THE EFFECTS OF 2 DIFFERENT ARM POSITIONS ON MAXIMUM TRUNK FLEXION IN THE BODYWEIGHT SQUAT

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INTRODUCTION

The bodyweight squat is a common exercise and is generally accepted as being safe and easy to perform. Despite the popularity of the exercise, there are many aspects of the movement that have yet to be explored. Technique variations have been shown to alter squat mechanics. Squatting to a specific depth resulted in greater hip flexion but decreased knee and ankle flexion (Flanagan, Salem, Wang, Sanker, & Greendale, 2003). Looking down resulted in increased hip flexion (Donnelly, Berg, & Fiske, 2006). Restricting anterior knee movement resulted in decreased torque at the knee with increased trunk flexion (Fry, Smith, & Schilling, 2003). Foot angle did not affect squat mechanics, but a narrow stance resulted in more gastrocnemius involvement (Escamilla, et al., 2001).

These studies all investigated the effect of technique variations on squat mechanics, but none examined the effects of varying arm positions. All of these studies also examined squatting in a healthy population. None examined what effect, if any, obesity would play in altering squat mechanics. Therefore, the purpose of this study was to examine the effects of two different arm positions, the arm held at the sides with the elbows flexed to approximately 90° and the arms held extended with the shoulders flexed to approximately 90° and slightly horizontally abducted, and weight status on maximum trunk flexion attained in the bodyweight squat.

METHODS

Participants were 28 college-aged females. Weight status was determined using BMI. There were 18 participants in the normal-weight group (NW) and 10 participants in the overweight group (OW).

Height and weight were obtained using a standard balance scale. Age was self-reported by the participants. For biomechanical analysis, the participants had reflective markers placed at the shoulder, hip, knee, base of the fifth toe, and heel. The participants were instructed on the squatting techniques to be used and were allowed to practice if desired. Participants were instructed to look straight ahead while performing both squat conditions. All participants completed the elbows at 90° condition before completing the shoulder at 90° condition. Data were recorded using a Canon ZR50 camcorder (Canon U.S.A., Inc., Lake Success, NY) and Peak 9 motion analysis software (Vicon Inc., Centennial, CO). Peak 9 motion analysis software was used to process the data. Trunk angle was defined as the angle between the shoulder and knee with hip serving as the axis. Full extension was set as 0° with trunk flexion resulting in a decreasing angle and trunk extension resulting in an increasing angle. Data were analyzed using a repeated measures analysis of variance with one within-subject factor (arm position) and one between-subjects factor (weight status) as described in O'Rourke, Hatcher, and

Stepanski (2005). SAS 9.2 (SAS Inc., Cary, NC) was used to analyze the data. Statistical significance was set at the $p < .05$ level.

RESULTS AND DISCUSSION

The groups were nearly identical in age (NW: 20.89 ± 1.37 years; OW: 20.80 ± 1.32 years) and height (NW: 1.67 ± 0.06 m; OW: 1.68 ± 0.06 m). Body weight (NW: 61.25 ± 6.90 kg; OW: 88.91 ± 16.86 kg; $p < .01$) and BMI (NW: 21.92 ± 1.68; OW: 31.64 ± 6.06; $p < .01$) were significantly different between the groups.

Trunk flexion values can be found in table 1. The interaction effect for arm position and weight status and main effect for arm position were not significant. The main effect for weight status approached significance ($p = .05$).

Results indicate that arm position did not significantly affect trunk flexion in this study. However, the effect of weight status approached significance with normal-weight participants demonstrating greater trunk flexion than overweight participants.

SUMMARY AND CONCLUSIONS

Arm position did not significantly affect trunk flexion during the bodyweight squat performed by college-aged females. Weight status affected trunk flexion, but not significantly so, with an overweight classification being associated with decreased trunk flexion. Further research is needed to examine technique variations in the bodyweight squat to determine if modifications are beneficial to the overweight population.

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Table 1: Means table (mean ± SD)

Variable	Normal-Weight	Overweight	Row Means
Trunk flexion 1	-90.65 ± 17.57^o	-78.18 ± 17.72^o	-86.20 ± 19.00^o
Trunk flexion 2	-95.65 ± 23.83^o	-76.85 ± 18.89^o	-88.94 ± 23.68^o
Column means	-93.15 ± 20.79^o	-77.51 ± 18.80^o	

Note. Ttrunk flexion 1 is with elbows at 90°; trunk flexion 2 is with shoulders at 90°