

Is obesity related to incidence of patellofemoral and tibiofemoral osteoarthritis? The Cohort Hip and Cohort Knee Study

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Purpose: Knee osteoarthritis (OA) is associated with considerable pain, functional limitations and overall reduced quality of life. Cross-sectional and longitudinal studies have shown that obesity is a risk factor for development of knee OA. However, most knee OA research has focused on tibiofemoral joint (TF) or knee joint as a whole and cases with patellofemoral joint (PF) OA are often pooled with TF OA or excluded. PF OA is evident in one-half of the people with knee pain or radiographic OA. Therefore, we aimed to determine the relation of body mass index (BMI) to incidence of radiographic PF OA and TF OA over 8 years in women and men with knee pain and to determine the relation of change in BMI from baseline to 8-year follow-up to incidence of PF OA and TF OA in women and men.

Methods: The Cohort Hip and Cohort Knee is a longitudinal, prospective, observational study of adults aged 45-65 years with hip and/or knee pain. Baseline and 8-year study follow-up knee x-rays were graded by experienced readers. The TF was graded according to the Kellgren and Lawrence (KL) criteria (grade 0-4), and the Burnett method was used to grade the PF (grade 0-3). PF OA was defined as grade ≥ 2 osteophyte on skyline or lateral x-rays, or joint space narrowing grade ≥ 2 and osteophytes grade ≥ 1 on skyline x-ray. TF OA was defined as KL grade ≥ 2 on postero-anterior x-ray. A sample of women and men who had no radiographic PF OA or TF OA in their index knee (i.e., side of worse knee pain) at baseline were included in the current study. At the 8-year follow-up, PF OA and TF OA incidence were defined as presence of radiographic OA in the PF and TF compartments, respectively. The following categories were formed based on participants' baseline BMI: (i) normal ($<25\text{kg/m}^2$), (ii) overweight (≥ 25 and $<30\text{kg/m}^2$); and (iii) obese ($\geq 30\text{kg/m}^2$) categories. Participants were also categorized based on their BMI at the 8-year follow-up relative to their baseline BMI: (i) no change (follow-up BMI $\leq \pm 5\%$ of baseline BMI), loss (follow-up BMI $\geq -5\%$ of baseline BMI) and gain (follow-up BMI $\geq +5\%$ of baseline BMI). Logistic regression analyses were conducted to determine the association of baseline BMI and change in BMI to PF and TF OA incidence at 8-year follow-up.

Results: Data from 398 women (age, 55 ± 5 years; BMI, $26 \pm 4 \text{ kg/m}^2$) and 105 men (age, 56 ± 5 years; BMI, $26 \pm 4 \text{ kg/m}^2$) without radiographic PF OA or TF OA at baseline were included in the current study. At the 8-year follow-up, 54.2% had no radiographic OA, 18.1% had isolated TF OA, 13.5% isolated PF OA and 14.3% had combined TF OA and PF OA. Relative to individuals with normal BMI at baseline, those who were obese had 1.9 (95% CI 1.1, 3.4) and 1.7 (95% CI 1.0 to 3.0) times the risk of developing PF OA and TF OA over 8 years, respectively. When data were stratified based on sex, obese women had 2.0 (95% 1.1 to 3.8) times the odds of developing radiographic PF OA 8 years later relative to women with normal BMI at baseline. The association of obesity to incidence of TF OA was not statistically significant in women (1.7, 95% CI: 0.9, 3.0). BMI was not statistically associated with incidence of PF OA and TF OA in men. There were no associations observed between BMI change from baseline to 8-year follow-up and incident of PF OA and TF OA (Table 2).

Conclusions: The impact of obesity on incidence of PF OA is as large as on TF OA. Obese individuals are approximately twice as likely to develop radiographic PF OA and TF OA 8 years later. Further research is also necessary to determine the relation of obesity to the progression of PF OA, and whether BMI change (loss or gain) is related to progression of PF OA in women and men.

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Table 1. Relation of baseline body mass index categories to the incidence of patellofemoral and tibiofemoral osteoarthritis at 8-year follow-up

	All (n=504)		Women (n=399)		Men (n=105)	
	Frequency of Outcome	Adjusted OR (95% CI)**	Frequency of Outcome	Adjusted OR (95% CI)*	Frequency of Outcome	Adjusted OR (95% CI)*
Radiographic patellofemoral osteoarthritis						
Normal	47/202 (23.3%)	Reference	40/167 (24.0%)	Reference	7/35 (20.0%)	Reference
Overweight	65/226 (28.8%)	1.3 (0.8, 2.0)	45/170 (26.5%)	1.1 (0.7, 1.9)	20/56 (35.7%)	2.3 (0.8, 6.3)
Obese	28/76 (36.8%)	1.9† (1.1, 3.4)	24/62 (38.7%)	2.0† (1.1, 3.8)	4/14 (28.6%)	1.7 (0.4, 7.0)
Radiographic tibiofemoral osteoarthritis						
Normal	60/202 (29.7%)	Reference	53/167 (31.7%)	Reference	7/35 (20.0%)	Reference
Overweight	71/226 (31.0%)	1.1 (0.7, 1.7)	56/170 (32.9%)	1.1 (0.7, 1.7)	15/56 (26.8%)	1.5 (0.5, 4.3)
Obese	32/76 (42.1%)	1.7† (1.0, 3.0)	27/62 (43.5%)	1.7 (0.9, 3.0)	5/14 (35.7%)	2.3 (0.6, 9.3)
Abbreviations: OR= Odds Ratios; CI: Confidence Interval **Adjusted for age and sex; *Adjusted for age; †Statistically significant (p<0.05)						

Table 2. Relation of body mass index change from baseline to 8-year follow-up to the incidence of patellofemoral and tibiofemoral osteoarthritis at 8-year follow-up

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