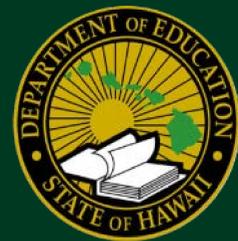




# Balance Error Scoring System Baseline Values Differ with Age but not Gender in High School Athletes



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## Context

Assessment of postural stability is an important part of concussion evaluation and a comprehensive concussion management program (CMP). Baseline values for balance testing are an important piece of data when making return to participation (RTP) decisions, and may not always be available. Using age and gender-specific norms may be useful in cases where no baseline data exist. Age-stratified normative values for the Balance Error Scoring System (BESS) for high school athletes have not been previously reported.

## Objective

To determine differences in age and to provide normative values for BESS baseline scores in healthy high school athletes.

## Design

Retrospective cross-sectional study.

## Setting

Controlled environment free of external stimuli in 28 participating high schools. Starting in 2010, baseline concussion testing was implemented by a statewide CMP led by a contingent of athletic trainers funded by the State of Hawaii Department of Health.

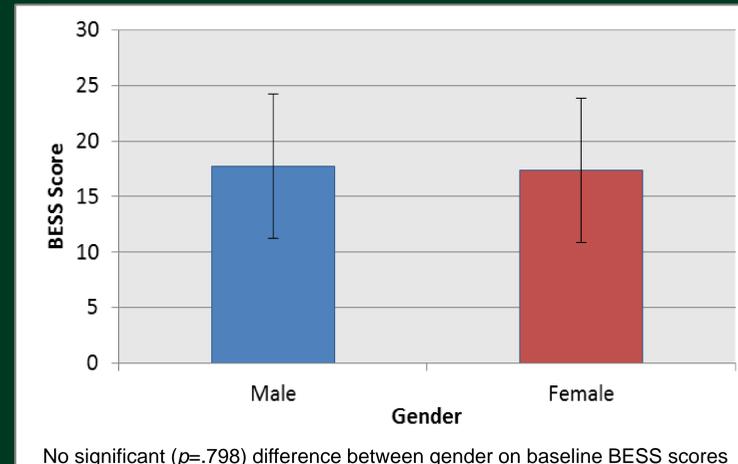
## Participants

De-identified data from baseline BESS tests from school year 2010-2011 for 2,825 [age=15.5±1.2 years old (y/o), females (F) n=979, males (M) n=1,846] high school athletes free of injury and not currently in a balance or postural stability training program.

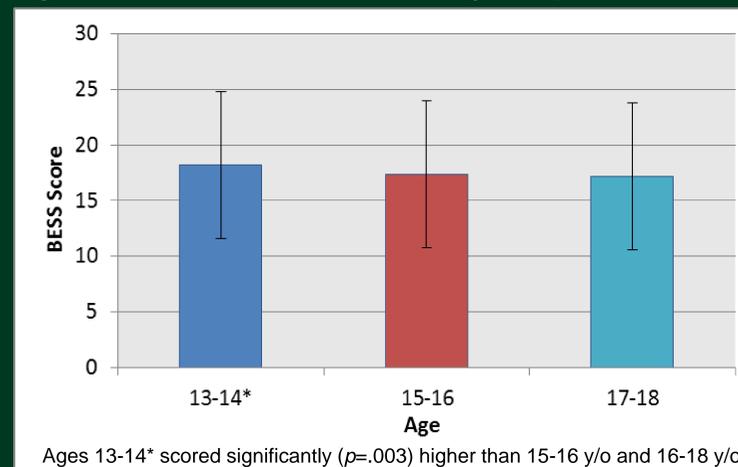
**Table 1.** Participant Distribution

Age Group	Male	Female	Total
13-14 y/o	533	318	851
15-16 y/o	992	534	1526
17-18 y/o	321	127	448
Total	1846	979	2825

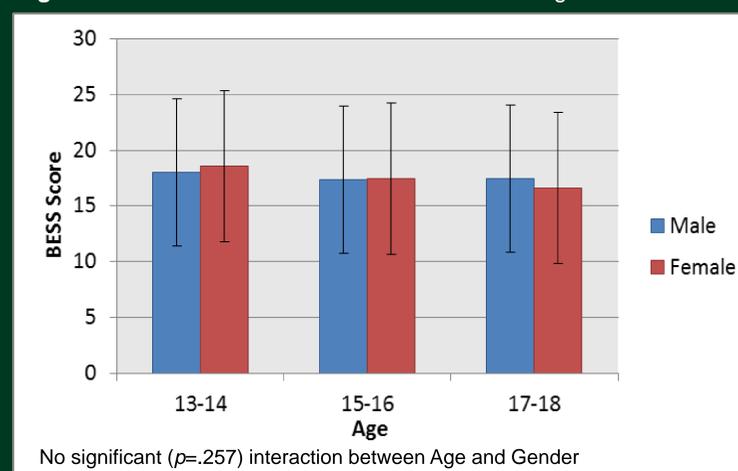
**Figure 1.** BESS baseline scores for Males and Females



**Figure 2.** BESS Baseline Scores across Age Groups



**Figure 3.** Male and Female BESS Scores across age



## Interventions

Baseline BESS testing for all contact sport athletes was administered in a setting of 8 participants per group. Baseline BESS scores were video recorded and scored by two athletic trainers (intratester reliability=.87) prior to the competitive season.

## Main Outcome Measures

Total error score on the BESS was compared using univariate analysis of variance on gender (M, F) and three age groups (13-14y/o n=851, 15-16y/o n=1,526, and 17-18y/o n=448). Mean, standard deviation (SD), and 95% confidence intervals were reported.

## Results

No significant ( $F_1=.066$ ,  $p=.798$ , power=.058) differences in baseline BESS scores were found between males ( $17.55 \pm 6.60$ , CI=17.26-17.93) and females ( $17.68 \pm 6.79$ , CI=17.02-18.01) (Figure 1). Significantly ( $F_2=5.874$ ,  $p=.003$ ) higher baseline BESS scores were found for 13-14y/o ( $18.19 \pm 6.60$ , CI=17.73-18.72) compared to 15-16y/o ( $17.37 \pm 6.65$ , CI=17.04-17.74) and 17-18y/o ( $17.22 \pm 6.76$ , CI=16.34-17.71) (Figure 2). No significant ( $F_3=1.361$ ,  $p=.257$ ) interaction between male and female BESS scores across age groups (Figure 3).

## Conclusions

In our substantial sample of high school athletes, we found no gender differences and that younger athletes (13-14y/o) committed more errors than older athletes. These findings support the recommendation that baseline BESS scores be obtained every two years during high school matriculation<sup>3,4</sup>. Regardless of gender, for the majority of high school athletes in this sample, baseline BESS values were similar for older (15-18 y/o) high school athletes, indicating that the BESS was a robust balance test in this setting. In cases where no baseline exists, normative data may help health care providers interpret a normal baseline range of BESS scores for high school athletes or when determining if baseline scores seem reasonably valid.

## References

- Riach CL, Hayes KC. Maturation of postural sway in young children. *Dev Med Child Neurol.* 1987;29:650-658.
- Valovich McLeod TC, Barr WB, McCrea M, Guskiewicz KM. Psychometric and measurement properties of concussion assessment tools in youth sports. *J Athl Train.* 2006;41(4):399-408.