



bioDensity™ Methodology: Use and quantification of baseline force production

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Background

- Traditional **resistance training (RT)** using free weights or cable-pulley machines has well-documented **sport-performance and health-promotion benefits**
 - e.g., prevention/attenuation of osteoporosis and sarcopenia, reduced fall risk, lower premature morbidity/mortality rates.
- bioDensity™ is a new (2009) form of high-intensity, low-volume RT** that may overcome the often cited “lack of time” barrier to adopting and adhering to a RT program.
- Traditional RT typically requires 2-3 sessions per week of 6-10 different exercises in which 2-3 sets of 8-12 repetitions are performed (**40-60 minutes**).
- bioDensity™ uses proprietary technologies (machine and software) to elicit near **total body maximal musculoskeletal loading** with only 4 exercises that can be completed in **~5 minutes**.
- To date, the recommended use and bioDensity™ training approach **has not been described or empirically evaluated**.
- Additionally, **familiarization and learning effects** in users who begin training with bioDensity™ have **not been investigated**. Learning effects may influence accurate quantification of bioDensity™ measured baseline strength.

Purpose

To describe the bioDensity™ methodology/approach and establish a procedure to quantify baseline strength that accounts for learning effect and sex differences.

Methods

Description of bioDensity™ methodology and approach

- See results section for details

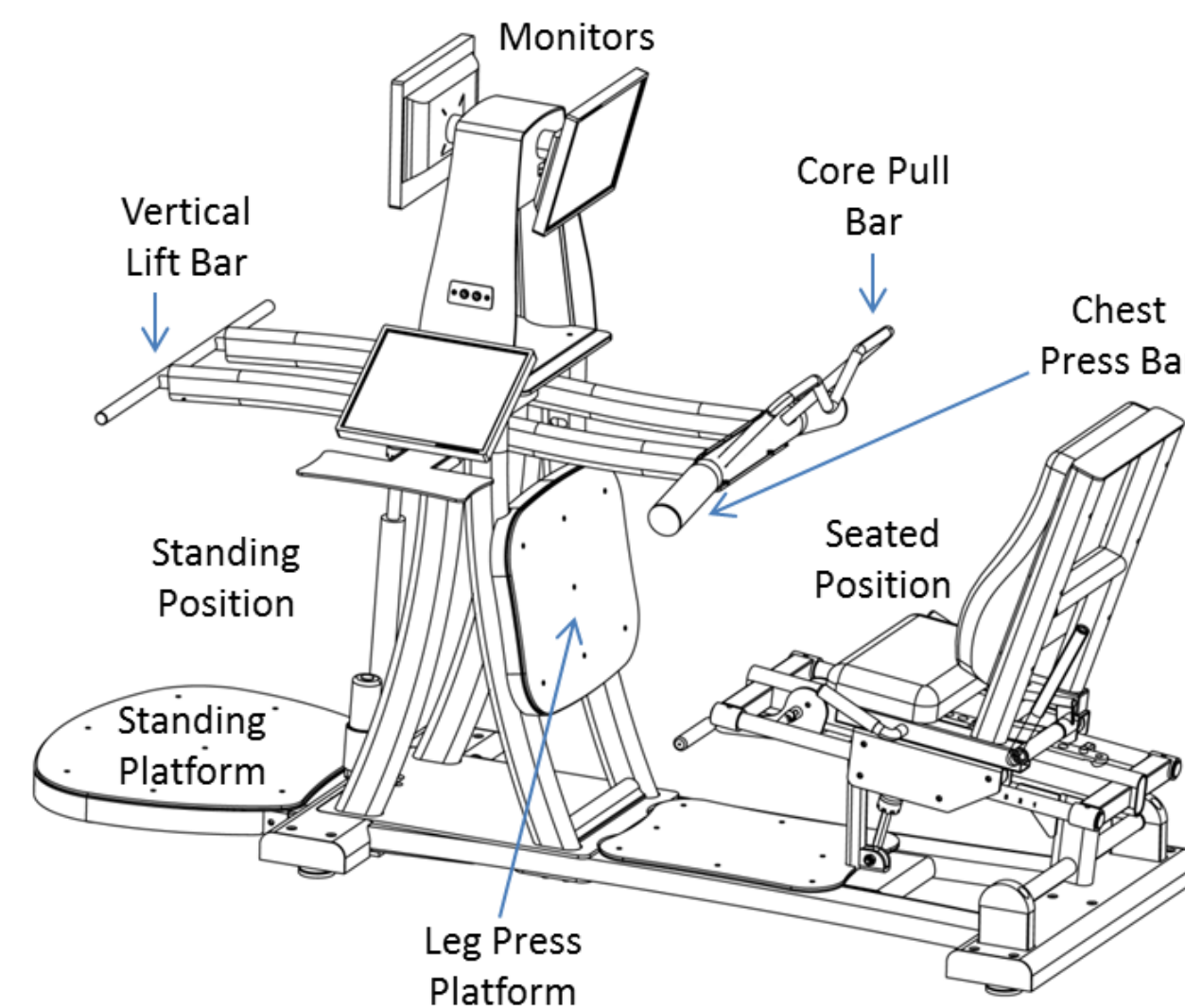
Quantification of baseline bioDensity™ strength that accounts for sex-differences in learning effect:

- Cross-sectional analyses of bioDensity™ data from 1,685 men (47.4±18.8 yrs) and 2,689 women (53.9±16.6 yrs)
- All participants completed at least 4 bioDensity™ sessions (1x/week) that included 4 different exercises
- Data was evaluated for learning effects, total force production (muscular strength), and sex differences
- Cessation of learning was assumed:**
 - When a plateau in force production (strength) occurred between repeat bioDensity™ sessions for all four exercises; or
 - When change in force production between repeat sessions was 5% or less.
- Data were analyzed by two-way repeated measures ANOVA (session x sex). * P<0.05

Results

bioDensity™ Equipment and Approach

- 4 limited-range exercises** performed **once per week** with direct supervision
- 3 seated exercises: **Chest Press (CP)**, **Leg Press (LP)**, **Core Pull (Core)**
- 1 standing exercise: **Vertical Lift (VL)**
- Exercises activate **multiple** large and small skeletal **muscle groups** across **multiple joints** → near total body musculoskeletal loading
- 5-second maximal-voluntary contraction** for each exercise
- CP, LP, VL** employ **ramping neuromuscular activation** protocol → progressively increase/ramp force application to submaximal level, inhale deeply, then **immediately apply maximal force** while exhaling
- Core** performed using **ballistic neuromuscular activation** protocol → inhale deeply, then **exert maximal force** from start of exercise while exhaling



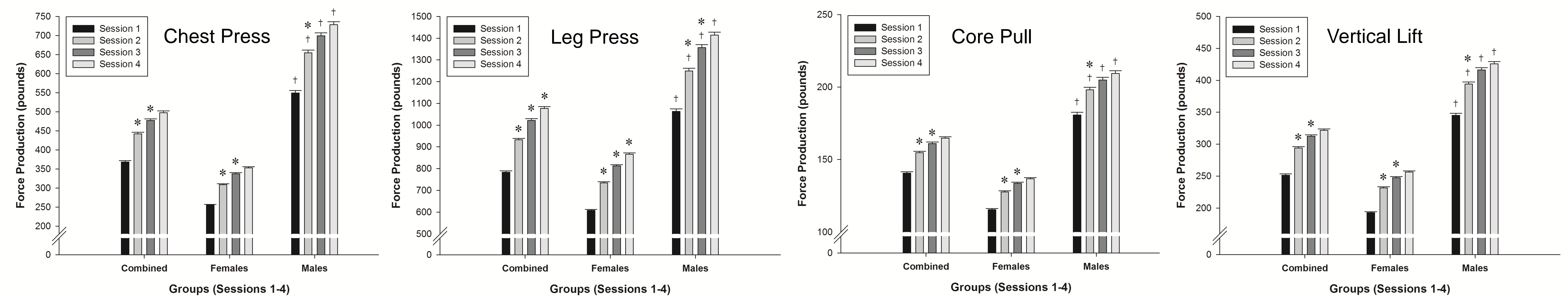
Exercise	Session Level	Males	Females	Males	Females
		Mean % Change	Mean % Change	Median % Change	Median % Change
Chest Press (CP)	1-2	14.7±32.7	15.1±29.9	15.3 (5.7;26.2)	15.4 (5.4;27.9)
	2-3	1.9±62.5	6.7±25.3*	6.7 (-0.29;14.3)	8.0 (0.0;16.1)*
	3-4	-1.5±68.5	2.2±28.2	3.9 (-1.8;10.4)	4.16 (-3.2;11.8)
Leg Press (LP)	1-2	13.5±26.8	15.2±21.3*	14.0 (6.0;23.5)	15.5 (7.1;24.9)*
	2-3	5.5±32.4	8.5±19.5*	7.7 (1.5;14.6)	9.3 (2.9;15.9)*
	3-4	-0.8±56.6	5.2±19.6*	5.1 (-0.1;10.5)	6.1 (0.2;12.3)*
Core Pull (Core)	1-2	4.0±49.0	6.2±32.2	8.2 (-2.2;19.8)	8.4 (-2.0;20.5)
	2-3	-1.2±44.2	2.0±28.3	3.6 (-5.6;12.6)	3.8 (-5.0;13.0)
	3-4	-3.6±52.3	-0.7±30.8	2.5 (-6.4;11.4)	2.4 (-6.5;10.8)
Vertical Lift (VL)	1-2	6.0±109.1	13.6±41.2*	12.7 (3.6;22.8)	15.7 (5.4;28.0)*
	2-3	-0.2±69.3	2.4±50.2*	5.0 (-1.8;11.4)	6.4 (-0.9;15.0)*
	3-4	-3.9±107.3	-2.4±60.8*	3.2 (-3.3;9.3)	3.8 (-3.1;10.9)*

Light Grey: represents diminishment of learning effect approaching or less than 5% change between sessions. * P<0.05 compared to males. Mean ± S.D. and Median (25% and 75% C.I.'s)

Additional Results

- As anticipated, men had greater absolute strength in all four exercises
- For the CP, Core, and VL in men, learning effect subsided/plateaued between sessions 2 and 3 (P≥0.05)
- In women, the learning effect plateaued between sessions 3 and 4 for CP, Core, and VL (P≥0.05)
- Maximal LP force production plateaued between exercise sessions 3 and 4 (5.1% change) in men but not in women (session 2-3 = 9.3% change vs. sessions 3-4 = 6.1% change; P<0.001).

Force production changes across four bioDensity™ sessions in males, females, and combined sample. † P<0.05 compared to females for the same training session. * P<0.05 compared to the previous session within group (combined; females only; males only). Mean±S.E.M.



Conclusions

- bioDensity™ is currently in 154 national and 9 international locations with a 200% increase in installations over the past 24 months. With this increasing use and application, it is critical that this novel RT methodology be accurately reported to the clinical/scientific communities to support future validation.
- Our findings suggest that force production generated during the third bioDensity™ session is generally representative of baseline strength in males and females across a wide age continuum.
- In women, baseline strength accuracy is increased with a fourth LP session.

