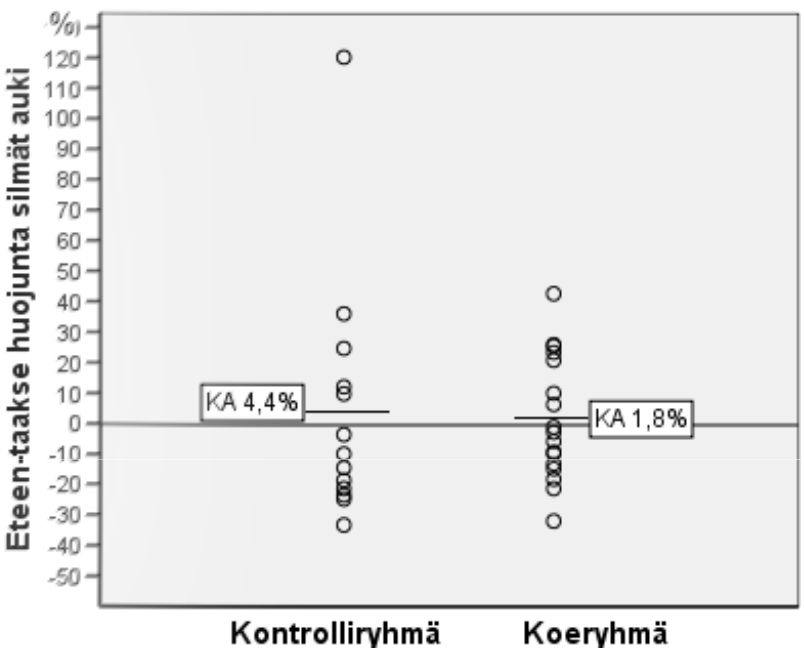


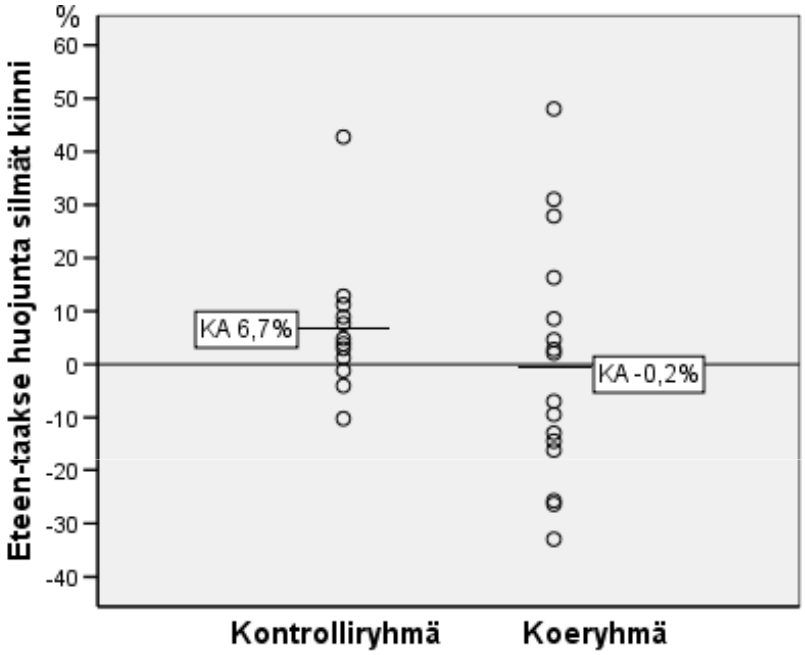
# Change in maximal isometric knee extension strength (N)




No statistically significant differences between groups in the change of maximal isometric knee extension strength

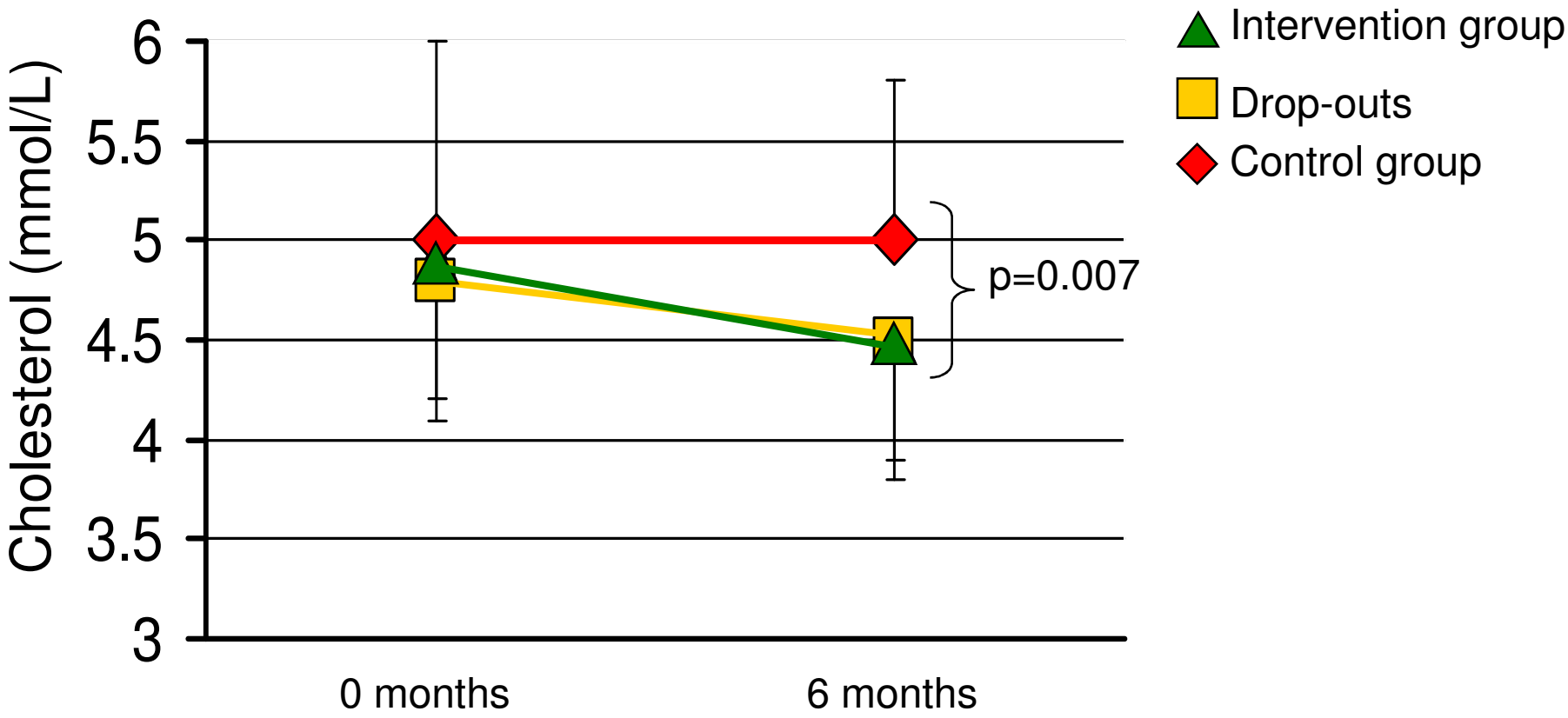
# Balance




Front- back sway eyes closed decreased during intervention, but decrease was not statistically significantly different in intervention- and control groups (p=0,112).

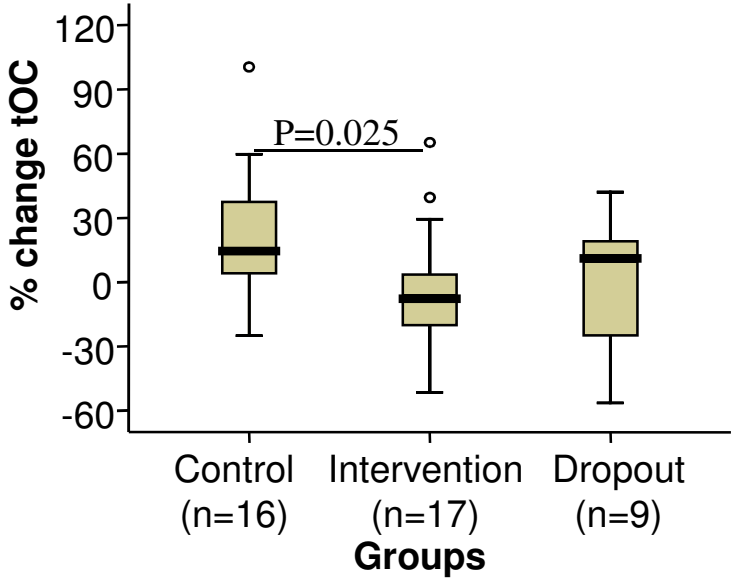
# Change in fasting cholesterol level (mmol/L)

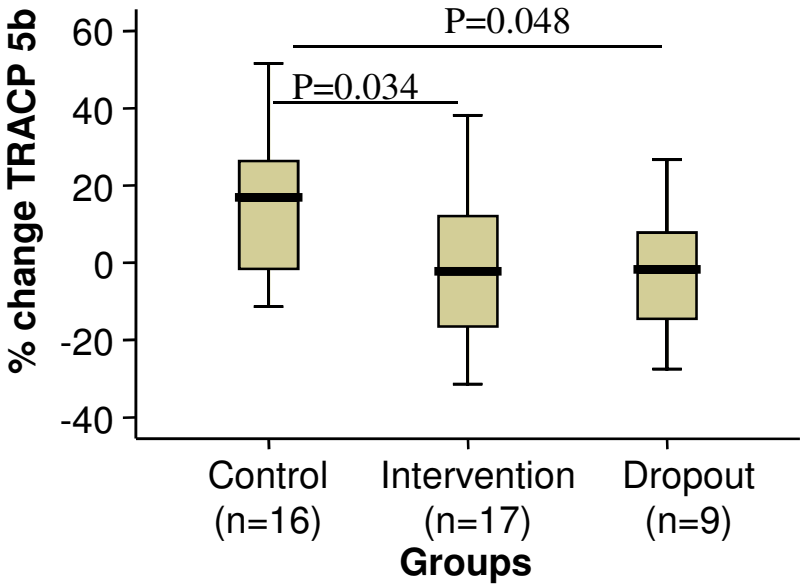


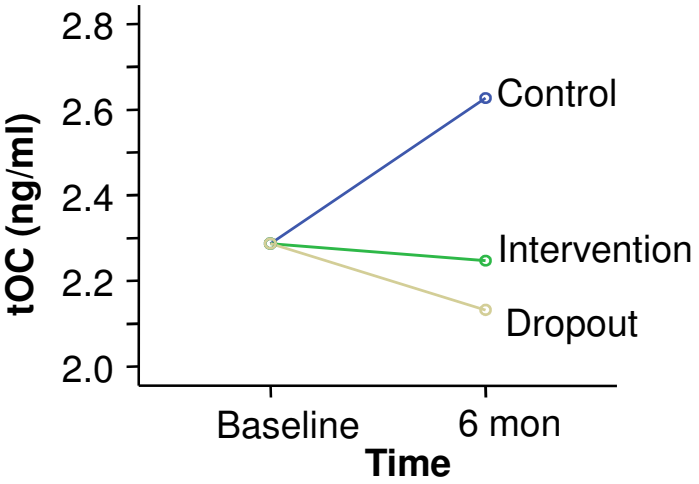

The cholesterol level decreased significantly in the intervention group compared to the control group

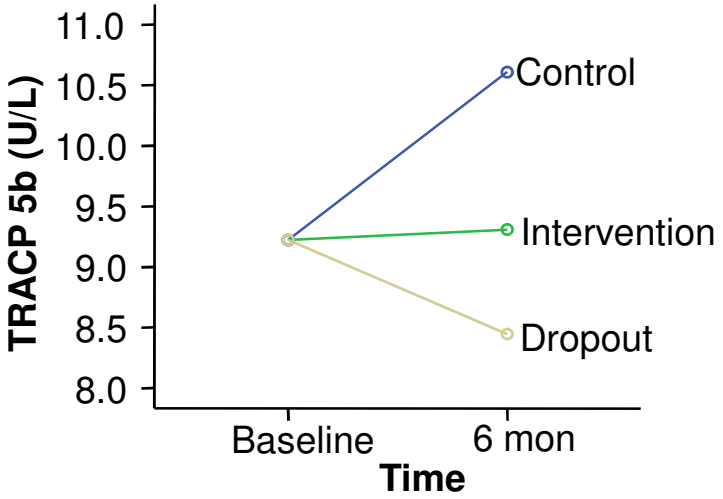
# Bone biomarkers

We found that the Physioacoustic Sound Wave Therapy has significant effect on bone biomarkers

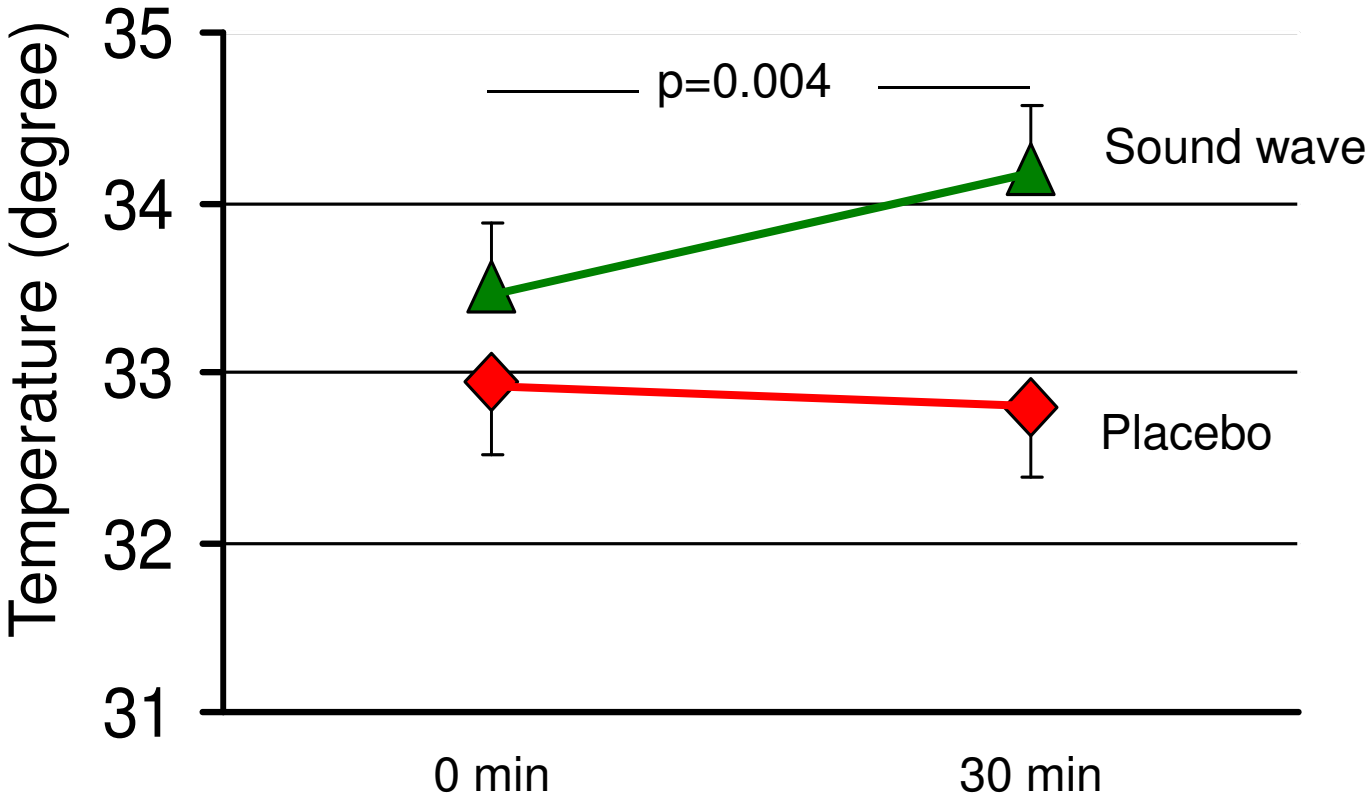


# Change in skin temperature on medial gastrocnemius muscle during sound wave sessions and placebo sessions




The increase in skin temperature of the gastrocnemius muscle was significant during chair sessions, in which the sound wave was actually given

# Summary

We conclude that participation in a low frequency sound wave therapy program may be capable of promoting the well-being of frail elderly subjects via

- improved functional capacity in terms of mobility
- reduced serum cholesterol
- decelerated bone turnover

# Summary

The effects found by using low frequency sound wave therapy program have some similarity to the effects of exercise.

Thus, low frequency sound wave therapy can be used as an alternative way of promoting the well-being of frail elderly subjects, especially in situations where subjects are too frail to participate in common exercise programs.

# Master theses

- **Anneli Hietikko and Piia Katajapuu-Riikonen:**
  The effects of low-frequency sound wave therapy on maximal isometric muscle force and standing balance in older persons (gerontology, JYU)
- **Sanna Rinne:**
  The effects of low-frequency sound wave therapy on walking speed in older persons (gerontology, JYU)