Improved Functional Independence, Balance, And Force Production With Low-volume, Alternative Training In Older Adults

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Background

- ***20%*** of today's population is ***aged 60 or older*** in developed countries; this is expected to rise to 32% by 2050.
- Age-related r***eductions in strength, balance, and functional independence diminish quality of life*** & ***increase healthcare costs.***
- Traditional ***resistance training (RT)*** has well-documented ***health, quality of life, and healthcare cost benefits***
- High-intensity RT has garnered attention as a time-efficient and health-promoting mode of physical exercise.
- ***bioDensity™ (bD)*** is a relatively new ***high-intensity, low-volume*** approach to ***RT*** that may present a safe and efficacious alternative to traditional RT for older adults.
- ***Whole-body vibration (WBV),*** has also been shown to ***improve balance, mobility, and fall prevention in older adults.***
- bD training, WBV, or the combination may improve strength, balance, and functional independence in older adults in a more time-efficient approach than traditional RT.

Purpose

To assess the efficacy of bD training, WBV training, or their combination on strength, balance, and functional independence in older adults who complete 12 weeks of training.

Methods

- 12-week randomized control trial
- Participants: 65-90 years residing in two assisted-living centers; free from uncontrolled cardiometabolic, respiratory, and neurologic disease, osteoporosis, and acute illness/injury
- 4 experimental groups: control; bD (bD training only); PP (PP training only); bD+PP (bD and PP training combined)
- Control group: instructed to maintain existing lifestyle
- bioDensity™ training:
  - One 5-sec maximal-voluntary effort once per week for each of the 4 exercises: Chest Press (CP), Leg Press (LP), Core and Arm Pull (Core Pull), Vertical Lift (VL)
- PowerPlate Training:
  - Two sessions per week: in a static, semi-squatted position, lifted one foot then the other for 60 seconds (repeated 3 times), 60 seconds rest between rounds, for a total time of 5 minutes
  - First two weeks, PP set at 30 Hz with 1 mm amplitude, then increased to 2 mm amplitude
  - For combined bD+PP group, PP session completed after the weekly bD training session
- Strength and balance assessed at baseline and after 6 and 12 weeks of assigned group conditions
- Functional Independence (FIM) assessed at baseline and after 12 weeks of assigned group conditions; 1-7 Likert scale with 1 = complete dependence and 7 = complete independence.
- Data were analyzed by a 2x2 (group x time) repeated measures ANOVA with Bonferroni *t*-test post hoc analyses
- Data are means±S.D. or S.E.M. * $P<0.05$

Results

bioDensity™ Training

- ***4 exercises: CP, LP, CORE, and VL performed in series***
- 2-familiarization sessions were employed for all participants
- *Session 1:* introduced to equipment; performed 3 practice trials of each exercise with gradually increasing intensity
- *Session 2:* 1 week later, performed exercises at moderate-to-high effort, after which exercises were performed to maximal voluntary effort to determine baseline strength

Table 1. Participant descriptive characteristics by group (control, bD, PP, & bD+PP) and by sex (N=60)

	Group				Sex		Between Group *P*-value	Between Sex *P*-value
	bD (N=16)	bD + PP (N=17)	PP (N=13)	Control (N=14)	Females (N=36)	Males (N=24)		
Age (years)	80.5±6.2	83.4±5.0	82.2±5.0	81.7±5.7	81.0±5.7	83.4±4.1	0.5	0.08
BMI (kg/m²)	24.3±3.3	26.2±3.6	26.2±3.6	27.2±6.1	25.2±4.4	27.0±3.8	0.3	0.1
Weight (kg)	66.8±6.8	74.5±6.7	75.4±7.8	72.3±7.4	65.6±3.8	82.1±4.6	0.07	<0.01
SBP (mmHg)	134±11	130±15	131±10	132±15	132±12	132±14	0.8	0.9
DBP (mmHg)	73±8	67±8	74±9	74±7	72±9	71±8	0.06	0.8
RHR (bpm)	69±7	69±9	71±11	72±7	71±8	69±8	0.7	0.4

Power Plate™

Figure 1. Force Production and Percent Change at Baseline, 6 and 12 weeks for bioDensity™ exercises (CP, LP & VL).

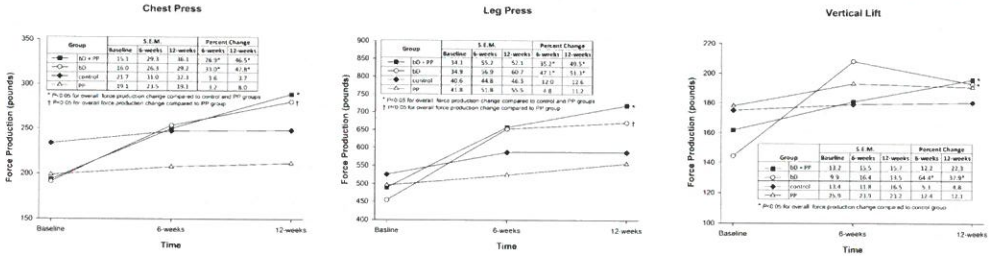
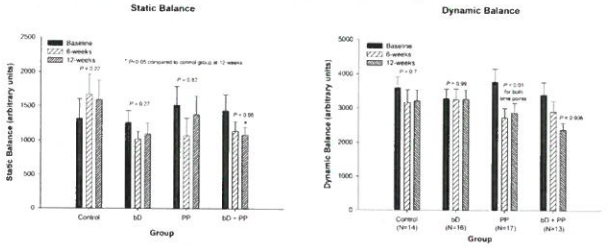


Figure 2. Static and dynamic balance at baseline, 6 and 12 weeks.



Functional Independence Measure (FIM) Results (baseline and 12 weeks):

- FIM has 4 subcomponents: self-care, mobility, communication, & social cognition
  - At baseline, groups were similar in all 4 subcomponent scores ($P>0.05$)
- Group x time interactions were significant for self-care ($F=4.33$; $P<0.01$) & mobility ($F=6.15$; $P<0.05$)
  - bD, PP, and bD+PP differentially improved self-care and mobility FIM subcomponents
  - Self-care Improvement → bD, PP, and bD+PP groups improved self-care; bD+PP > control; bD+PP ≠ bD or PP
  - Mobility Improvement → bD, PP, and bD+PP groups improved mobility; bD and bD+PP > control; PP > control at 12 weeks but change within PP group from baseline to 12 weeks was not significant

Conclusions

- Interventions that favorably impact physical strength, balance, & functional independence of older adults may have significant value at the individual & societal levels (e.g., healthcare costs).
- Low-volume training, 1-2 times per week (< 12 minutes) , with bD, PP, or bD+PP differentially yield clinically and individually meaningful improvements in muscular strength, balance, and functional independence in older adults.
- High-intensity bD training was well tolerated by older adults – no reported injuries with any of the training interventions.
- Improvements in static & dynamic balance & strength observed with training indicate that two primary factors for falling & fall-related fractures were favorably modified in 12 weeks. The CDC reports that the 2013 direct medical costs of older adult falls were $34 billion.
- The direct economic impact of bD, PP, & combination training is unknown but likely to be significant in context of improved functional independence & fall risk reduction. These encouraging findings warrant replication and future investigation.