EFFECTS OF LOW-VOLUME HIGH-INTENSITY STRENGTH 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 in individuals with T2D and sacropenia (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 , Y-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 (MCV) 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)

Results

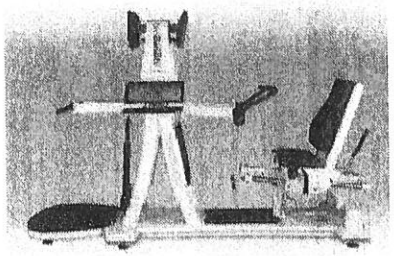

Figure 1: bioDensity equipment (4 exercises: 3 seated and 1 standing).
Intervention:
Frequency = once per week
Intensity = maximal-voluntary contraction
Time = one repetition sustained for 5 seconds
Type = four bioDensity™ exercises

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

Males/Females	3/5
Age (years)	61.4±5.7
BMI (kg/m²)	30.8±5.6
% Medicated	88

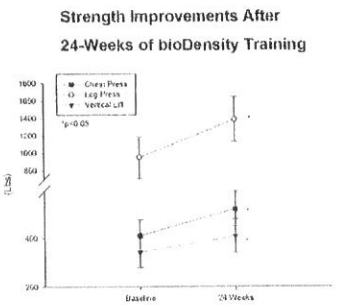

Figure 2: Force production (strength) changes from baseline to 24 weeks

Table 2: Pre-diabetics and T2D variable(s) values over 24 Weeks of bioDensity™ Training Intervention (N=8)(* indicated significant P-value (p≤0.05))

Variable(s)	Baseline Mean±SEM	24 Weeks Mean±SEM	P-Value
Fat Free Mass (FFM)	52.5±5.8	51.6±5.4	0.06
% Lean Mass (LM)	49.8±3.0	50.6±3.4	0.06
% Body Fat (BF)	41.2±3.5	41.5±3.1	0.06
Waist Circum. (WC)	105.03±4.31	104.36±3.89	0.39
BMI	30.80±1.98	30.96±1.96	0.65
Fasting Glucose	124.5±15.999	128.8±15.42	0.44
HbA1c	6.8±0.3	6.4±0.3	0.06
Total Cholesterol	174±9	170±11	0.85
Triglycerides	161±16	176±31	0.56
LDL	98±7	92±7	0.09
HDL	46±5	47±5	0.67
30 sec Chair Stands	12±1	14±1	0.02*
Arm Curl	18±1	20±1	0.13
2 Min Step Test	96±9	87±9	0.12
Sit & Reach (cm)	-1.63±3.922	-0.75±3.984	0.74
# Foot Up & Go	6.49±0.52	6.19±0.41	0.36
Floor to Stand	5.19±1.36	4.40±0.66	0.29
Back Scratch Stretch (cm)	12.8±3.0	9.9±2.2	0.05*
# Pushups	26±6	25±6	0.52
# Sit-ups	7±6	9±3	0.46
Y-Balance (Rt. Composite)	48.6±5.5	55.0±6.0	0.04
Y-Balance (Lt. Composite)	47.5±4.8	54.8±5.9	0.14

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 hypothesize 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.