INTRODUCTION
Walking and running involve coordination of lower extremity joints, associated with kinematic and kinetic pattern changes. Joint stiffness and stance phase joint work are important for maintaining efficiency when locomotion task or speed changes. Previous studies have separately investigated ankle and knee joint stiffness (K_{ankle}, K_{knee}) in different movement conditions [1], and stance phase joint work (W_{joint}) in walking and running [2], respectively. Little is known about the combined K_{ankle}, K_{knee}, and K_{hip} patterns, and the relationship between K_{joint} and W_{joint}.

Currently available assistive devices tend to have fixed stiffness and work parameters. The coordination of lower extremity joint stiffness and joint work when locomotion speeds change may be critical to the design of assistive devices suitable for walking and running over different speeds in patient populations. We hypothesized that K_{joint} and W_{joint} will increase when locomotion speed increased.

METHODS
 Subjects were first instructed to walk on a force-instrumented treadmill (Bertec, Inc., Columbus, OH) at a range of seven speeds from 0.8 to 2.0 m/s (0.2 m/s intervals), for 90 seconds per stage. Then they were asked to run on at six speeds ranging from 1.8 to 3.8 m/s (0.2 m/s intervals), for 75 seconds per stage.

Segmental kinematic data were collected at 120 Hz using an 8-camera motion capture system (Motion Analysis Corp., Santa Rosa, CA). Ground reaction force data were collected at 1200 Hz using the force-instrumented treadmill. Kinematic and kinetic data were filtered with a low-pass fourth-order Butterworth filter at 6 Hz and 50 Hz, respectively. Lower extremity joint angles, moments and powers were calculated using the inverse dynamics model in Visual 3D (C-Motion, Inc., Germantown, MD). Joint stiffness (K_{joint}) was calculated as a change in joint moment (ΔM_{joint}) divided by joint angular displacement (Δθ_{joint}) in the braking phase of ground contact [1]. Stance phase joint positive work (W^{+}_{joint}) and negative work (W^{-}_{joint}) were calculated as the sum of all positive or negative joint power integrated over stance phase time [2], respectively. Statistical analysis was performed using a 2-way ANOVA (joint x speed) in SPSS (V22.0, IBM, Armonk, NY).

RESULTS AND DISCUSSION
To date, six subjects (24 ± 6.7 years, 175 ± 10.9 cm, 76 ± 11.5 kg) have participated in this ongoing study. Initial analysis indicates that K_{knee} was significantly higher than K_{hip} across different walking speeds (p = 0.004) (Fig.1). K_{ankle} also tended to be higher than K_{hip} in walking. In running conditions, K_{ankle} was significantly greater than K_{knee} across speeds (p = 0.008) (Fig. 2). K_{knee} was generally lowest in running. In walking conditions, W^{+}_{ankle} tended to be higher than W^{+}_{knee} and W^{+}_{hip} across walking speeds.

CONCLUSIONS
Variation of K_{joint} patterns were different between walking and running. K_{hip} was positively associated with locomotion speed during walking conditions. In running conditions, K_{ankle} and K_{knee} were both positively associated with speed. As walking speed increased, W^{+}_{ankle} tended to increase, and W^{-}_{ankle} decreased. W^{+}_{knee} and W^{+}_{knee} tended to increase when walking speed increased, indicating that the knee joint is important to absorb and generate energy as speed increases. Lastly, the ankle joint is critical for producing positive work.

REFERENCES