Relationship between balance confidence and dynamic computerized posturography

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ABSTRACT

One of the greatest threats to the physical and psychological health of the growing geriatric population in the United States is the occurrence of a fall. The development of valid and reliable, cost-effective tool used to predict fall risk is warranted. Currently, the Balance Efficacy Scale (BES) is used to measure an individual's perception of their balance confidence. How this BES relates to a performance-based measure, e.g., the Sensory Organizational Test (SOT), remains unclear. The purpose of this study was to examine the relationship between balance confidence, as measured by the BES, and performance on the SOT as measured by the composite SOT score. 51 subjects, 16 male and 35 female with a mean age of 74 ($\pm$ 6) years volunteered to participate in the Center For Healthy Living and Longevity (CHLL) fall prevention program at the University of Texas at Arlington. As part of an initial evaluation at the beginning of the program, participants completed the BES questionnaire and underwent a 6 condition SOT test. Pearson Product Correlation Coefficient between SOT and BES was determined for all subjects. Comparisons between High-SOT (SOT $\geq$ 70) and Low-SOT (SOT$\leq$69) groups were made using unpaired t-tests. Multiple regression analysis (stepwise backward elimination) was utilized to predict SOT scores using a variety of independent variables. There was a moderate correlation between SOT and BES scores in all subjects (R = 0.49). In addition, the High-SOT group had greater BES scores (89.9$\pm$10.7) than the Low-SOT group (71.5$\pm$23.2, p < 0.001). Multiple regression analysis resulted in the prediction of SOT from a linear combination of the BES, ht, wt and BMI (R^2 = 0.34, p<0.001). While there appears to be a relationship between balance confidence (BES) and performance-based indices of postural control (SOT), the predictive power of such a tool is strengthened following the incorporation of other individual anthropometric characteristics. Future studies are warranted to refine the ability to assess and predict fall risk in older adults.

PURPOSE

The purpose of this study was to examine the relationship between balance confidence, as measured by the BES, and performance on the SOT as measured by the composite SOT score.

INTRODUCTION

One of the greatest threats to the physical and psychological health of the growing geriatric population in the United States is the occurrence of a fall. The development of valid and reliable, cost-effective tool used to predict fall risk is warranted. Currently, the Balance Efficacy Scale (BES) is used to measure an individual's perception of their balance confidence. How this BES relates to a performance-based measure, e.g., the Sensory Organizational Test (SOT), remains unclear.

METHODS

Participants
51 subjects over age 65

Measurements
• Sensory Organization Testing (SOT) - NeuroCom
• Balance Efficacy Scale (BES)
• Age (yrs), Height (cm), Weight (kg), BMI (kg/m^2)

Sensory Organizational Test
• Six conditions testing participants use of visual, vestibular and somatosensory information
• Each condition tested 3 times with 20 seconds rest between condition
• Six condition repeated with visual (video of roller coaster), audio (street and traffic noise), and cognitive (Stroop test) distractors
• SOT composite score used for analyses

Balance Efficacy Scale (BES)
18 question psychometric assessment of balance confidence (California State University at Fullerton's Center for Successful Aging)

Protocol
• Visit 1: Subject characteristics recorded and BES taken followed by SOT procedures (Table 1)

Data analysis
Relationship between SOT and BES for all subjects (n = 51). Relationship between SOT and BES for subjects assigned to High SOT ($\geq$70) and Low SOT groups ($\leq$69).

Statistical analysis
Unpaired t-test used for Low-SOT and High-SOT comparisons. Pearson Correlation between SOT composite and BES for all subjects. Backward step-wise elimination multiple regression analysis (dependent variable=SOT; independent variables=Age, Ht, Wt, BMI, BES). α = 0.05

RESULTS

Table 1. Subject Characteristics

	All Subjects	Low-SOT	High-SOT	P value
Age, $_{yr}$	74 $\pm$ 6	75 $\pm$ 23	72. 7 $\pm$ 7	0.23
Height, $_{cm}$	168.3 $\pm$ 8.3	167.4 $\pm$ 5	169.2 $\pm$ 7.5	0.45
Weight, $_{kg}$	78.4 $\pm$ 17.5	84.1 $\pm$ 20.2	72.4 $\pm$ 11.5	0.02
BMI, $_{kg/m^2}$	27.6 $\pm$ 5.4	29.9 $\pm$ 6.1	25.2 $\pm$ 3.2	<0.01
BES	80.5 $\pm$ 20.3	71.5 $\pm$ 32.2	89.9 $\pm$ 10.7	<0.01
SOT, $_{Composite}$	66.9 $\pm$ 5.4	58.9 $\pm$ 7.9	75.2 $\pm$ 3.3	<0.01

BMI, Body Mass Index; BES, Balance Efficacy Scale; SOT, Sensory Organization Testing. P value for Low-SOT vs High-SOT t-tests
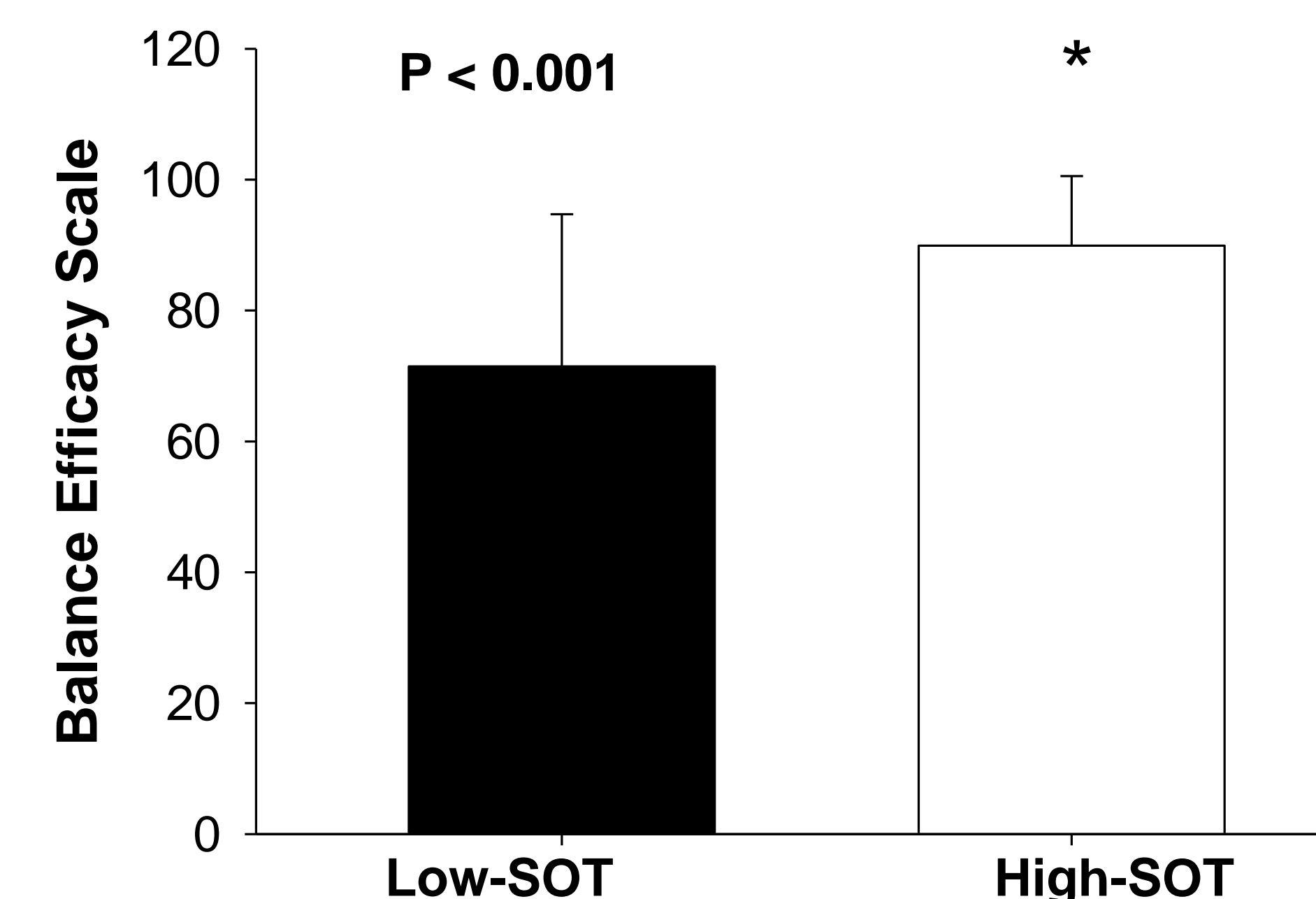

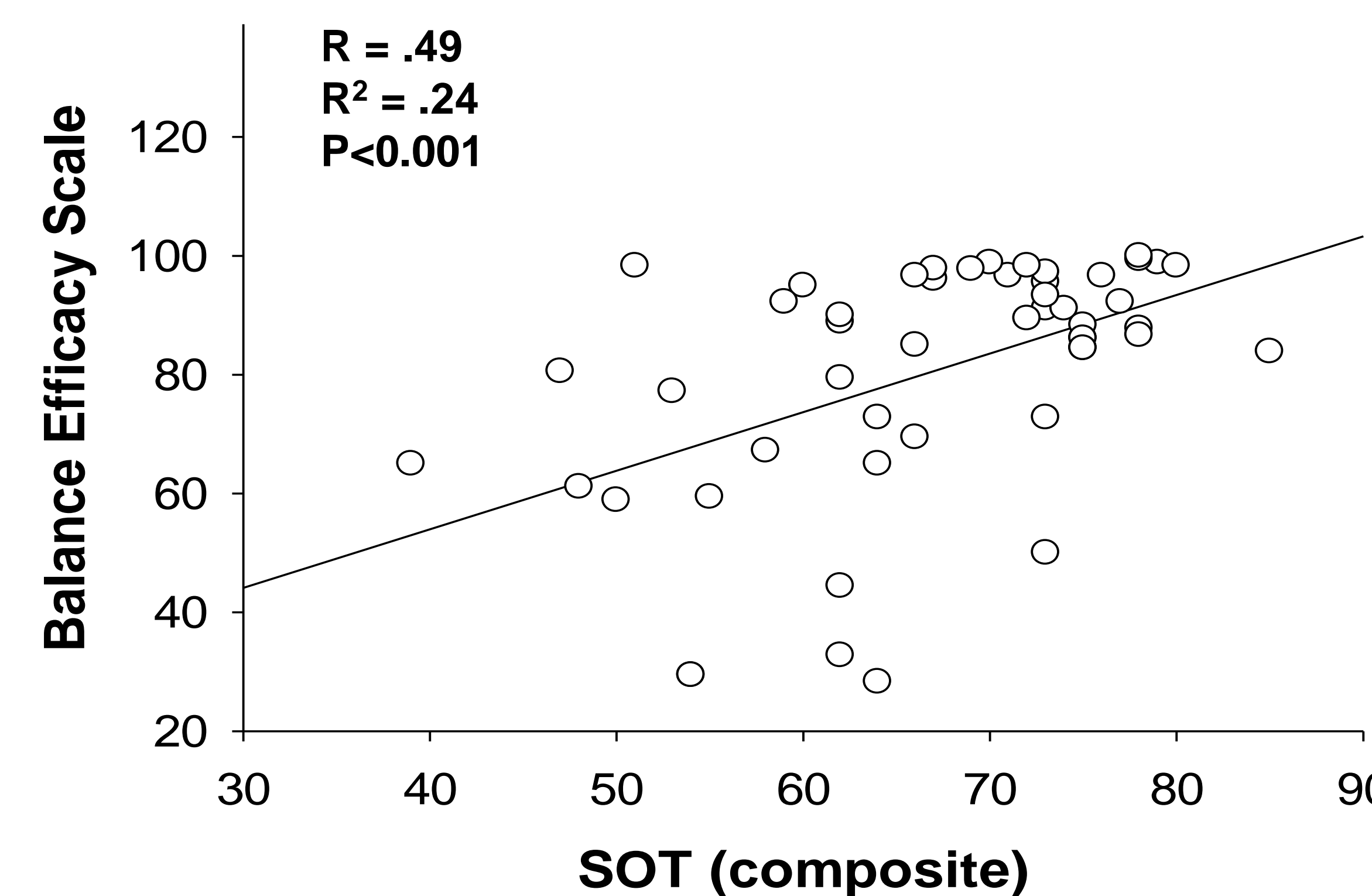**Figure 1.** BES scores in Low-SOT (composite $\leq$ 69) versus High-SOT (composite $\geq$ 70) groups

Figure 2. The relationship between BES and SOT composite scores in all subject

$SOT_{PRED} = -266.4 + (BES*0.26) + (BMI*4.6) + (Ht*1.9) - (Wt*1.7)$
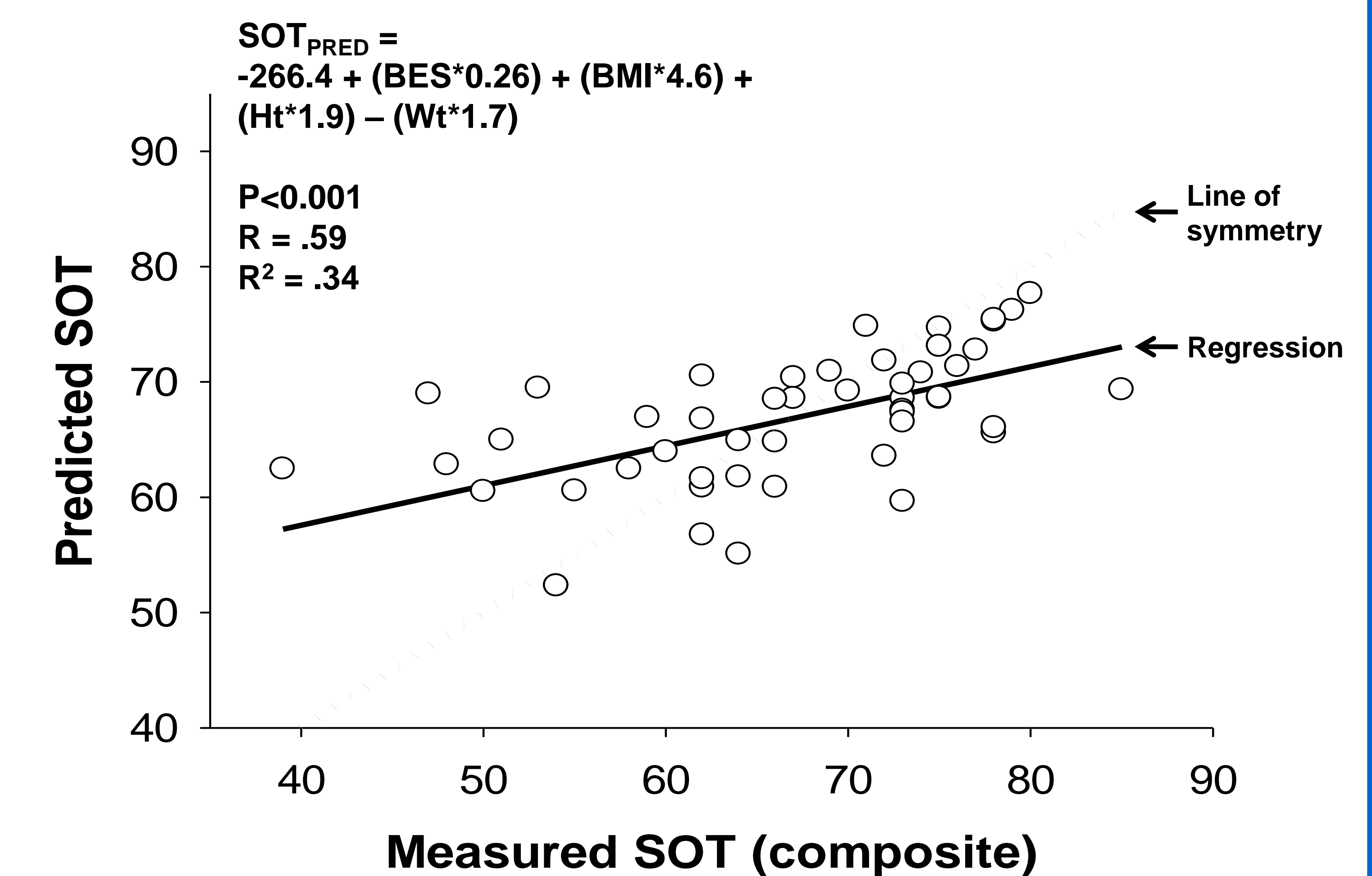
P<0.001
R = .59
R^2 = .34

Figure 3. Measured SOT composite scores and Predicted SOT scores resulting from the regression equation:

$SOT_{PRED} = -266.4 + (BES*0.26) + (BMI*4.6) + (Ht*1.9) - (Wt*1.7)$

CONCLUSION

Individuals with high SOT scores ($\geq$ 70) had higher balance confidence as measured by the BES than those that had low SOT scores (Figure 1).

The findings of this study support the existence of a moderate relationship between SOT composite scores and BES scores (r = 0.49) in the elderly (Figure 2).

This *prediction* of postural control (i.e., SOT), determined using backward step-wise elimination multiple regression analysis, utilized the following variables: BES score, BMI, height, and weight (Figure 3).

Further investigation is warranted to determine if these relationships may prove useful toward the development of cost effective and precise tools used to predict fall risk in the geriatric population.