Hypertension, but not Normotension, is Associated with an Age-Dependent Decline in Knee Osteoarthritis Pain: An Analysis of Middle-Aged and Older Adults

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INTRODUCTION: Osteoarthritis (OA) is a painful and prevalent disease among older adults. Hypertension, commonly comorbid with OA and associated with aging, may influence OA pathology and pain[1,2]. We hypothesized that hypertension would influence pain outcomes in an age-dependent manner and be associated with greater radiographic OA severity among middle-aged and older adults.

METHODS: This study involved a cross-sectional analysis of a multisite study performed at the University of Florida (UF) and the University of Alabama at Birmingham (UAB) evaluating community-dwelling middle-aged and older individuals (45-85 years) with and without symptomatic knee osteoarthritis (OA) pain recruited from both sites and approved by the UF IRB01. All participants provided written informed consent (N=253) and included non-Hispanic Black and non-Hispanic White males and females. Exclusion criteria for the original study included uncontrolled hypertension (BP > 150/95 mmHg), along with other relevant clinical conditions. Radiographic OA was assessed using Kellgren-Lawrence (KL) grades. Physical function was evaluated with the short physical performance battery (SPPB), which includes balance, walking, and chair-stand tasks, with an ordinal score from 0–12, where higher scores indicate better physical performance. To measure movement-evoked pain, participants rated their pain on a numerical rating scale from 0 to 100 (0 = no pain; 100 = most intense pain imaginable) after each component of the battery. KL grade and SPPB score categories were analyzed using binary logistic regression. For WOMAC total and movement-evoked pain ratings, linear models were used, and a Type III ANOVA was conducted. All models were adjusted for BMI, study site, race, age, biological sex, diabetes status, and KL score category.

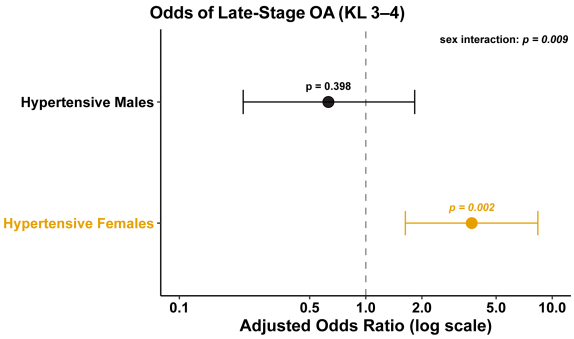

Fig 1. Odds of late-stage OA (KL score: 3–4) in hypertensive compared to normotensive males and females. Point estimates show the odds ratio adjusted for BMI, site, race, age, sex, diabetes, and hypertension-by-sex interaction. Error bars indicate the 95% confidence intervals. The dashed line represents an odds ratio of 1, indicating no difference from the reference group (normotensive male/female). Statistical significance is denoted by $p < 0.05$.

RESULTS: The association between hypertension and KL score category was moderated by sex (interaction, p = 0.009). Specifically, females with hypertension had greater odds of late-stage radiographic OA than normotensive females (AOR = 3.70, 95% CI = 1.63–8.37; p = 0.002); this was not observed in males (AOR = 0.63, 95% CI = 0.22–1.83; p = 0.398; **Fig. 1**). Age also moderated the association between hypertension and WOMAC total score (interaction, p = 0.037). Here, hypertensive individuals showed a significant decrease in WOMAC total scores with increasing age (β = -0.952, p < 0.001), whereas scores remained stable in normotensive individuals (β = -0.258, p = 0.270, **Fig. 2**). Similarly, age moderated the association between hypertension and movement-evoked pain (balance: interaction, p = 0.049; chair-stand: interaction, p = 0.047). Specifically, hypertensive individuals reported decreasing pain ratings with increasing age (balance: β = -0.815, p = 0.003; chair stand: β = -1.017, p = 0.001), whereas pain ratings remained stable in normotensive individuals (balance: β = -0.126, p = 0.607, **Fig. 3A**; chair stand: β = -0.235, p = 0.394, **Fig. 3B**). The interaction between age and hypertensive status on walking-related pain ratings showed a similar pattern but did not reach statistical significance (p = 0.063, **Fig. 3C**). Finally, hypertensive individuals had greater odds of poor physical performance than normotensive individuals (AOR: 1.96, 95% CI: 1.08–3.70; p = 0.029).

DISCUSSION: Hypertension was associated with an age-dependent decline in reported knee pain, poorer physical function, and more severe radiographic OA in females. These findings suggest hypertensive individuals may deviate from a progressive OA pain trajectory and contribute to discordance between joint damage and pain.

SIGNIFICANCE/CLINICAL RELEVANCE: Hypertension is a common comorbidity of OA. Since patients primarily seek care for pain, our findings highlight the importance of considering hypertension when assessing OA, as pain and pathology may be even more mismatched in these individuals.

REFERENCES: 1) Ching et al., 2021; 2) Sacco et al., 2013

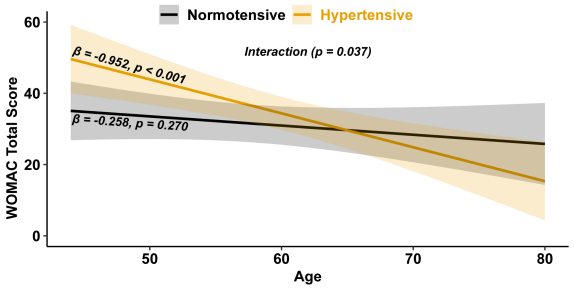

Fig 2. WOMAC total scores across age by hypertension status. Marginal estimates are adjusted for site, race, sex, BMI, age, diabetes, KL score category, and hypertension-by-age interaction. Lines represent predicted means; shaded bands indicate 95% confidence intervals. Statistical significance is denoted by $p < 0.05$; β values = slopes.

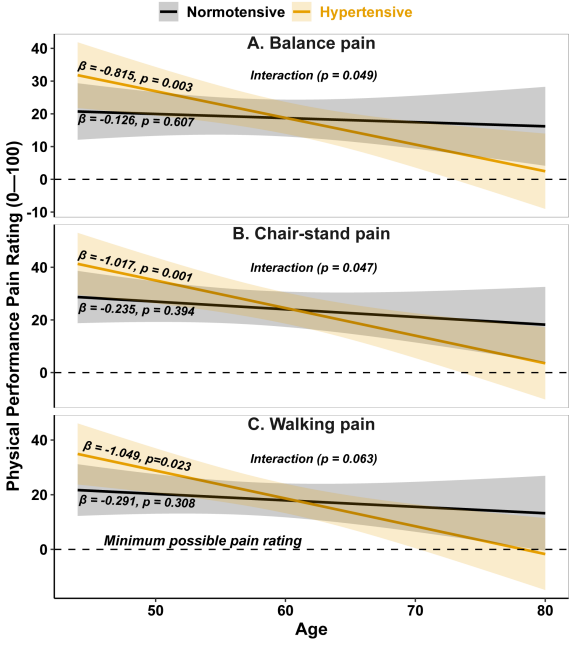

Fig 3. Movement-evoked pain ratings for balance, chair stand, and walking tasks across age, by hypertensive status. Marginal estimates are adjusted for site, race, sex, BMI, age, diabetes, KL score category, and hypertension-by-age interaction. Lines represent predicted means; shaded bands indicate 95% confidence intervals. The dashed line marks the minimum possible pain rating (0 of 100). Statistical significance is denoted by $p < 0.05$; β values = slopes.