RACIAL DIFFERENCES IN GAIT MECHANICS

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INTRODUCTION: Race has rarely been investigated in biomechanics studies despite racial health disparities in the incidence of musculoskeletal injuries and diseases [1-3]. Racial differences in gait mechanics could drive disease progression and their examination may enable the identification of factors associated with racial health disparities. As race is a social construct, differences in gait mechanics between racial groups could be driven by specific factors other than racial classification itself.

The purpose of this study was to (1) test the hypothesis that racial differences in fundamental gait measures between African Americans (AA) and white Americans (WA) exist and (2) that these differences would be explained by a combination of anthropometric, strength, and health status factors.

CLINICAL SIGNIFICANCE: Equivalency in gait measures between racial groups should not be assumed. Racial diversity of study samples should be a priority to enable consideration of racial differences in the development of future research and individualized treatment protocols.

METHODS: 92 participants were equally divided by self-identified race and sex. Self-selected walking speed was measured, and 3D motion capture and force plate data were recorded during 7 walking trials at regular (1.35 m/s) and fast (1.6 m/s) speeds. Step length and width, peak vertical ground reaction force (pvGRF), and peak hip extension (pHEA), knee flexion (pKFA), and ankle plantar-flexion angles (pAPfA) were obtained. Heart rate, blood pressure, stress questionnaires, activity level, anthropometry, lower extremity strength, and blood levels of glucose, interleukin-6, C-reactive protein, and cortisol were also assessed.

Separate multivariate ANOVA models were fit for spatiotemporal, kinetic, and angular measures in both regular and fast walking speed trials to determine main and interaction effects of race and sex (SPSS V26, α=0.05). For each significant MANOVA finding, post-hoc univariate ANOVA models were fit and partial eta squared effect sizes were computed for all effects. Further analyses were run after separating data by sex. Stepwise linear regression models were fit including race and all independent variables correlated with the outcome measure ($r \geq 0.25$); this was done for each outcome measure with an observed racial difference. If race was no longer significant in the regression model after the inclusion of the independent variable(s), those variables were considered to have explained the effect of race.

RESULTS: MANOVA findings were significant for spatiotemporal (*p<0.001*) and angular (*regular: p=0.001, fast: p<0.001*) models, but not for kinetic models (*regular: p=0.895, fast: p=0.200*). No significant interactions between race and sex were found. Self-selected walking speed was slower in AA (*p=0.004*) (Table 1). pHEA [fast: p=0.007, η_p^2=0.08] and pAPfA [regular: p=0.012, η_p^2=0.07 | fast: p<0.001, η_p^2=0.14] were smaller in AA (Table 1). In males, no racial differences in gait were explained. In females, slower self-selected walking speed in AA was explained by larger Q-angle and decreased ankle dorsiflexion strength. Smaller pAPfA during gait in AA females was explained by weaker ankle plantarflexion strength.

Table 1: Outcome measures with significant effect of race (p<0.05) in MANOVA models

	AA males	**WA males**	**AA females**	**WA females**
Self-Selected Walking Speed (m/s)	1.23 (0.15)	1.34 (0.21)	1.21 (0.17)	1.33 (0.15)
pAPfA (º) *[Regular]*	14.74 (3.85)	18.32 (5.48)	13.92 (4.06)	15.27 (4.87)
pHEA (º) *[Fast]*	10.77 (6.99)	15.05 (5.34)	10.84 (5.65)	13.07 (5.10)
pAPfA (º) *[Fast]*	15.73 (4.44)	20.48 (5.61)	14.48 (4.44)	17.51 (5.42)

DISCUSSION: These results support our hypothesis that racial differences in gait mechanics exist and that a combination of anthropometric, strength, and health status factors contribute to their explanation, however, these observations were only in women. The possibility for additional factors to explain the observed racial gait differences should be investigated further, especially in men. For women, a mix of innate and modifiable factors explained racial differences. Innate metrics such as Q-angle contributing to racial differences suggests the need for racially diverse normative datasets. Modifiable factors such as ankle dorsi-flexion and plantar-flexion strength that are associated with racial differences could provide targets for interventions aimed at injury prevention and optimizing rehabilitation. Identified targets may also be useful in reducing or potentially eliminating racial health disparities in musculoskeletal injury and disease.

REFERENCES: [1] Allen KD. *Curr Opin Rheumatol*. 2010;22(5):528–32. [2] Cruz-Almeida Y, et al. *Arthritis Rheumatol*. 2014;66(7):1800–10. [3] Faulkner KA, et al. *J Am Geriatr Soc*. 2005;53(10):1774–9

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