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# Effects of Exercise and Vibration Therapy on Body Composition in β-Thalassemia Patients

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**Abstract** The genetic condition *beta thalassemia* is one of the most frequent in the world. Beta thalassemia is a blood condition in which hemoglobin synthesis is reduced. Age, gender, gonadal status, nutrition, exercise, and hormonal variables are all factors that impact body composition. The main objective was to see how exercise combined with vibration therapy affected body composition in β-Thalassemia patients. Ten female β-Thalassemia volunteers, aged 18 to 32, were separated into two groups: control group (5 subjects) and experimental/intervention group (5 subjects). Dual-energy X-ray absorptiometry was used to determine body composition. A 12-week exercise regimen was designed to be conducted on a vibration platform with a frequency programmed from 15-30 MHz, in total 50 minutes per session including warm-up and cool down. After the intervention, ANOVA findings demonstrated a significant difference in the dependent variable (Fat tissue %) between the experimental and control groups ($F(1)=9.111$, $p=0.017$). In the measurements that were repeated after the intervention, the dependent variable (Lean tissue %) showed no significant difference ($p>0.05$) between the experimental and control groups ($F(1)=2.671$, $p=0.141$). Exercise combined with vibration therapy improved body composition parameters in the intervention group, indicating that this form of intervention can be utilized to enhance general health in thalassemia patients. Other studies need to be carried out to better identify risk factors, prevention strategies, and to introduce special guidelines in designing customized physical activity programs for different social groups.

**Keywords** β-Thalassemia, Body Composition, Exercise Program, Vibration Therapy

## 1. Introduction

The genetic condition beta thalassemia is one of the most frequent disorders in the world. Beta thalassemia is a blood condition in which hemoglobin synthesis is reduced. When compared to the general population, transfusion-dependent thalassemia patients, that is patients treated on a regular basis with blood transfusion are often shorter, have a lower truncal height [1], and a less healthy body weight [2]. Patients with thalassemia exhibit aberrant growth, pubertal development, immunological function, and abnormalities in bone mineral acquisition, among other things. The harmful consequences of transfusion-related iron excess are linked to these co-morbidities. Chronic transfusion needs may have long-term implications on diet, physical activity, and development. Hypoparathyroidism, diabetes, growth hormone shortage, hypothyroidism, hypogonadism, and osteoporosis are among the endocrine problems linked with iron excess [3]. All of the foregoing characteristics, as well as bone marrow hyperactivity, iron overload, and decreased bone mineral density, are known to be compromised in individuals with thalassemia major [4,5]. Until the middle age, lean tissue mass has been demonstrated to be significantly linked with bone mineral density, after which fat mass begins to account for a larger variance [5]. Despite this, only a few studies have looked at physical activity in Thal patients, and those few studies have only focused on the influence of iron overload on physical activity [6]. Age, gender, endocrine system status, diet, and exercise are all factors that determine body composition [7]. There is a lot of evidence that links increased physical activity and intensity with weight loss [8,9], and there are approved instruments for measuring physical activity levels. Nonetheless, fat accumulation is linked to the pancreas' release of bone-active hormones such insulin [10] and amylin [11], the synthesis of leptin [12], and the aromatization of testosterone into estrogen [10]. Despite the existence of recommended ranges [13], and the introduction of new reference ranges [14], there are no widely accepted body fat percentage criteria to classify people as underweight or overweight [15]. Filosa [16] found that in six young males with Thal, delays in pubertal development were connected to a steady BMI or lack of an increase in body fat [17]. Females in the same research who had considerable increases in BMI, on the other hand, had a more regular transition into puberty. DEXA-scan has been shown to be a reliable tool for determining body composition in a variety of patient groups, including those with thalassemia [18-21]. Body composition analysis, BIA, is a non-invasive, low-cost, safe, and reproducible approach for determining body fat mass (FM), fat-free mass (FFM), muscle mass (MM), total body water (TBW), extracellular water (ECW), intracellular water (ICW), and body mass index (BMI) [22,23]. There is a scarcity of published data on this population's body composition, particularly during maturity. On the other hand, several therapies, like vibration therapy, are considered to promote lifestyle as well as general physical fitness.

# 2. Objectives

The main objective of this study was to see how exercise combined with vibration treatment affected body composition in Beta Thalassemia patients and compare the results against a control group.

# 3. Materials and Methods

The Ethical Committee of Sports University of Tirana has granted approval for this study. Prior to the intervention, each subject willingly gave written informed consent of their participation. A total of 10 ß-Thalassemia individuals (18-32 years old) accepted to take part in this study.

On a stadiometer, anthropometric parameters (height and weight) were measured to the closest 0.1 cm. Subjects were instructed to take off their shoes and dress in light clothing, as well as to stand with their backs to a neutral standing position and a relaxed stance. Using a physician's scale, body mass was calculated to the closest 0.1 kg (Model 500KL eye level digital beam scale). Body Mass Index (BMI) was determined using the formula kg/m$^2$. The DEXA-Scan (GE Healthcare Lunar DPX NT + 151 392; Scan Mode: Standard 20.0 μGy) diagnostic instrument was used to measure the percentage of Lean tissue and Fat tissue in the whole body. During the scanning procedure, subjects were told to stand in the typical supine laying posture, with feet strapped together and hands flat on the table close to the side of the body. The average duration of the scanning was around 13 minutes. DEXA scans were performed before and after the exercise intervention program by the same technician. All intervention procedures were carried out in full compliance with the guidelines approved by the Helsinki Declaration for studies conducted in humans, and research exercise protocols designed in collaboration with the Department of Sports Medicine at the Faculty of Movement Sciences.

### 3.1. Criteria for Subject Selection

Subjects chosen as a sample for the research had to comply with the criteria as below:

- Thalassemia patients between the ages of 18 and 32 with no history of heart and lung issues.
- Patients who had not received other treatments than iron overload therapy.
- No past instances of a stroke, lack of hydroxyurea.
- No hospitalization or other health concern for at least 2 weeks prior to the exercise intervention.

### 3.2. Criteria for Subject Exclusion

Subjects were deemed not eligible for the study if:

- They had previously experienced health difficulties.
- They were hemodynamically unstable.
- Or if they had neurological or orthopedic illnesses that could restrict their ability to exercise.

Following the main selection, eventually 10 subjects were shortlisted to participate in this study. For the control group five individuals were randomly chosen from the Regional Hospital "Ihsan Çabej" in the city of Lushnja, which is a regional center for treating of Hemoglobinopathies. While for the intervention group five other individuals were chosen at random from the city of Tirana, who were receiving treatment at the National Centre for Hemoglobinopathies in the Mother Teresa

University Hospital Centre. All of the individuals (control and intervention) continued to receive transfusions at a regular basis to keep their hemoglobin concentrations within norm (10 g/dL). In addition, the subjects were constantly transfused medications to reduce their iron concentration levels (Fe) in the blood. During the study period, the participants in the control group went on with their daily routine activities and did not participate in any organized physical exercise program.

### 3.3. Exercise Intervention Training, the Use of Vibrating Platforms

As stated in Table 1, the intervention group were subjected to a 12-week (3 sessions per week) fitness training program, in total 50 minutes per session, which included a combination of physical exercises and vibration therapy. The platform used for the therapy was a Turner TP-5 with varied degrees of vibration ranging from 15 to 40 MHz. During the therapy, subjects were requested to stand barefoot (or wear sports shoes with orthopedic insoles) for 20 minutes on the vibration platform programmed at a working frequency of 15-30 MHz. The platform was set on a sturdy, non-slippery surface and turned off automatically every 10 minutes. Participants were subjected to two 10-minute sessions on the platform with a 10-minute time-out in between. Each exercise session started and ended with warm-up and cool down exercises.

### 3.4. Statistical Analysis

Statistical analyses were carried out using IBM SPSS Statistics 26 software. A total of ten patients were used as a sample in this study. The sample was divided into two groups (experimental and control) and two measurements (prior to and after the intervention). For the anthropometric variables and dependent variables Fat Tissue (%) and Lean Tissue (%), descriptive statistics (Mean ± Standard Deviation) were used, as well as a comparison between the two measures. After the intervention, a repeated measures ANOVA was utilized to find significant changes in the dependent variables across groups.

## 4. Results

After the intervention exercise program, the control group's average total body weight increased from 47.2 kg to 49.3 kg, consequently resulting in an increase in average BMI results from 19.3 to 20.6. While data reveal a lowering of the body weight in the intervention group individuals, respectively from 55 kg to 54.2 kg, with a corresponding drop in BMI average values from 21.56 to 21.26 (Table 2).

**Table 1.** Exercise Intervention Training and the Use of Vibrating Platforms

| **Warm-up:** 5-10 min including: Walking, jogging, stretching exercises, exercises with gymnastic balls, TheraBand's. | | | |
|---|---|---|---|
| **Main part:** 20 min (2 times x 10 min = 20 min) on the vibrating platform including: | | | |
| **Type of exercise** | **The frequency of the vibrating platform (MHz)** | **Repetitions and set** | **Comments** |
| **Exercise 1: Side leg lift** | 20 | 10-15 reps, 2-4 set | From 1-5 week 10 reps, 2 sets<br>From 6-10 week 15 reps, 4 sets |
| **Exercise 2: Bent over row** | 20 | 10-15 reps, 2-4 set | From 1-5 week 10 reps, 2 sets |
| **Exercise 3: Knee Raises** | 15-20 | 10-15 reps, 2-4 set | From 6-10 week 15 reps, 4 sets |
| **Exercise 4: Modified Push-ups** | 20 | 10-15 reps, 2-4 set | From 1-5 week 10 reps, 2 sets |
| **Exercise 5: Squat** | 15-30 | 8-12 reps, 2-4 set | From 1-5 week 8 reps, 2 sets<br>From 6-10 week 12 reps, 4 sets |
| **Cool down, 5-10 min, including:** Stretching of the major muscle groups, relaxation music on gymnastic mattresses, combination of relaxation therapy with music. | | | |

**Table 2.** Anthropometric Profile of Control Group (n=5) (females) and Intervention Group (n=5) (females), for the First and Second Measurement.

| **Control group (n = 5) (F)** | | | **Intervention group (n = 5) (F)** | | |
|---|---|---|---|---|---|
| | Mean ± St. Dev. (Pre) | Mean ± St. Dev. (Post) | | Mean ± St. Dev. (Pre) | Mean ± St. Dev. (Post) |
| Age (years) | 23.6±4.27 | | Age (years) | 25.4±5.13 | |
| Weight (kg) | 47.2±9.3 | 49.3±10.11 | Weight (kg) | 55±7.18 | 54.2±6.26 |
| Height (cm) | 155.3±9.4 | | Height (cm) | 159.8±10.85 | |
| BMI | 19.3±2.2 | 20.6±2.2 | BMI | 21.56±2.04 | 21.26±1.18 |

*Note.* F: Females; Pre: First Measurement; Post: Second Measurement

The intervention group's dual-energy X-ray absorptiometry data (N=5), composition reference: Total Body showed a drop in Fat Tissue (%) of subjects from 37.36 percent to 36.5 percent between first and second measurements (Table 3).

While the Lean Tissue (%) variable increased from 62.64 percent in the first measurement to 64.70 percent in the second measurement (Table 3). Table 4 shows the findings of descriptive statistics for Fat Tissue (%) and Lean Tissue (%) before and after the intervention.

**Table 3.** Body Composition Profile, Fat Tissue (%) and Lean Tissue (%), of Control Group (n=5) (Females) and Intervention Group (n=5) (Females), for the First and Second Measurement. (Measure Reference, Dual-Energy X-ray Absorptiometry)

| Control group (n = 5) (F) | | | Intervention group (n = 5) (F) | | |
|---|---|---|---|---|---|
| | **Mean ± St. Dev. (Pre)** | **Mean ± St. Dev. (Post)** | | **Mean ± St. Dev. (Pre)** | **Mean ± St. Dev. (Post)** |
| Fat Tissue (%) Total body | 33.88±3.80 | 34.86±5.49 | Fat Tissue (%) Total body | 37.36±6.72 | 36.5±5.71 |
| Lean Tissue (%) Total body | 66.12±3.80 | 65.74±4.96 | Lean Tissue (%) Total body | 62.64±6.72 | 64.70±5.45 |

*Note.* F: Females; 1 M: 1 Measurement; 2 M: 2 Measurement.

**Table 4.** Descriptive Statistics Results for Fat Tissue (%) and Lean Tissue (%) Before and After Intervention

| Group | | Fat Tissue (%) _Pre | Fat Tissue (%) _Post | Lean Tissue (%) _Pre | Lean Tissue (%) _Post |
|---|---|---|---|---|---|
| experimental | N | 5 | 5 | 5 | 5 |
| | Mean | 37.36 | 36.50 | 62.64 | 64.72 |
| | Std. Deviation | 6.72 | 5.71 | 6.72 | 5.45 |
| | Minimum | 30.00 | 29.00 | 55.50 | 57.60 |
| | Maximum | 44.50 | 43.40 | 70.00 | 71.00 |
| | Kurtosis | -2.859 | -1.176 | -2.85 | -1.65 |
| | Std. Error of Kurtosis | 2.00 | 2.00 | 2.00 | 2.00 |
| | Skewness | .012 | -.121 | -.012 | -.374 |
| | Std. Error of Skewness | .913 | .913 | .913 | .913 |
| control | N | 5 | 5 | 5 | 5 |
| | Mean | 33.88 | 34.86 | 66.12 | 65.74 |
| | Std. Deviation | 3.80 | 5.50 | 3.80 | 4.98 |
| | Minimum | 29.80 | 27.30 | 62.10 | 60.01 |
| | Maximum | 37.90 | 41.00 | 70.20 | 72.70 |
| | Kurtosis | -2.92 | -1.20 | -2.92 | -.769 |
| | Std. Error of Kurtosis | 2.00 | 2.00 | 2.00 | 2.00 |
| | Skewness | -.250 | -.524 | .250 | .523 |
| | Std. Error of Skewness | .913 | .913 | .913 | .913 |
| Total | N | 10 | 10 | 10 | 10 |
| | Mean | 35.62 | 35.68 | 64.38 | 65.23 |
| | Std. Deviation | 5.47 | 5.35 | 5.47 | 4.95 |
| | Minimum | 29.80 | 27.30 | 55.50 | 57.60 |
| | Maximum | 44.50 | 43.40 | 70.20 | 72.70 |
| | Kurtosis | -.93 | -1.07 | -.925 | -1.070 |
| | Std. Error of Kurtosis | 1.33 | 1.33 | 1.33 | 1.33 |
| | Skewness | .525 | -.216 | -.525 | -.024 |
| | Std. Error of Skewness | .687 | .687 | .687 | .687 |

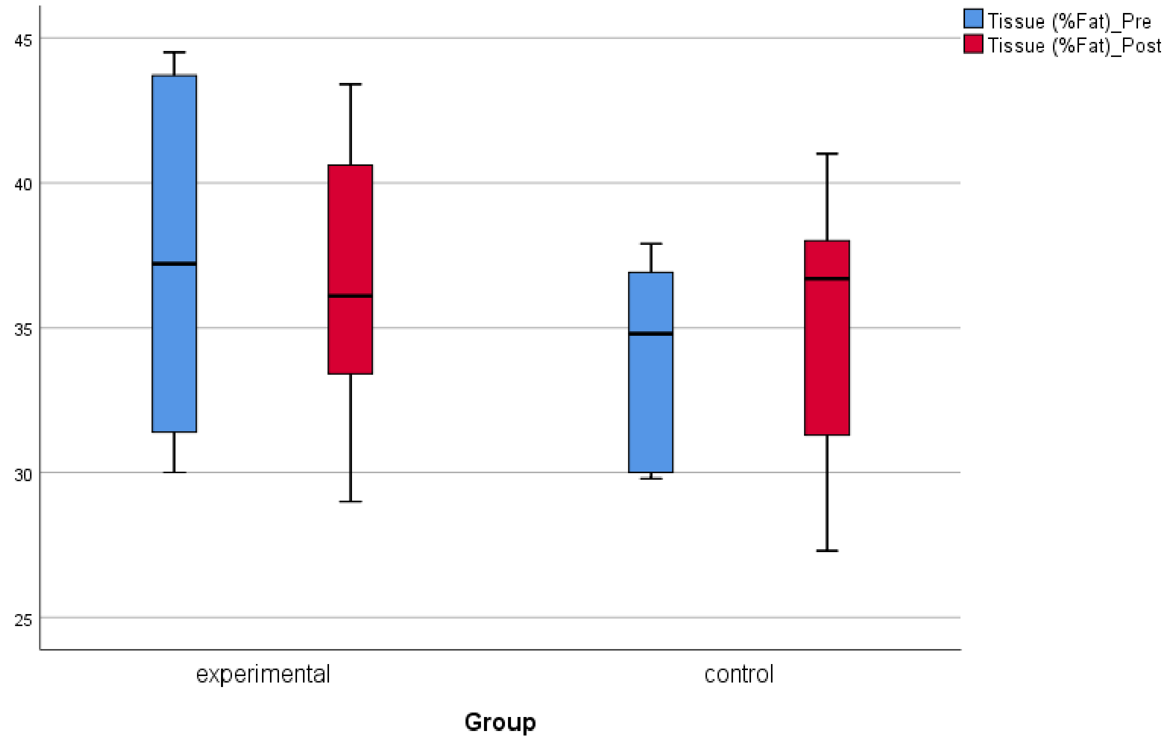


**Figure 1.** Box-Plot for Tissue (%Fat) for the Two Measurements of Body Composition for Experimental and Control Group

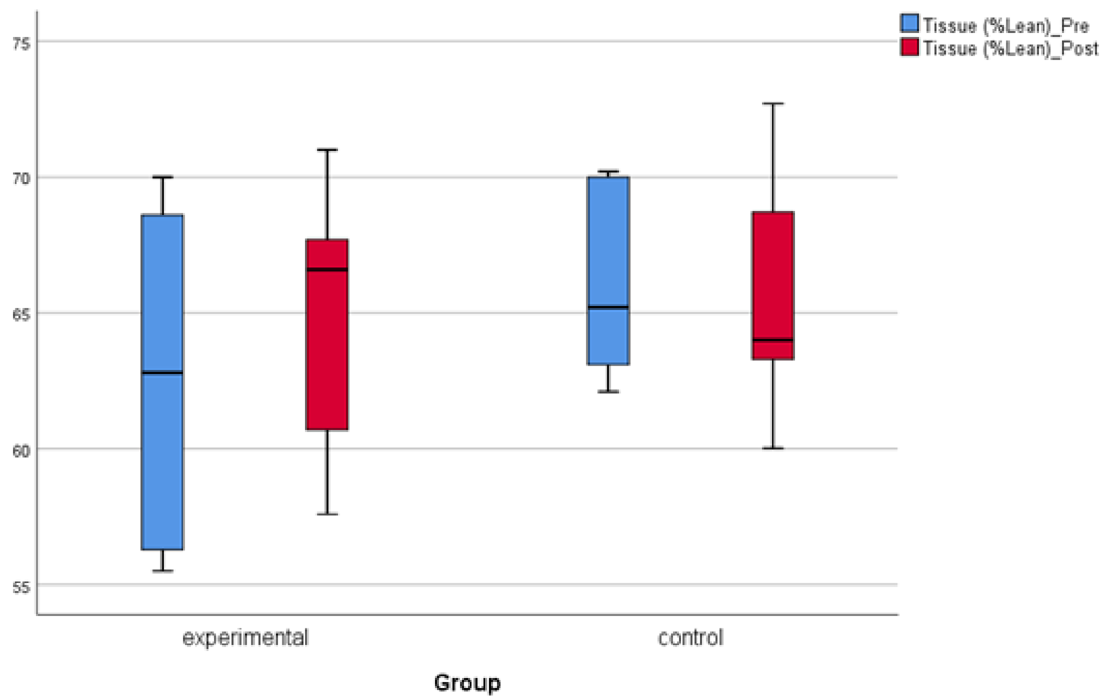


**Figure 2.** Box-Plot for Lean Tissue (%) for the Two Measurements of Body Composition for Experimental and Control Group

Boxplots for the two measurements of Fat Tissue (%) grouped by the experimental and control groups are presented in Figure 1. Repeated Measures Results for the pre and post intervention Fat Tissue (%) data, using control/experimental group as a factor between groups are presented as follows. Repeated measures ANOVA results revealed a significant difference of the depended variable Fat Tissue (%) between experimental and control groups after the intervention ($F(1)=9.111$, $p=0.017$).

Boxplots for the two measurements of Lean Tissue (%) grouped by the experimental and control groups are presented in Figure 2. Repeated measures ANOVA results revealed a non-significant difference ($p>0.05$) in the depended variable Lean Tissue (%) between experimental and control groups after the intervention (F (1) =2.671, p=0.141).

## 5. Discussion

Several studies have looked at the relationship between body composition and BMD, but the relationship between fat, muscle, and bone density has produced mixed results. Failure to recognize the presence of multicollinearity between body weight and body composition parameters can lead to inconsistent results [26,17]. While there is little research on body composition in β-Thalassemia patients [25], osteoporosis on the other hand, that mainly results from iron overload and secondary endocrinopathies disrupting molecular pathways of bone metabolism, is extensively documented [24,17].

The effects of exercise and vibration treatment on body composition in individuals with β-Thalassemia were studied in this research. The intervention group was subjected to a 12-week (3 sessions/week) fitness training program with a total of 50 minutes each session (as compared to the control group).

When comparing the data from the experimental and control groups, the results showed that the experimental group's body composition parameters improved. Using repeated measures (pre and post intervention), a dependent variable (Fat Tissue %) comparison between experimental and control groups indicated a significant difference between groups. While the dependent variable (Lean Tissue %) comparison between experimental and control groups indicated a non-significant difference between groups.

The results of this study revealed that a combination of workouts and vibration treatment improved body composition parameters in the intervention group, indicating that this sort of intervention may be utilized as a reliable strategy for improving general health in thalassemia patients.

## 6. Conclusion

In conclusion, the results of the intervention program showed a significant difference in Fat Tissue percentage between the experimental and control groups, indicating that an exercise intervention program combined with vibration therapy had a positive effect on body composition parameters in Beta Thalassemia patients.

Despite the fact that the results demonstrated a non-significant difference in Lean Tissue percentage following the exercise intervention program between the experimental and control groups, data showed a drop in Fat Tissue percentage between pre and post measures.

Other research is needed to better identify risk factors, preventative strategies, and agree on a set of specific guidelines when designing physical activity programs tailored according to the needs and health conditions of this social category. Regular physical activity, which is one of the greatest and most efficient approaches to enhance body composition parameters without resorting to medications and is suggested by physicians and field professionals, can significantly improve these patients' body composition.

## Study Limitations

First, due to the specifics of this category and the inclusion criteria, the number of patient subjects is quite limited. Second, due to the special needs of this group, long-distance facilities, and the subjects' particular financial concerns, as well as the general adverse effects of the post-transfusion period, the exercise intervention time was brief. The subjects were for the first time subjected to a body composition examination, thus there was no historical data to compare.

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