COMPARISON OF BESS, BIODEX BALANCE SYSTEM SD, AND SWAY BALANCE APP

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BACKGROUND AND PURPOSE

- Balance is an essential component to both static and dynamic movements
  - Deficits in balance have been noted in patients who suffer mild-traumatic brain injury/concussion[1]
- Assessment of balance is needed for a thorough functional assessment
  - Both objective and subjective balance assessment tests have been developed over the past several years[1]
  - Balance Error Scoring System (BESS) Test, Biodex Balance SD™ (BBS), and Sway Balance App (SBA) are three such assessment platforms
- A correlation study comparing SBA to BESS has been done,[2] but not for comparing SBA to BBS
  - Pearson r for SBA to BESS (r = – 0.787, $p < 0.01$) [2]
- No correlational studies comparing BESS to BBS were found in the literature
- A pair of concurrent validity studies comparing SBA to BBS have been done, but no validity studies for SBA & BESS
  - No statistical difference between the SBA & BBS devices on a firm surface ($p > 0.05$) [3] indicating validity
  - Statistical difference found standing on a foam surface ($p < 0.05$) [3]
  - No statistical difference using a single leg stance among SBA & BBS devices ($p = 0.818$) [4] indicating validity
- The purpose of our study was to determine if a relationship exists between BESS, BBS, and SBA

PARTICIPANT CHARACTERISTICS

- Our subjects were physically-active, college-age, volunteer students
- Exclusion criterion included anyone who had suffered a lower extremity, musculoskeletal injury in the past 6 months
- Provider contact information:
  - Airex (BESS Foam Pads), Industrie Nord 26, CH-5643 Sins, Switzerland; https://www.my-airex.com/en
  - Biodex Balance System SD, 20 Ramsey Road, Shirley, NY 11967-4704; 1-800-224-6339; http://www.biodex.com/physical-medicine/products/balance/balance-system-sd
  - Sway Medical LLC, 10026-A S Mingo Rd #180, Tulsa, OK 74133; 612-888-7929; http://swaymedical.com/system/balance

Table 1. Subject demographics

	Age	Height (cm)	Weight (kg)
All subjects (N = 21)	20.7 ± 2.1	171.12 ± 11.46	68.6 ± 11.33
Males (n = 9)	20.33 ± 1.41	181.19 ± 9.01	76.86 ± 11.03
Females (n = 12)	20.75 ± 2.60	163.62 ± 5.88	62.41 ± 6.88

METHODS

- Groups of 3 subjects were assessed simultaneously, randomly assigned the order for each balance platform
  - For the BBS, participants were tested in Clinical Test of Sensory Integration of Balance mode (Figure 1)
    - Subjects' were tested in a bilateral stance, 4 ways: on firm & foam surfaces, with eyes open & eyes closed
    - Each test position was performed for 30 seconds
  - For the BESS, standard assessment procedures were followed as per David Bell[4] (Figure 2)
    - Three stances on two different surfaces with eyes closed, attempting to hold set position for 20 seconds
      - Stances: bilateral, single leg, and tandem (standing heel-toe)
      - Surfaces: firm and foam
    - The number of errors committed by the subject in a balance position was recorded
  - For the SBA, a mobile device, (iPhone 5s) was held by the subject at their chest while balancing (Figure 3)
    - Stances, surfaces and eyes open/closed were done as per BBS above
    - Stances, surfaces and eyes closed were done on firm & foam surfaces as done for BB & on a firm surface as per BESS stances were performed
- The BBS and SBA were scored by each unit, measuring the a subject's postural sway
  - Each unit graded on a different numerical scale:
    - BBS scale 0 (perfect balance) to 4 (poor balance)
    - SBA scale 100 (perfect balance to 0 (no balance)
- The BESS was scored by the number of errors the subject committed while in the specified stances
- Balance scores were then converted to z-score for standardization & correlations were run with like stances
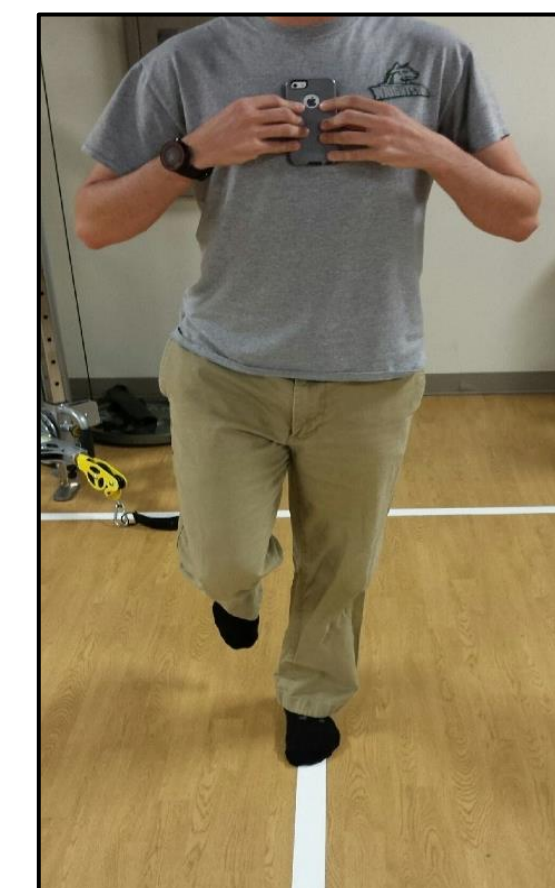
Figure 1. Biodex Balance System

Figure 2. BESS stance

Figure 3. Sway Balance App

RESULTS

- There were no significant correlations between any of the three balance assessment tools
- Pearson r correlation statistics were run on the balance assessment tools (Tables 2-4; Figures 4-6)
- There were no statistically significant results found with these subjects, in these circumstances

Table 2, Figure 4: Sway vs. BESS
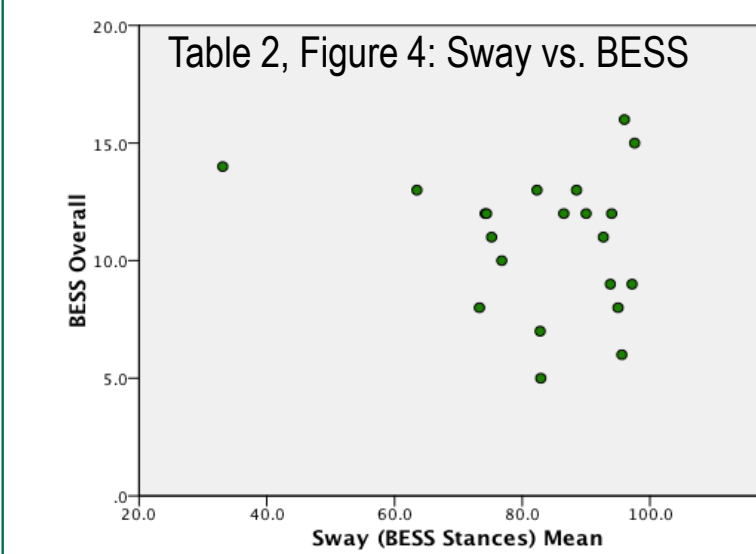
	Mean (sd)	r (z-scores)
SBA	83.1 (± 15.0)	-0.19
BESS	10.9 (± 2.9)	

Table 3, Figure 5: Sway vs. BBS
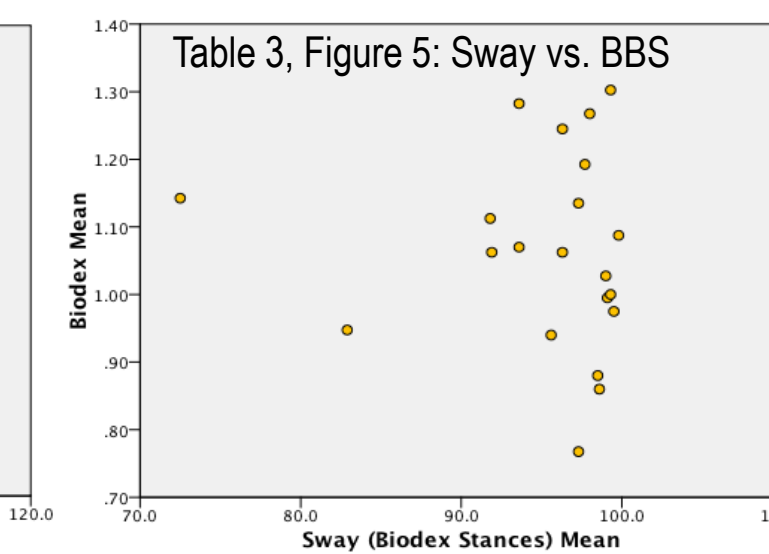
	Mean (sd)	r (z-scores)
BBS	1.1 (± 0.14)	-0.08
SBA	95.1 (± 6.50)	

Table 4, Figure 6: BBS vs. BESS
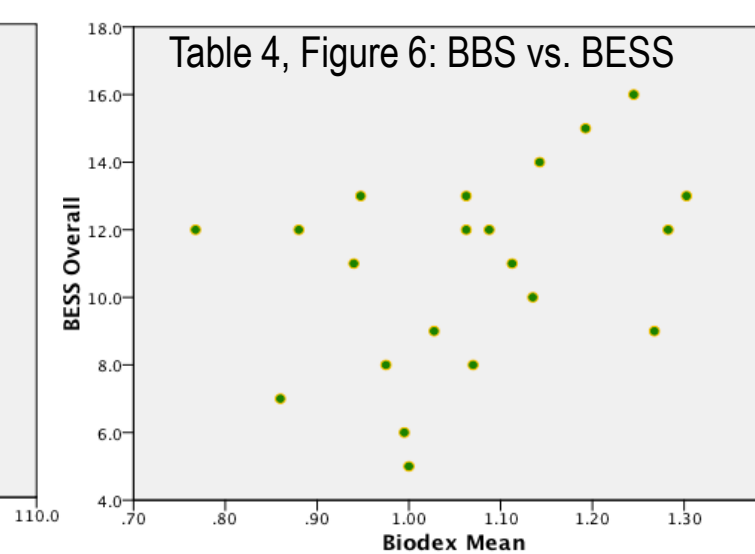
	Mean (sd)	r (z-scores)
BBS	1.1 (± 0.14)	-0.08
BESS	10.9 (± 2.9)	

EVIDENCE-BASED RECOMMENDATIONS / CLINICAL RELEVANCE

- No correlation was found between the systems
  - Despite no statistically significant results, each of these tools can be used to assess balance effectively
- Recommendations for further research might include:
  - Repeating the research with a larger and more diverse sample
  - Simultaneous testing of SBA with the BESS and BBS tools for more accurate comparison
  - Use the same foam pad for all three tests to eliminate differences between the density of the foam
    - Repeat the study using the each of the 2 types of foam pads (BBS vs BESS) to determine relationships

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4. Patterson J A, Amick RZ, Thummar T, Rogers ME. Validation of Measures from the Smartphone Sway Balance Application: A Pilot Study. *Int J Sports Phys Ther.* 2014;9(2):135-139.
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