Are Running Athletes at Risk of Knee Osteoarthritis in later Life?

Manit Arora*, Manish Tripathi, Nikhil Singh and Tanima Arora

Department of Orthopaedics, Padmashree Dr. D.Y. Patil Hospital and Research Centre, Navi Mumbai, Maharashtra, India

Abstract: *Introduction*: Osteoarthritis (OA) is one of the most common causes of disability in developed countries. Long-distance and marathon running are relatively safe sports. A natural progression is that the joints of runners subject to repetitive loading would at some point of time fail due to OA. The aim of this narrative review is to explore the association between running and the development of knee OA.

Method: A search of MEDLINE, EMBASE and Cochrane Databases was performed in July 2014. The authors further canvassed the reference list of selected articles and online search engines such as Google Scholar. An inclusion criterion was studies that assessed the prevalence and/or incidence of knee OA in athletes (competitive or amateur).

Results and Discussion: Animal data suggests that intrinsic injury or excessive exercise leads to a higher incidence of OA, however, moderate exercise may offer a protective effect against OA. Running athletes can be divided into two groups based on age at which they began running: early age athletes and middle-to-older age athletes. For early athletes there is conflicting data about the prevalence of knee OA or earlier OA. It appears that despite worse radiological OA, clinically these patients are no different to non-running younger people in later life. For the middle-older age runners, running as a tool of exercise is not associated with increased risk of knee OA and may in turn provide a protective effect against a variety of chronic diseases in the elderly.

Conclusion: Middle to older age patients should be encouraged to pursue running to improve overall fitness and explained about the non-impact on earlier knee OA as is commonly perceived by the population. For the younger athletes, further work is needed to conclusively prove an association or non-association.

Keywords: Knee osteoarthritis, running athletes, middle age, elderly, young.

INTRODUCTION

Osteoarthritis (OA) is one of the most common causes of disability in developed countries. Knee OA is seen radiographically in 33% of the population older than 60 years of age and is responsible for a higher incidence of disability than any other chronic condition [1]. An increase in the level of recreational physical activity is a widely administered public health initiative to combat cardiovascular disease and osteoporosis, yet the risks associated with excessive sports activity is unclear.

People engaged in sports or other physically demanding activities are widely perceived to suffer from disorders, present or future, of their most active joints. Part of this apparent correlation can be explained by the increased risk of joint injury associated with their sports [2]. Long-distance and marathon running are relatively safe sports [3]. A natural progression is that the joints of runners subject to repetitive loading would at some point of time fail due to OA. However, this association has not been proved conclusively in the literature, with a recent systematic review finding that runners have no increased risk of hip OA [4]. The data on knee OA is more conflicting.

This review explores animal studies of running on knee OA, followed by some general human study data and then a specific focus on runners.

METHOD

A search of MEDLINE, EMBASE and Cochrane Database was performed in August 2014 (search terms: “knee osteoarthritis” AND “runners”; “knee osteoarthritis” AND “athletes”; and associated synonyms). The authors further canvassed the reference list of selected articles and online search engines such as Google Scholar. Inclusion criteria was studies that assessed the prevalence and/or incidence of knee OA in athletes (competitive or amateur).

Animal Studies

Animal studies have attempted to simulate repetitive joint stresses that may be experienced by runners. Radin and co (1982) found that sheep exposed to hard surface walking versus soft surface walking (wood-chip and pasture) had significant histopathological changes to their knee joints two and half years down the track, suggestive of arthritis [5].

In a canine based study, Kiviranata *et al*. (1988) found that running beagle dogs had improved cartilage

*Address correspondence to this author at the Department of Orthopaedics, Padmashree Dr DY Patil Medical College and Hospital, Navi Mumbai, Maharashtra, India; Tel: +918452846005; E-mail: manit_arora@hotmail.com

E-ISSN: 2313-0954/15

thickness and gylocsaminoglycan content at a period of 40 weeks compared with control dogs [6], suggesting that moderate running improves joint condition. In contrast to this moderate level of running, excess running load in male Wistar rats was found to increase the incidence of osteoarthritic changes [7], which the authors suggested may be due to an increase in MMP-3 production with greater running loads. Of note here, the difference may be due to the different species and hence different joint cartilage thickness and viscosity.

Laprvetaleainen *et al.* (2001) compared wheel running in normal mice and those with heterozygous inactivation of Col2a1 gene coding for the type II procollagen (to make the articular cartilage more susceptible to OA)m and homozygrous inactivation of the Col11a2 gene [8]. The authors found that OA prevalence in the genetically deficient mice was higher than controls, but that life long wheel running offered a protective effect against OA even in the genetically defcicent mice.

Overall, the animal data suggests that intrinsic injury or excessive exercise leads to a higher incidence of OA, however, moderate exercise may offer a protective effect against OA.

Human Studies of Middle-Older Age Runners

Middle to older age people are often advised to increase their level of physical activity to combat diseases such as cardiovascular and cerebrovascular disease. Some voluntarily undertake recreational running whereas others have a more doctor-advocated initiation. This age group I define as the middle-older age runners, that is, those that begin running at a later age and were not engaged in competitive running in the younger years.

Although widely advocated as a 'good' form of exercise for middle and older age individuals, running suffers from the stigma of causing knee OA in this age group. Much of this stems from the most early works of the HANES I study which found that occupational physical knee bending demands increase the risk of knee OA [9].

Much conflicting literature on the effects of running in this population group has been published in the three decades since the HANES I study. In a review of the literature in 2009, Bosomworth showed that provided trauma is avoided, moderate levels of exercise (jogging/light running) does not lead to acceleration of knee OA, whether or not there is evidence of pre-existing disease [10]. In fact, there appears to be improved physical conditioning and reduction of pain and disability in those who exercise.

Some noteworthy studies include the studies by Lane and colleagues who found that middle-to-older age runners did not suffer from an increased risk of knee OA, but that their bone mineral density increased over the 9 year study period [11,12]. In the much publicized Framingham study, Felson and co (2007) found that among middle-to-elderly age persons without knee OA, many of whom were overweight, recreational exercise neither protects nor increases the risk of knee OA [13].

In a 10 year American follow-up study of 17000 patients, Cheng *et al.* (2000) found that those involved in higher levels of physical activity (walking or running more than 20 miles per week) and men were more likely to have knee OA [14]. The study was limited by the fact that subjects were demographically uniform (i.e. well educated, non-Hispanic white men of high socioeconomic status) and there was no data available on the patients occupational activities or history of physical data, or clinical encounters, relying instead on self-reported data for follow-up.

In a more direct comparison of middle-to-older age long distance runners with health non-runners over a period of two decades, Chakravaty *et al.* (2008) found that long distance running did not significantly accelerate the rate of OA compared to controls [15]. Risk factors for progression of OA in both groups were higher initial BMI and initial evidence of radiographic damage [15]. No significant association was found with relation to gender, education, previous knee injury or mean exercise time. This suggests that a sound knee will endure the load of long distance running, however for non-healthy knees there is a progression towards OA.

Thus overall it seems that moderate and even long distance running in the middle-older age group may not increase the progression of knee OA, provided that the beforementioned risk factors are not present. As such, this group can be treated separately to the subjects below.

Human Studies of Early Age Runners

The early age runners are the ones who represent the real problem to the sports physician. These runners, competitive or non-competitive, have traditionally been thought to expose their knee joints to

considerable forces over their sporting career and may present in the future with an earlier onset of knee OA.

Certainly, the low contact nature of running makes it less likely to cause early OA compared with other sports. In a retrospective study of 117 male former top-level athletes across four disciplines (long-distance runners, soccer players, weight lifters and shooters), Kujala *et al.* (1995) found that soccer players had the highest prevalence of tibiofemoral OA and weight-lifters the highest prevalence of patellofemoral OA on radiography [16]. Further, the authors found that the risk of knee OA increased with previous knee injuries, higher BMI at the age of 20 years, and previous participation in heavy work. Further, in a Finnish retrospective study, 2049 male former elite athletes, mixed sports and power sports were found to result in earlier OA, but endurance sports such as running led to knee OA at a much older age [17].

In a comparative study of 504 former varsity cross-country runners with 287 college swimmers after an average follow-up of 25 years, runners had an incidence of severe knee pain of 2% which was not statistically different to former swimmers (2.4%) [18]. The authors concluded no association between moderate long-distance running and future development of knee OA [18]. Further, no relationship was found between number of running years and knee OA [18]. Limitation of this study was the lack of a general population control group and the use of a validated instrument to determine OA.

In a retrospective study of 81 female former elite athletes (67 middle and long distance runners), Spector *et al.* (1996) found that the former athletes had greater evidence of OA, especially at the tibio-femoral and patella-femoral, compared with controls [19]. Runners were particularly susceptible to PF arthritis compared to former tennis players and controls. Overall, they found a 2 to 3-fold increase in the incidence of radiographic knee OA compared to controls standardized for age. However, the authors found similar incidence of reported knee pain between the former athletes and the control group. Limitations were small sample size, combining runners and tennis players into one study group, and female only. However, this may suggest that although runners have worse knees radiologically, the adaptive mechanisms for stress control across the knee render them clinically comparable to the general population.

There is a need for long term studies to follow runners throughout their careers to determine the risk of knee OA compared with age and gender matched controls. Also, the histopathological, biomechanical and biochemical contributing factors need to be better investigated. In a recent study, Miller *et al.* (2014) explained that compared with walking, the relatively short duration of ground contact and relatively long length strides in running seem to blunt the effect of high peak joint loads, such that the load per unit distance is no higher than in walking [20].

CONCLUSION

Running athletes can be divided into two groups based on age at which they began running: early age athletes and middle-to-older age athletes. For early athletes there is conflicting data about the prevalence of knee OA or earlier OA. It appears that despite worse radiological OA, clinically these patients are no different to non-running younger people in later life. For the middle-older age runners, running as a tool of exercise is not associated with increased risk of knee OA and may in turn provide a protective effect against a variety of chronic diseases in the elderly. Middle to older age patients should be encouraged to pursue running to improve overall fitness and explained about the non-impact on knee OA as is commonly perceived by the population. For the younger athletes, further work is needed to define an association or prove a non-association.

REFERENCES

[1] Felson DT. An update on the pathogenesis and epidemiology of osteoarthritis.RadiolClin North Am. 2004 Jan; 42(1):1–9, v. http://dx.doi.org/10.1016/S0033-8389(03)00161-1

[2] Baker P, Coggon D, Reading I, Barrett D, McLaren M, Cooper C. Sports injury, occupational physical activity, joint laxity, and meniscal damage. J Rheumatol. 2002 Mar 1; 29(3): 557–63.

[3] Levine BD, Thompson PD. Marathon maladies. N Engl J Med. 2005 Apr 14; 352(15): 1516–8. http://dx.doi.org/10.1056/NEJMp058043

[4] Walther M, Kirschner S. Is running associated with premature degenerative arthritis of the hip? A systematic review. Z FürOrthopIhreGrenzgeb. 2004 Apr; 142(2): 213–20.

[5] Radin EL, Orr RB, Kelman JL, Paul IL, Rose RM. Effect of prolonged walking on concrete on the knees of sheep. J Biomech. 1982; 15(7): 487–92. http://dx.doi.org/10.1016/0021-9290(82)90002-1

[6] Kiviranta I, Tammi M, Jurvelin J, Säämänen AM, Helminen HJ. Moderate running exercise augments glycosaminoglycans and thickness of articular cartilage in the knee joint of young beagle dogs. J Orthop Res Off PublOrthop Res Soc. 1988; 6(2): 188–95. http://dx.doi.org/10.1002/jor.1100060205

[7] Pap G, Eberhardt R, Stürmer I, Machner A, Schwarzberg H, Roessner A, *et al.* Development of osteoarthritis in the knee joints of Wistar rats after strenuous running exercise in a running wheel by intracranial self-stimulation. Pathol Res Pract. 1998; 194(1): 41–7. http://dx.doi.org/10.1016/S0344-0338(98)80010-1

[8] Lapveteläinen T, Hyttinen M, Lindblom J, Långsjö TK, Sironen R, Li SW, *et al.* More knee joint osteoarthritis (OA) in mice after inactivation of one allele of type II procollagen gene but less OA after lifelong voluntary wheel running exercise. OsteoarthrCartil Oars Osteoarthr Res Soc. 2001 Feb; 9(2): 152–60. http://dx.doi.org/10.1053/joca.2000.0370

[9] Anderson JJ, Felson DT. Factors Associated with Osteoarthritis of the Knee in the First National Health and Nutrition Examination Survey (hanes I) Evidence for an Association with Overweight, Race, and Physical Demands of Work. Am J Epidemiol. 1988 Jul 1; 128(1): 179–89.

[10] Bosomworth NJ. Exercise and knee osteoarthritis: benefit or hazard? Can Fam Physician. 2009 Sep 1; 55(9): 871–8.

[11] Lane NE, Michel B, Bjorkengren A, Oehlert J, Shi H, Bloch DA, *et al.* The risk of osteoarthritis with running and aging: a 5-year longitudinal study. J Rheumatol. 1993 Mar; 20(3): 461–8.

[12] Lane NE, Bloch DA, Jones HH, Marshall WH, Jr, Wood PD, *et al.* Long-distance running, bone density, and osteoarthritis. JAMA. 1986 Mar 7; 255(9): 1147–51. http://dx.doi.org/10.1001/jama.1986.03370090069022

[13] 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 Care Res. 2007 Feb 15; 57(1): 6–12. http://dx.doi.org/10.1002/art.22464

[14] 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 ClinEpidemiol. 2000 Mar 1; 53(3): 315–22. http://dx.doi.org/10.1016/S0895-4356(99)00168-7

[15] Chakravarty EF, Hubert HB, Lingala VB, Zatarain E, Fries JF. Long Distance Running and Knee Osteoarthritis: A Prospective Study. Am J Prev Med. 2008 Aug;35(2):133–8. http://dx.doi.org/10.1016/j.amepre.2008.03.032

[16] Kujala UM, Kettunen J, Paananen H, Aalto T, Battié MC, Impivaara O, *et al.* Knee osteoarthritis in former runners, soccer players, weight lifters, and shooters. Arthritis Rheum. 1995 Apr 1;38(4):539–46. http://dx.doi.org/10.1002/art.1780380413

[17] Kujala UM, Kaprio J, Sarno S. Osteoarthritis of weight bearing joints of lower limbs in former elite male athletes. BMJ. 1994 Jan 22;308(6923):231–4. http://dx.doi.org/10.1136/bmj.308.6923.231

[18] Sohn RS, Micheli LJ. The effect of running on the pathogenesis of osteoarthritis of the hips and knees.ClinOrthop. 1985 Sep;(198):106–9.

[19] Spector TD, Harris PA, Hart DJ, Cicuttini FM, Nandra D, Etherington J, *et al.* Risk of osteoarthritis associated with long-term weight-bearing sports: a radiologic survey of the hips and knees in female ex-athletes and population controls. Arthritis Rheum. 1996 Jun;39(6):988–95. http://dx.doi.org/10.1002/art.1780390616

[20] Miller RH, Edwards WB, Brandon SCE, Morton AM, Deluzio KJ. Why don't most runners get knee osteoarthritis? A case for per-unit-distance loads. Med Sci Sports Exerc. 2014 Mar;46(3):572–9. http://dx.doi.org/10.1249/MSS.0000000000000135

Received on 31-08-2014 Accepted on 20-10-2014 Published on 27-05-2015

DOI: http://dx.doi.org/10.12974/2313-0954.2015.02.01.1