Arthroplasty as a life-saving intervention: lessons from wearables, machine learning, and epidemiology.

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Introduction: Epidemiological studies suggest that people with arthritis die younger than non-arthritic aged-matched comparators. However, the causal mechanism underpinning this association has not been conclusively demonstrated. One possible explanation is a lack of physical activity (PA) in those with end-stage lower limb arthritis. Given emerging evidence from large cohort studies using wearables and machine learning to estimate PA, is it time we considered arthroplasty a life-saving intervention?

Methods: We conducted a harmonisation review, drawing upon recently published literature on PA and all-cause mortality (Strain *et al*., 2020) and PA and arthritis (Small et al., 2024) in the UK Biobank. The UK Biobank is a large population cohort study with 96,476 participants with wrist-worn accelerometry data, 3506 of whom have been studied independently as arthritis patients. We harmonised the literature to explore the potential mortality risk reduction conferred by arthroplasty in end-stage arthritis patients.

Results: Small et al. demonstrate patients with an ipsilateral hip replacement have equivalent PA levels to their non-arthritic peers at more than 1-year post-surgery. Further, end-stage arthritis patients have significantly lower moderate-vigorous activity than non-arthritic peers. Strain et al. show that low PA and lower-intensity PA are strongly associated with all-cause mortality, suggesting that arthroplasty reduces all-cause mortality risk.

Discussion: Extrapolation of recently published epidemiological studies using wearables and machine learning suggests that arthroplasty reduces all-cause mortality through the restoration of PA. Further method development is required to optimise surveillance techniques in free-living arthritis patients, including those with significant gait disturbance, and draw aetiological associations between the severity of MSK dysfunction and limited PA. Additional studies are needed to evaluate the risk/benefit of early intervention vs. traditional orthopaedic considerations such as revision and lifetime infection/failure risk. Only then can a holistic approach that prioritises both lifespan and health span be taken to the timing and type of intervention offered to arthritis sufferers.

Significance: This study uses population-based data to reframe arthroplasty as a life-saving intervention. Further, within-individual-longitudinal data are required to confirm the PA differences reported cross-sectionally. If the association is confirmed, these findings may warrant earlier arthroplasty in arthritic patients to preserve their physical activity and maximise their holistic health.

References:
Strain, T. *et al.* Wearable-device-measured physical activity and future health risk. *Nat Med* 1–7 (2020) doi:10.1038/s41591-020-1012-3.
Small, S. R., Khalid, S., Price, A. J. & Doherty, A. Device-Measured Physical Activity in 3506 Individuals with Knee or Hip Arthroplasty. *Med. Sci. Sports Exerc.* **56**, 805–812 (2024).