Longitudinal changes in physical activity and knee osteoarthritis progression: data from the osteoarthritis initiative

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INTRODUCTION: Knee osteoarthritis (KOA) is a prevalent degenerative joint disease with a marked increase in incidence among the aging population. KOA is classically described as slowly progressing, however, recent evidence indicates heterogeneity in how it progresses across the affected population. Although research supports the benefits of regular physical activity in improving joint flexibility, reducing inflammation, and easing pain, there's a lack of comprehensive investigation into how KOA symptoms progress alongside physical activity over time. In this study, by leveraging the longitudinal data from the Osteoarthritis Initiative (OAI) accelerometer sub-study, we aim to systematically uncover the relationship between diverse physical activity outcomes and the progression of clinical, functional, and radiographical indicators in KOA patients.

METHODS: This research employed a secondary data analysis approach, leveraging data from the Osteoarthritis Initiative (OAI) accelerometer sub-study. Longitudinal data were extracted from 782 participants assessed two years apart. Extracted data included demographic characteristics, patient-reported outcome measures(Western Ontario and McMaster University Osteoarthritis Index - WOMAC), functional capacity (gait speed, five times sit-to-stand), radiographic-based structural outcomes(minimum medial joint space width), and accelerometry-based physical activity measures(7-day hip-worn Actigraph). Participants were further classified into worsening/stable groups based on whether their WOMAC score increased more than 10 points (recognized as the minimal clinically importance difference -MCID). Physical activity was further categorized by intensity (Sedentary [SED], light PA [LPA], moderate-to-vigorous PA [MVPA]) using established accelerometry thresholds. Average activity accumulation for each 3-hour interval during waking hours was also computed. Paired-wise comparisons between the stable and worsening groups were performed.

RESULTS SECTION: Out of the total of 782 participants, 659 were categorized as the stable group while 123 were in the worsening group. At the baseline visit, the two groups had no significant difference in age, gender, BMI, WOMAC, gait speed, and joint space width measures, as well as all physical activity measures, except for the Sit-to-Stand time, which notably varied between the groups(Table 1). From the longitudinal data, the worsening group showed a greater reduction in total daily activity counts compared to the stable group (18% vs 10%, p=0.02). The differences in reduced physical activity accumulation between groups were primarily featured during the 3-9 PM period (21% vs 6%, p=0.01, Figure 1). Both groups showed a similar trend in increasing SED time and reduction in LPA and MVPA, and no significant difference between groups was detected. The worsening group also showed a greater decline in functional capacity (gait speed, 5% vs 1% p=0.01, sit to stand, 5% vs 0%, p=0.01) and a trend toward greater joint space narrowing compared with the stable group (0.13mm vs 0.05 mm, p=0.06).

DISCUSSION: Through minute-by-minute analyses of accelerometry data in a relatively large population, this study systematically evaluated the connection between physical activity and the longitudinal change in clinical, functional, and structural measures in patients with KOA. The worsening KOA group (defined by longitudinal WOMAC decline) had a significantly greater physical activity reduction than the stable group and significantly greater declines in functional capacity and joint space narrowing. We further observed the reduction of physical activity accumulation in the worsening group primarily centered around the late afternoon to evening periods. This finding suggests that activity accumulation during these hours could be crucial in determining the progression of KOA symptoms, or conversely, that worsening symptoms during these hours might deter patients from engaging in physical activity.

SIGNIFICANCE/CLINICAL RELEVANCE: Findings from this work highlight the unique physical activity accumulation pattern that may be useful for KOA progression prediction, and the development of targeted interventions for better management of KOA.

Baseline	Stable N=659	Worsening N=123
Age	64.8 (8.9)	65.9(9.8)
Gender (Female)	55.2%	56.9%
Race (Non-White)	14.9%	10.6%
BMI	28.5 (4.7)	28.9 (4.9)
WOMAC	12.1 (15.5)	10.8 (10.9)
Gait speed [m/s]	1.34 (0.20)	1.33 (0.21)
Sit to Stand [s]	10.50 (3.95)	11.53 (5.00)
Joint space [mm]	3.79 (1.44)	3.70 (1.5)
Total Activity (10^5)	2.2 (1.1)	2.2 (1.1)
SED min (%)	581.2 (66.2%)	572.0 (65.4%)
LPA min (%)	277.0 (31.5%)	283.9 (32.4%)
MVPA min (%)	19.8 (2.2%)	19.0 (2.2%)

Table 1. Baseline Characteristics Comparison

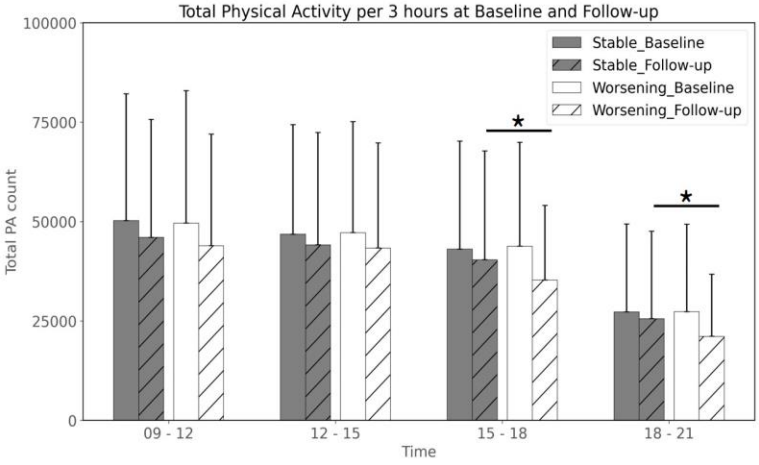

Figure 1. Comparison of total physical activity count by time of the day.