DIFFERENCES IN JOINT KINETICS IN GIRLS DUE TO CHOICE OF BODY SEGMENT PARAMETERS

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INTRODUCTION

The effects of gender on lower extremity mechanics during landing have been studied extensively in adults, but little is known about landing mechanics in preadolescent populations. By studying landing strategies in preadolescent children, body morphology differences between the genders are essentially eliminated. However, joint kinetics calculated during landing using inverse dynamics are affected by the method used to estimate body segment parameters (BSPs) [1]. Some BSP data sets contain primarily elderly specimens, and many contain primarily males [1].

For preadolescents and young adults, not many studies have provided equations to estimate BSPs. According to Zatsiorsky et al [2], BSPs for girls from 9 to 10 years old (28 to 30 kg) can be calculated with little error using the equations for boys the same age. BSPs for boys, in turn, are calculated using equations for men as long as the boys have normal tissue composition (body fat between 15% and 20%). Our subject group, girls between the ages of 9 and 12, spans the suggested age dividing line for using male or female data. Therefore, it was not clear whether their BSPs should be calculated using the equations for men or women. The purpose of this study was to compare the joint kinetics from the same landing trials when calculated with male and female BSP data. To our knowledge, this is the first study to examine the effect of body segment parameters on joint kinetics during landing.

METHODS

From a larger study of gender effects on landing mechanics, a subset of five female subjects (10 to 12 years of age) were randomly selected for this study. In the larger study, subjects dropped from a horizontal bar (net drop 30.5cm) landing barefoot on one leg. The test leg was randomized. The landing surface was a force platform sampling at 1250 Hz. Each subject performed 5 to 10 trials and the first five successful trials were analyzed.

Pelvis and lower extremity kinematic data were collected at 250 Hz. The 3-D marker coordinate data were smoothed using a 4th order Butterworth filter with a cutoff frequency of 17 Hz. Kinematics of the pelvis, hip, knee, and ankle were calculated using Euler angles.

Internal joint resultant forces and moments for the instrumented lower extremity were calculated using inverse dynamics. Body segment parameters for all subjects were computed using data from de Leva [1] referencing Zatsiorsky [2], first using data from female subjects and then using data from male subjects [1]. Comparisons of joint kinetic variables between the data processed using male and female BSPs were made using two tailed Student's t-tests with an α level of 0.05.

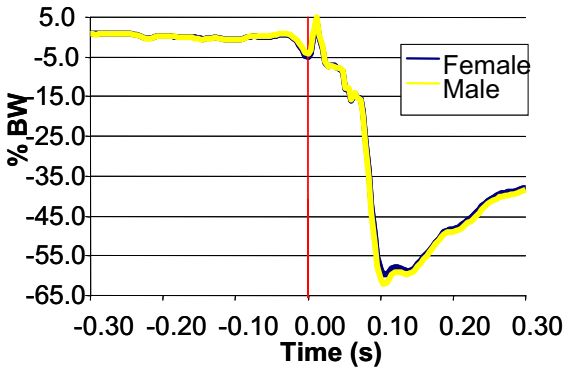

Figure 1: Hip anterior-posterior shear force computed using male and female BSP values.

RESULTS AND DISCUSSION

In most cases the joint force and moment components were not significantly different when computed with different BSP data. Differences between variables calculated with male and female BSPs ranged from –8.8 to 7.3%, and were usually more pronounced for components in which the ground reaction force had little effect (Fig 1). Peak knee distraction force was significantly greater for trials in which female BSPs were used (5.51±0.20 %BW vs. 5.15±0.19 %BW, p=0.018), although peak knee compression was the dominant force in the superior-inferior direction and its at values were not significantly different between groups (235±43 %BW vs 237±44 %BW, p=0.939).

Although not necessarily statistically significant, differences in joint kinetic values of 5-8% might be clinically significant. Many studies comparing landing mechanics data between genders do not specify how BSPs were calculated. Differences in joint kinetics between groups could be either positive or negative, so group differences may be either minimized or inflated by the use of BSPs from a data set that does not adjust for gender.

CONCLUSIONS

For most variables of interest, use of male or female BSPs did not significantly affect our results. However, differences of as much as 8.8% in certain joint force components were due solely to differences in BSPs, even with the same ground reaction forces and joint kinematics. The use of inappropriate BSPs may influence the results of a gender comparison either positively or negatively.

REFERENCES

1. de Leva P. *J Biomech* **29**, 1223-1230, 1996
2. Zatsiorsky VM, et al. *Contemporary Problems of Biomechanics*, CRC Press, Boca Raton, FL.