

# EFFECTS OF LOW-VOLUME HIGH-INTENSITY TRAINING ON HEALTH/FITNESS FACTORS AND GLYCEMIC CONTROL IN PRE-DIABETES AND TYPE 2 DIABETES



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## Background

- The obesity epidemic in the US and globally is highly correlated with the increased risk of developing pre-diabetes and type 2 diabetes (T2D).
- Traditional resistance training with the use of weight machines and free weights confers health benefits for individuals with T2D and sarcopenia (age-related loss of muscle mass).
- In addition to increasing muscular strength and factors related to independence, resistance training has been shown to increase lean muscle mass, decrease fat mass, and improve glycemic control.
- High-intensity training favorably modulates several T2D risk factors and clinical indicators including: glucose uptake, insulin resistance and cardiorespiratory fitness; High-intensity training may also improve capacity to perform activities of daily living and maintain independence.
- bioDensity™ is a low-volume, high-intensity mode of resistance training designed to load the skeleton up to multiples of body weight
- The novel equipment/software is being used in 200+ clinical and fitness sites internationally. Because training volume is limited to one 5-7 minute session per week, the low-volume may help overcome the often cited "lack of time" barrier to performing health promoting physical activity
- To date, the potential merit of bioDensity™ training on T2D risk factors and clinical endpoints has not been evaluated.

## Purpose

To determine whether 24 weeks of bioDensity™ training improves T2D risk factors, glucose metabolism, insulin resistance and health/fitness factors in pre-diabetics (primary prevention) and T2D patients (secondary prevention).

## Methods

**Participants:** N=8 pre-diabetic and T2D participants; free from contraindications to exercise  
**Study Design (on-going)**

- Longitudinal (pre- and post-intervention assessment)
- Measures:
  - Body composition (body mass index, waist circumference, % body fat, fat-free mass by DEXA); blood pressure
  - Senior Fitness Test; V-Balance Test, muscular strength, endurance, and power
  - Blood chemistry (glucose, insulin, HbA1c, lipids/cholesterol)

## 24-week bioDensity™ Training Intervention:

- Once per week, 4 exercises performed (5 seconds each) using maximal-voluntary contraction (MVC) with limited range of motion
  - Chest press (CP), Leg press (LP), and Vertical lift (VL) use ramping protocol (50% MVC followed by 100% MVC)
  - Core pull (CORE) uses ballistic protocol (100% MVC immediately)
- Statistical Analysis:** Paired t-tests (baseline vs. 24-week assessment)

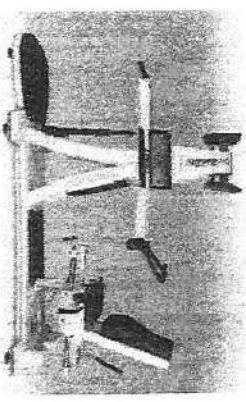


Figure 1: bioDensity™ equipment (4 exercises: 3 seated and 1 standing).  
 Intensity = once per week  
 Frequency = once per week  
 Intensity = maximal voluntary contraction  
 Time = one repetition sustained for 5 seconds  
 Type = four bioDensity™ exercises

**Table 1: Pre-diabetes and T2D participant descriptions (N=8; baseline)**

Age (years)	61.455.7
Male/Female	7/8
DM (mg/dl)	30.8/50.0
% Medication	88

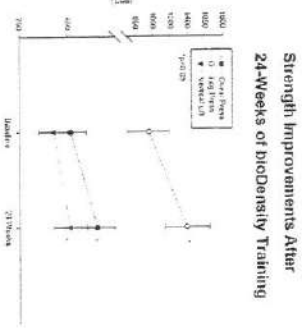


Figure 2: Force production (strength) changes from baseline to 24 weeks

## Results

**Results Summary**

- 24-weeks of bioDensity™ training resulted in:
  - Strength improvements in 3 of 4 exercises (CP, LP, and VL; Figure 2)
  - 5.9% reduction in HbA1c that is trending towards significance
  - Improved LDL levels that are trending towards significance

- With the exception of the chair stand test which is a measure of core and lower body muscular strength and endurance, the health and functional impact of 24-weeks of bioDensity™ training appears to be minimal
- The observed strength improvements may be favorably impacting balance – significant right side improvements and trending left side improvements
- Limitations: It is important to note that this study is on-going and these preliminary results are limited due to the small sample size of participants that have completed 24-weeks of training. Based on the number of participants training but have not completed 24 weeks, it is anticipated that the sample size will exceed 20 participants. Currently, 4 participants are missing fasting insulin results preventing a representative determination of insulin resistance.

## Conclusions

- From the 8 participants that have completed 24 weeks of bioDensity™ training, the strength and HbA1c results are encouraging.
- The bioDensity™ Training, low volume, high intensity, protocol may be a valuable exercise intervention for older adults at risk or diagnosed with pre-diabetes/T2D.
- It is hypothesized that as the study progresses, there will be greater statistical support to justify these claims, as well as give greater indication on the effects of bioDensity™ training on T2D risk factors, glucose metabolism, insulin resistance, and health/fitness factors in pre-diabetic and T2D patients.

Table 2: Pre-diabetic and T2D variables (values over 24 Weeks of bioDensity™ Training Intervention (N=8)\* indicated significant P-value to 500.00)

Variable	Baseline Mean±SD	24 Week Mean±SD	P-value
Pre Pre Mass (kg)	52.4±3.8	51.4±5.4	0.08
% Body Fat (BF)	43.8±1.4	38.6±1.1	0.06
% Body Fat (BF)	41.2±1.5	41.5±1.1	0.05
Waist Circum. (W)	105.0±14.33	101.26±13.83	0.39
HDL	40.60±1.98	30.58±1.96	0.65
Triglycerides	124.53±1.989	128.01±1.562	0.64
HbA1c	6.8±0.3	6.4±0.3	0.06
10g glycerides	101±15	107±91	0.86
HDL	98±7	97±7	0.90
LDL	46±15	47±15	0.87
LDL (mg/dl)	121±11	115±11	0.07
Arm Circ	18.11	20.21	0.11
2 Min Stand Test	961.9	812.90	0.02
8x8 Chair Stand	1.60±1.022	0.75±1.084	0.24
8 Feet Up & Gg	6.08±0.55	6.10±0.64	0.98
8 Feet Sit/Stand	132.8±3.0	9.91±2.3	0.05*
% Balance	25.5	25.5	0.52
% Balance (Composite)	21.6	24.5	0.66
% Balance (1-Quartile)	40.6±5.9	55.0±5.0	0.04
% Balance (2-Quartile)	47.0±7.8	54.0±5.9	0.17