OBESITY'S IMPACT ON JOINT KINETICS AND KINEMATICS DURING GAIT

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Introduction

Obesity poses a significant burden on the musculoskeletal system, where individuals with higher waist circumference and body mass demonstrate difficulty in walking, balance, and maintaining strength and mobility while performing basic daily living activities. Quantifying the effect of obesity on the biomechanics (kinematics/kinetics) of gait remains inconsistent [1]. The study aims to quantify hip, knee and ankle joint kinematics and kinetics during gait in young participants with different BMI using subject-specific upper body mass distribution [2].

Methodology

Gait motion capture was performed for six healthy male subjects (normal weight BMI: 23.34±0.74, over-weight BMI: 27.05±0.43 and obese BMI: 31.15±0.18 kg/m3) using IMU sensors. IRB approval and informed consent were obtained prior to data collection. Fifteen anthropometric measurements, in addition to the subject's height and weight, were recorded, and a full-body musculoskeletal model (AnyBody) was used to predict joint reaction forces and moments. The model was personalized using our subject-specific trunk segment mass (T1-S1) and CoM location prediction algorithms, which account for the subject's body shape and internal tissue distribution, in addition to weight and height [2]. The algorithms utilized 15 anthropometric measurements of a male subject to predict the body shape, and a scalable cross-section template created based on the Visible Human Project (VHP) male subject images to compute the bone, fat, and lean tissues volumes [3]. The peak resultant joint reaction forces (JRF) and moments (JRM) at the hip, knee, and ankle were computed, normalized to the subject's body weight and height, and averaged over four gait cycles for each subject. Joint range of motion (RoM) in sagittal plane was obtained at all three joints. One-way ANOVA was performed to compare the JRF, JRM, and RoM among normal, overweight, and obese subjects.

Results

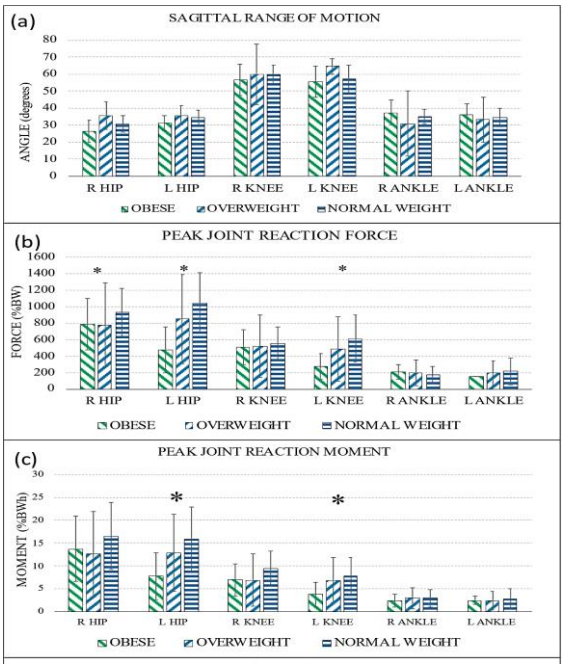

Figure 1 Sagittal Joint range of motion, peak joint reaction forces, and moments at hip, knee, and ankle averaged over four gait cycles.

Discussion and Conclusion

Magnitudes of JRFs and JRMs were higher in right joints of obese subjects [1]. However, comparison of their normalized values showed an overall decrease with BMI. Significant difference was observed in both hip JRF, left knee JRF, left hip and knee JRM. Increase in BMI had no significant effect on RoM. Ratio normalization of forces to mass is needed for comparing subjects of different masses [4].

Reference

[1] Sanford B, et al CBM 2014 .
[2] Hulleck et al 2022.
[3] Pearsall D et al Ann Biomed Eng 1996
[4] Mullineaux DR et al J Appl Biomech 2006