

Table G5.A3. Cohort and Case-Control Studies Reporting a Measure of Association Between General Accumulated Recreational/Leisure-Time Physical Activity and the Development of Osteoarthritis

Part 1. Cohort Studies (n = 8)

Reference	Subjects*	Osteoarthritis Physical Activity Outcome	Physical Activity Exposure*	OR/RR/HR (95% CI)*	Comments
Hart et al., 1999 (1)	N = 715 Sex: Women Age: Mean 54.1(SD 5.9)	Radiographic JSN KL ≥ 1 and osteophytes KL ≥ 1	No detailed definition provided, but classified as: Walking† 5 miles per week >5 miles per week Job Sedentary Active >50% of the day Sports 2 hours per week >2 hours per week	Incident JSN: Walking 0.38 (0.15 – 0.93) Job 0.56 (0.18 – 1.79) Sports 0.98 (0.42 – 2.30) Incident Osteophyte: Walking 0.60 (0.22 – 1.71) Job 1.48 (0.34 – 5.64) Sports 1.23 (0.54 – 2.81)	Walking protective for incident JSN
Lane et al., 1999b (2)	N = 6,418 Sex: Women Age: 65+ years Source: Country: USA	Radiographic hip osteoarthritis (OA) defined as moderate-severe (KL Grades 3 and 4)	Lifetime history of frequency per week of recreational physical activity (PA), classified into quartiles and aggregated by 3 age strata: Total all ages As a teenager At age 30 At age 50	Total PA all ages: Quartile 1 1.0 (referent) Quartile 2 1.1 (0.8-1.6) Quartile 3 1.1 (0.7-2.0) Quartile 4 1.4 (1.0-2.0) [Q4 = >4 times/week] As a teenager: Quartile 1 1.0 (referent) Quartile 2 1.7 (1.1-2.4) Quartile 3 1.4 (0.9-2.0) Quartile 4 1.7 (1.1-2.4) At age 30: Quartile 1 1.0 (referent) Quartile 2 0.8 (0.5-1.1) Quartile 3 1.0 (0.7-1.5) Quartile 4 1.4 (1.0-1.6) At age 50: Quartile 1 1.0 (referent) Quartile 2 1.5 (1.1-2.1) Quartile 3 1.0 (0.7-1.4) Quartile 4 1.4 (1.0-1.9)	Adjusted for age and body mass index (BMI) No adjustment for previous hip injury Weight-bearing PA was no more strongly associated with hip OA than all forms of PA Highest quartile of PA was also associated with greater odds of \geq grade 2 osteophytes but not ≥ 2 grade JSN

Table G5.A3. Cohort and Case-Control Studies Reporting a Measure of Association Between General Accumulated Recreational/Leisure-Time Physical Activity and the Development of Osteoarthritis (continued)

Part 1. Cohort Studies (n = 8) (continued)

Reference	Subjects*	Osteoarthritis Physical Activity Outcome	Physical Activity Exposure*	OR/RR/HR (95% CI)*	Comments
McAlindon et al., 1999 (3)	N = 470 Sex: Men and women Age: 63-91 years Source: Community, volunteers Country: USA	1. Incident radiographic knee OA defined as \geq KL Grade 2 radiographic changes 2. Symptomatic knee OA defined as radiographic OA plus pain in the same knee during follow-up period	Number flights of stairs climbed/day Number city blocks walked/day Number hours/day of light, moderate, and heavy leisure, occupational, and household activities	<p>Radiographic Knee OA:</p> <p>Stairs: None 1.0 (referent) ≥ 4 1.2 (0.6-2.7)</p> <p>Blocks: None 1.0 (referent) ≥ 4 1.2 (0.4-3.8)</p> <p>Hours/day Physical Activity:</p> <p>Heavy ‡</p> <p>0 1.0 (referent) 1 2.2 (1.2-4.2) 2 1.7 (0.7-4.1) 3 2.9 (1.2-6.9) ≥ 4 7.2 (2.5-21.0)</p> <p>Moderate ‡</p> <p>0 1.0 (referent) 1 1.3 (0.6-2.7) 2 1.1 (0.5-2.7) 3 1.5 (0.6-3.5) ≥ 4 1.6 (0.6-4.1)</p> <p>Light ‡</p> <p>0 1.0 (referent) 1 1.7 (0.7-4.5) 2 2.0 (0.7-5.4) 3 1.9 (0.7-5.6) ≥ 4 1.5 (0.4-5.6)</p> <p>Symptomatic Knee OA:</p> <p>Hours/Day Heavy PA ‡</p> <p>0 1.0 (referent) 1-2 2.1 (0.7-6.7) ≥ 3 5.3 (1.02-24.0)</p> <p>No association with moderate or light physical activity</p>	—

Table G5.A3. Cohort and Case-Control Studies Reporting a Measure of Association Between General Accumulated Recreational/Leisure-Time Physical Activity and the Development of Osteoarthritis (continued)

Part 1. Cohort Studies (n = 8) (continued)

Reference	Subjects*	Osteoarthritis Physical Activity Outcome	Physical Activity Exposure*	OR/RR/HR (95% CI)*	Comments
Cheng et al., 2000 (4)	Number: 16,961 Sex: M+W Age: 20-87 years Source: Community, volunteers Country: USA	Incident self-reported, doctor-diagnosed hip/knee OA	Sedentary: No PA Low: Walk/jog <10miles/week Moderate: Walk/jog 10-20 miles/week High: Walk/jog >20 miles/week Other: Regular PA, no walk/jog	<p>Men Age < 50 years:</p> <p>Sedentary 1.0 (referent) Low 1.0 (0.6-1.5) Moderate 1.2 (1.0-1.4) High 2.4 (1.5-3.9) Other 1.4 (0.9-2.0)</p> <p>Women Age < 50 years:</p> <p>Sedentary 1.0 (referent) Low 0.8 (0.4-1.6) Moderate .2 (0.9-1.5) High 1.5 (0.4-5.1) Other 1.1 (0.6-2.0)</p> <p>Men Age 50+ years:</p> <p>Sedentary 1.0 (referent) Low 1.3 (0.9-1.8) Moderate 1.0 (0.8-1.2) High 1.2 (0.6-2.3) Other 1.1 (0.7-1.5)</p> <p>Women Age 50+ years:</p> <p>Sedentary 1.0 (referent) Low 0.6 (0.3-1.2) Moderate 1.2 (0.9-1.5) High 1.4 (0.4-4.6) Other 0.7 (0.4-1.3)</p>	Significant interaction between age and physical activity level No adjustment for previous joint injury
Cooper et al., 2000 (5)	N = 354 Sex: Men and women Age: ≥55 years Source: Population, community Country: England	Radiographic OA KL-grade ≥2	Regular sports participation = at least weekly participation in sports or other activities (gardening, cycling, walking, etc.) for a decade or longer after leaving school.	Weekly participation = 1.0 (0.5-2.1)	Mean length of follow-up, 5.1(SD 0.4) years Adjusted for age, sex, BMI, knee pain, Heberden's nodes Regular participation also not associated with radiographic progression

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Part 1. Cohort Studies (n = 8) (continued)

Reference	Subjects*	Osteoarthritis Physical Activity Outcome	Physical Activity Exposure*	OR/RR/HR (95% CI)*	Comments
Hootman et al., 2003 (6)	N = 5,284 Sex: Men and women Age: 20+ years Source: Community, volunteers Country: USA	Self-reported, doctor-diagnosed hip/knee OA	Usual physical activity in past 12 months, taking into account frequency, duration, intensity, and joint stress level categorized: 1. Sedentary (none) 2. Low (bottom 25%) 3. Moderate (middle 50%) 4. High activity (top 25%)	Men: ‡ Sedentary 1.0 (referent) Low 0.80 (0.54-1.19) Moderate 0.85 (0.62-1.16) High 1.31 (0.92-1.87) Women: ‡ Sedentary 1.0 (referent) Low 1.25 (0.61-2.57) Moderate 1.16 (0.64-2.12) High 1.07 (0.47-2.42)	No association of training parameters (mileage, pace, frequency) with incident hip/knee OA among walkers and runners
Szoeke et al., 2006 (7)	N = 224 Sex: Women Age: 45-55 years Source: Community, volunteers Country: Australia	Total OP = OP in any of the 3 knee compartments Total JSN = JSN in any of the 3 knee compartments	Frequency (0 – 7 scale) of participation in sports/recreation/fitness activities, summed per year of follow-up and averaged (divided by the years of follow-up).	Total OP: 1.76 (0.22-13.91) Total JSN: 5.91 (0.87-40.10)	Adjusted for age, BMI, sex; did not control for previous joint injury
Felson et al., 2007 (8)	N = 1,279 Sex: Men and women Age: 26-81 years Source: Community, volunteers Country: USA	Incident knee OA: 1. Radiographic 2. Symptomatic radiographic 3. Tibiofemoral JSN	Subjects were asked 3 general physical activity questions: Do you walk regularly for exercise? Miles per session? Times per week? How many times per week do you engage in intense physical activity to work up a sweat? How would you compare your activity level to others your age?	Symptomatic Radiographic Knee OA: Walk for exercise: ‡ No 1.0 (referent) <6 miles/week 0.96 (0.57-1.62) ≥6 miles/week 0.78 (0.49-1.24) Work up a sweat: ‡ No 1.0 (referent) <3 times/week 1.41 (0.82-2.44) ≥3 times/week 1.23 (0.72-2.10) PA compared to peers: ‡ Less 0.81 (0.46-1.43) Same 1.0 (referent) More 0.94 (0.60-1.47)	Similar null associations found for other 2 outcomes: radiographic OA and tibiofemoral JSN No associations were found between any physical activity exposure and any OA outcome among persons below median BMI or those at/above median BMI

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Part 2. Case-Control Studies (n = 4)

Reference	Subjects*	Osteoarthritis Physical Activity Outcome	Physical Activity Exposure*	OR/RR/HR (95% CI)*	Comments
Vingard et al., 1998 (9)	N = 503 Sex: Women Age: 50-70 years Cases = Surgical registry Controls = Population registry, community Country: Sweden	Total hip replacement due to primary osteoarthritis	Aggregated hours of participation to age 50 in about 20 activities: Low = <100 hours Medium = 100-799 hours High = ≥800 hours	Aggregated PA to age 50 Low 1.0 (referent) Medium 1.5 (0.9-2.5) High 2.3 (1.5-3.7) Combined effect from aggregated PA and physical load from work: Low-Low 1.0 (referent) Low-Medium 1.1 (0.5-2.0) Low-High 1.7 (0.8-3.5) Med-Low 1.1 (0.3-3.4) Med-Med 1.8 (0.8-4.1) Med-High 2.7 (1.1-7.0) High-Low 2.0 (0.7-5.2) High-Med 2.7 (1.2-5.9) High-High 4.3 (1.7-11.0)	Controls matched to cases on age and hospital referral area or county Adjusted for age, BMI, occupational work load, smoking, and hormone therapy Did not adjust for previous hip injury
Manninen et al., 2001 (10)	N = 805 Sex: Men and women Age: 55-75 years Cases = hospital registry Controls = community random sample Country: Finland	Surgical total knee replacement for primary osteoarthritis	Lifetime accumulation of hours of recreational exercise: Low = Below median High = Median and above None = No participation Unknown = Hours could not be calculated.	All cumulative exercise: Men:‡ None 1.0 (referent) Low 0.80 (0.28-2.23) High 0.28 (0.08-0.96) Unknown 0.82 (0.31-2.13) Women:‡ None 1.0 (referent) Low 0.62 (0.32-1.20) High 0.59 (0.30-1.16) Unknown 0.85 (0.53-1.37)	Controls matched to cases on age and sex No further significant findings when stratified by different life time periods Some exercise may be protective for severe OA requiring surgical treatment

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Part 2. Case-Control Studies (n = 4) (continued)

Reference	Subjects*	Osteoarthritis Physical Activity Outcome	Physical Activity Exposure*	OR/RR/HR (95% CI)*	Comments
Manninen et al., 2002 (11)	N = 805 Sex: Men and women Age: 55-75 years Cases = Surgical registry Controls = Population, community Country: Finland	Total knee replacement surgery for primary osteoarthritis	Hours of lifetime history of recreational exercise aggregated to age 49: None = No physical activity (PA) Low = Below mean High = At/above mean	Regular PA to age 49: None 1.0 (referent) Low 0.59 (0.38-0.91) High 0.41 (0.20-0.81)	Controls matched to cases by age and sex Associations were similar after stratification by sex Not adjusted for age, BMI, or previous knee injury
Rogers et al., 2002 (12)	N = 2,410 Sex: Men and women Age: 20-87 years Source: Community, volunteers Country: USA	Incident self-reported, doctor-diagnosed hip/knee osteoarthritis	Participation in physical activity classified by amount of joint stress: None = No physical activity Low = Low impact forces at the hip and knee (e.g., walking, stationary cycling, swimming) Moderate/High = Moderate to high impact forces at the hip/knee (e.g., aerobic dance, jogging, soccer, racquet sports)	Men:‡ None 1.0 (referent) Low 1.30 (0.94-1.80) Moderate/High 0.62 (0.43-0.89) Women:‡ None 1.0 (referent) Low 0.58 (0.34-0.99) Moderate/High 0.24 (0.11-0.52)	—

BMI, body mass index; CI, confidence interval; JSN = joint space narrowing; HR, hazards ratio; KL, Kellgren and Lawrence scale; OA, osteoarthritis; OP, osteophytes; OR, odds ratio; PA, physical activity; RR, relative risk; SD, standard deviation;

† No details on the physical activity categories were described by Hart et al (1). Another publication from the same cohort (Hassett 2003) (13) described the classifications provided in the table.

‡ Adjusted for 4 primary confounders: sex, age, body mass index, previous injury.

Reference List

1. Hart DJ, Doyle DV, Spector TD. Incidence and risk factors for radiographic knee osteoarthritis in middle-aged women: the Chingford Study. *Arthritis Rheum.* 1999 Jan;42(1):17-24.
2. Lane NE, Hochberg MC, Pressman A, Scott JC, Nevitt MC. Recreational physical activity and the risk of osteoarthritis of the hip in elderly women. *J.Rheumatol.* 1999 Apr;26(4):849-54.
3. McAlindon TE, Wilson PW, Aliabadi P, Weissman B, Felson DT. Level of physical activity and the risk of radiographic and symptomatic knee osteoarthritis in the elderly: the Framingham study. *Am.J.Med.* 1999 Feb;106(2):151-7.
4. Cheng Y, Macera CA, Davis DR, Ainsworth BE, Troped PJ, Blair SN. Physical activity and self-reported, physician-diagnosed osteoarthritis: is physical activity a risk factor? *J.Clin.Epidemiol.* 2000 Mar 1;53(3):315-22.
5. Cooper C, Snow S, McAlindon TE, Kellingray S, Stuart B, Coggon D, Dieppe PA. Risk factors for the incidence and progression of radiographic knee osteoarthritis. *Arthritis Rheum.* 2000 May;43(5):995-1000.
6. Hootman JM, Macera CA, Helmick CG, Blair SN. Influence of physical activity-related joint stress on the risk of self-reported hip/knee osteoarthritis: a new method to quantify physical activity. *Prev.Med.* 2003 May;36(5):636-44.
7. Szoek C, Dennerstein L, Guthrie J, Clark M, Cicuttini F. The relationship between prospectively assessed body weight and physical activity and prevalence of radiological knee osteoarthritis in postmenopausal women. *J.Rheumatol.* 2006 Sep;33(9):1835-40.
8. Felson DT, Niu J, Clancy M, Sack B, Aliabadi P, Zhang Y. Effect of recreational physical activities on the development of knee osteoarthritis in older adults of different weights: the Framingham Study. *Arthritis Rheum.* 2007 Feb 15;57(1):6-12.
9. Vingard E, Alfredsson L, Malchau H. Osteoarthrosis of the hip in women and its relationship to physical load from sports activities. *Am.J.Sports Med.* 1998 Jan;26(1):78-82.
10. Manninen P, Riihimaki H, Heliovaara M, Suomalainen O. Physical exercise and risk of severe knee osteoarthritis requiring arthroplasty. *Rheumatology.(Oxford)* 2001 Apr;40(4):432-7.
11. Manninen P, Heliovaara M, Riihimaki H, Suoma-Iainen O. Physical workload and the risk of severe knee osteoarthritis. *Scand.J.Work Environ.Health* 2002 Feb;28(1):25-32.

12. Rogers LQ, Macera CA, Hootman JM, Ainsworth BE, Blairi SN. The association between joint stress from physical activity and self-reported osteoarthritis: an analysis of the Cooper Clinic data. *Osteoarthritis.Cartilage*. 2002 Aug;10(8):617-22.
13. Hassett G, Hart DJ, Manek NJ, Doyle DV, Spector TD. Risk factors for progression of lumbar spine disc degeneration: the Chingford Study. *Arthritis Rheum*. 2003 Nov;48(11):3112-7.