

**FINANCIAL DISCLOSURES**

The authors of this study have no financial disclosures

**BACKGROUND**

Long-distance running is a popular form of cardiovascular exercise with many well-described health benefits, from improving heart health to the management of obesity, diabetes, and mental illness. The impact of long-distance running on joint health in recreational runners however remains inconclusive.

**OBJECTIVE**

To examine the cumulative effect of long-distance running and the presence of hip and knee osteoarthritis.

**METHODS**

A survey was distributed to all participants registered for the 2019 or 2021 Chicago marathon (n=37,917). Surveys collected runner demographics and assessed for hip/knee pain, osteoarthritis, family history, surgical history, and running-related history. Running history included the number of marathons run, number of years running, average running pace, and average weekly mileage. The overall prevalence of osteoarthritis was identified, and a multivariable logistic regression model was used to identify variables associated with the presence of hip and/or knee osteoarthritis.

**RESULTS**

3,804 participants completed the survey. Participants completed an average of 9.5 marathons per runner (median 5, range 1-664). The number of marathons completed by each runner were the following: 650 completed 1, 1,420 completed 2-5, 786 completed 6-10, 574 completed 11-20, 299 completed 21-50, 51 completed 51-100, and 25 completed >100.

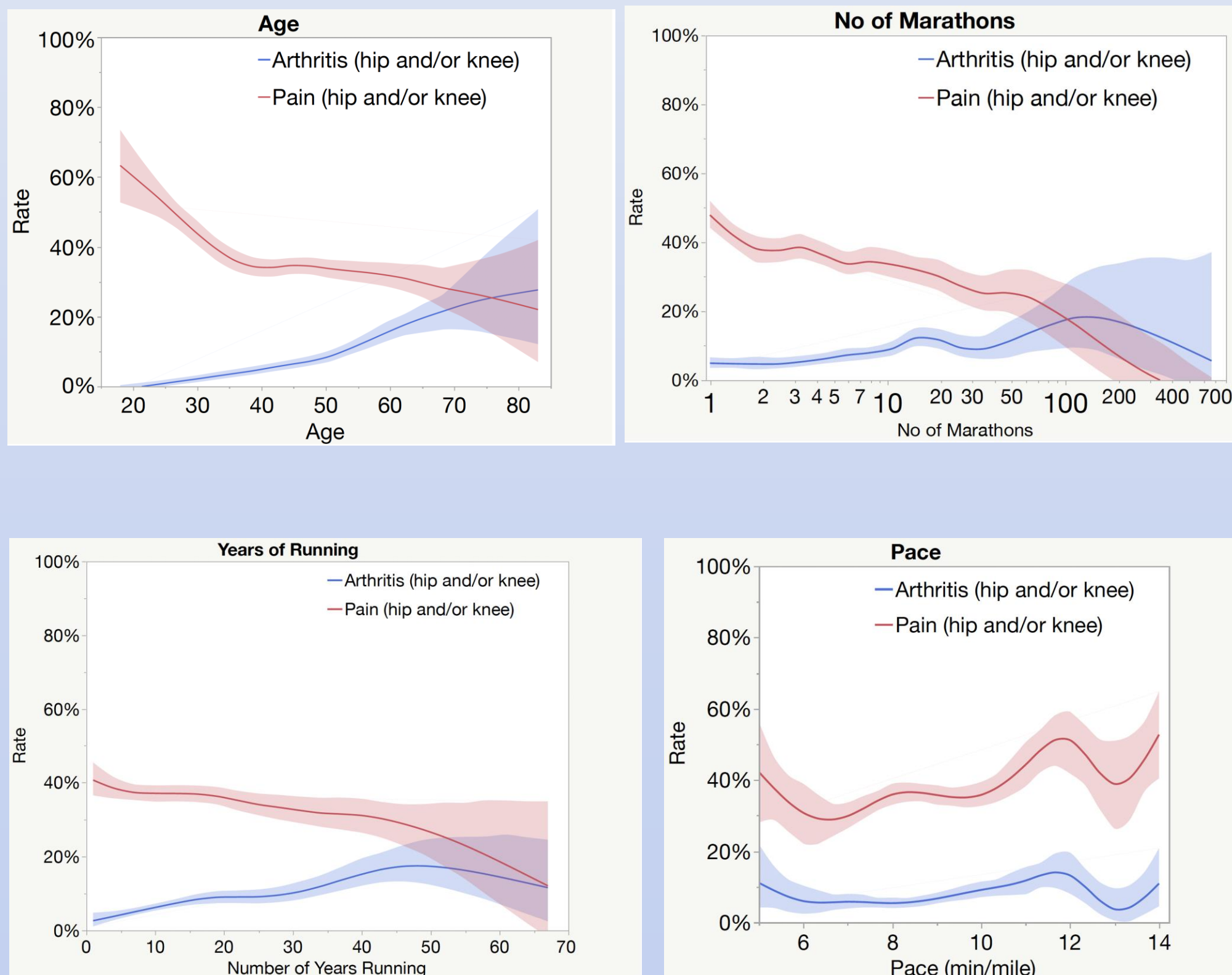
Body Region	Condensed Procedure List	Count	Percent of All Runners	
Knee	Knee arthroscopy/meniscal surgery	247	66.8%	
	ACLR	48	13.0%	
	ACLR, meniscus surgery	37	10.0%	
	Knee arthroplasty	7	1.9%	
	Patella tendon surgery/repair	6	1.6%	
	Proximal tibia fracture repair	4	1.1%	
	Multiligamentous knee injury repair	2	0.5%	
	Patellar instability surgery	2	0.5%	
	Cartilage repair of the knee	1	0.3%	
	Quad tendon surgery/repair	1	0.3%	
	Other - knee	15	4.0%	
	Hip	Hip arthroscopy	22	51.2%
		Hip arthroplasty	8	18.6%
Hip fracture repair		6	14.0%	
Hip dislocation		2	4.6%	
Proximal hamstring injury repair		2	4.6%	
Other - hip		3	7.0%	

**RESULTS**

**Table 1. Runner Characteristics and Prevalence of Hip and/or Knee Pain and Arthritis**

Demographic Characteristics	All Marathoners n = 3,804	Pain <sup>†</sup>		Arthritis <sup>#</sup>	
		Yes n = 1,383 (36.4%)	No n = 2,421 (63.6%)	Yes n = 277 (7.3%)	No n = 3,527 (92.7%)
Age‡	43.9 ± 11.4 (18-83)	42.3 ± 11.5 (18-77)*	44.7 ± 11.2 (18-83)	51.7 ± 10.8 (25-75)**	43.2 ± 11.2 (18-83)
Sex§					
Male	1,984 (52.2)	615 (44.5)*	1,369 (56.6)	160 (57.8)	1,824 (51.7)
Female	1,816 (47.7)	766 (55.4)*	1,050 (43.4)	117 (42.2)	1,699 (48.2)
Prefer not - say	4 (0.1)	2 (0.1)*	2 (0.1)	0 (0.0)	4 (0.0)
BMI‡ (kg/m <sup>2</sup> )	23.8 ± 3.5 (15.5-42.6)	24.0 ± 3.6 (16.2-42.6)	23.7 ± 3.4 (15.5-42.3)	24.5 ± 3.6 (17.3-36.6)**	23.8 ± 3.5 (15.5-42.6)
No. of marathons‡¶	9.5 ± 18.6 (1-664)	7.5 ± 10.8 (1-120)*	10.7 ± 21.7 (1-664)	13.4 ± 20.2 (1-172)**	9.2 ± 18.4 (1-664)
Duration of running‡ (yrs)	14.7 ± 11.0 (1-67)	14.0 ± 10.3 (1-55)*	15.2 ± 11.3 (1-67)	19.4 ± 12.8 (1-55)**	14.4 ± 10.7 (1-67)
Mileage‡ (miles/week)	27.9 ± 15.5 (0-180)	25.7 ± 14.2 (0-130)*	29.2 ± 16.0 (0-180)	26.6 ± 14.3 (0-85)	28.0 ± 15.5 (0-180)
Pace for training runs (avg ± SD, min/mile)	8:52 ± 1:38	9:02 ± 1:42*	8:46 ± 1:34	9:12 ± 1:45	8:50 ± 1:37
Family history of hip/knee arthritis§	993 (26.1)	408 (29.5)*	585 (24.2)	123 (44.4)**	870 (24.7)
History of hip/knee injury that prevented running§	1,892 (49.7)	948 (68.6)*	944 (39.0)	238 (85.9)**	1,654 (46.9)
History of hip/knee surgery§	413 (10.9)	210 (15.2)*	203 (8.4)	130 (46.9)**	283 (8.0)
Hip	43 (1.1)	27 (2.0)	16 (0.7)	13 (4.7)	30 (0.9)
Knee	370 (9.7)	183 (13.2)	187 (7.7)	117 (42.2)	253 (7.2)
Cross train§	2,873 (75.5)	1,050 (75.9)	1,823 (75.3)	214 (77.3)	2,659 (75.4)
Participate in other sports§	1,470 (38.6)	532 (38.5)	938 (38.7)	107 (38.6)	1,363 (38.6)

† History of hip and/or knee pain within the past year that prevented running  
# History of hip and/or knee arthritis  
‡ Values are given as mean and standard deviation, with range in parentheses  
§ Values are given as number of runners, with percentage in parentheses  
¶ Includes ultra-marathon distance events  
\* p < 0.05 compared to patients without hip/knee pain  
\*\* p < 0.05 compared to patients without hip/knee arthritis



**RESULTS**

**Table 3. Multivariable Logistic Regression Analysis of Risk Factors for Hip and/or Knee Pain and Arthritis**

Risk Factor	Pain <sup>†</sup>		Arthritis <sup>#</sup>	
	Odds' ratio	p-value	Odds' ratio	p-value
History of hip/knee surgery	1.50 (1.20-1.87)	<0.001*	5.85 (4.33-7.92)	<0.001*
Age, per year	0.99 (0.98-0.99)	0.0011*	1.08 (1.06-1.10)	<0.001*
History of hip/knee injury that prevented running	3.30 (2.85-3.83)	<0.001*	5.04 (3.45-7.34)	<0.001*
Family history of hip/knee arthritis	1.16 (0.98-1.37)	0.12	3.47 (2.52-4.79)	<0.001*
BMI, per kg/m <sup>2</sup>	1.02 (0.99-1.05)	0.054	1.10 (1.05-1.15)	<0.001*
Pace for training runs, per min/mile	1.04 (0.98-1.10)	0.19	0.88 (0.79-0.99)	0.031
Female sex, compared to men	1.43 (1.20-1.70)	<0.001*	1.41 (0.99-2.01)	0.082
Participation in other sports	1.04 (0.90-1.21)	0.59	0.87 (0.64-1.17)	0.35
Weekly mileage, per mile	0.99 (0.98-0.99)	<0.001*	0.99 (0.98-1.01)	0.36
No. of marathons, per marathon	0.99 (0.98-0.99)	0.0037*	1.00 (0.99-1.01)	0.56
Duration of running, per year	1.00 (0.99-1.01)	0.64	1.00 (0.98-1.01)	0.66
Cross training	0.88 (0.74-1.04)	0.14	0.98 (0.69-1.40)	0.91

† History of hip and/or knee pain within the past year that prevented running  
# History of hip and/or knee arthritis  
\* Significant after Bonferroni correction (p < 0.0042)

**CONCLUSIONS**

The overall prevalence of hip and/or knee arthritis among Chicago marathon participants was 7.3%.

A history of hip/knee injuries or surgery, advancing age, family history, and BMI were risk factors for arthritis.

Cumulative number of years running, number of marathons completed, weekly mileage, and mean running pace were not significant predictors for arthritis.

The majority (94.2%) of runners planned to run another marathon, despite 24.2% of all participants being told by a physician that they should reduce the amount they run or stop running all together.

Healthcare providers should consider these findings when discussing the risks and benefits of running.

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