Annals of Physical and Rehabilitation Medicine 59 (2016) 196–206

Available online at ScienceDirect www.sciencedirect.com

Elsevier Masson France EM|consulte www.em-consulte.com

Review

Is physical activity, practiced as recommended for health benefit, a risk factor for osteoarthritis?

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ARTICLE INFO

Article history:
Received 30 November 2015
Accepted 28 February 2016

Keywords:
Physical activity
Exercises
Sports
Osteoarthritis
Risk factor
Injuries
Joint injuries
Impact
Elite athletes

ABSTRACT

In this critical narrative review, we examine the role of physical activity (PA), recreational and elite sports in the development of knee/hip osteoarthritis (OA), taking into account the role of injury in this relationship. The process of article selection was unsystematic. Articles were selected on the basis of the authors' expertise, self-knowledge, and reflective practice. In the general adult population, self-reported diagnosis of knee/hip OA was not associated with low, moderate or high levels of PA. For studies using radiographic knee/hip OA as a primary outcome, the incidence of asymptomatic radiographic OA was higher for subjects with the highest quartile of usual PA than the least active subjects. The risk of incident radiographic knee/hip OA features was increased for subjects with a history of regular sports participation (for osteophyte formation but not joint space narrowing). This risk depended on the type of sport (team and power sports but not endurance and running), and certain conditions (high level of practice) were closely related to the risk of injury. The prevalence of radiographic OA was significantly higher, especially the presence of osteophytes, in former elite athletes than controls. The risk of OA was higher with participation in mixed sports, especially soccer or power sports, than endurance sport. However, the prevalence of clinical OA between former elite athletes and controls was similar, with less hip/knee disability in former athletes. Moderate daily recreational or sport activities, whatever the type of sport, are not a consistent risk factor for clinical or radiographic knee/hip OA. Risk of injury in different sports may be the key factor to understanding the risk of OA related to sport.

1. Introduction

The 2008 Physical Activity Guidelines Advisory Committee report [1] and the recent update of the INSERM French report [2,3] provide overwhelming evidence for the health benefits of physical activity (PA) and exercise and support the national promotion of a physically active lifestyle. A distinction should be made between physical activity, sport and exercise. PA is defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" [4]. The broad components of physical activity are occupational, transport, domestic, and leisure time (which consists of exercise, recreational or competitive sport). Exercise has the features of "planned, structured and repetitive bodily movement, the objective of which is to improve or maintain physical fitness" [4]. Sport is a subset of exercise that can be undertaken individually or as a part of a team. Participants adhere to a common set of rules or expectations, and a defined goal exists. However, formal sport participation, whether competitive or not, is not necessary for a physically active lifestyle.

The latest evidence supports the positive effects of participating in regular physical activities, including recreational activities or competitive sports, because it improves general health, reduces obesity, and may increase longevity [3]. However, concerns have been raised about the possible association of increased levels of PA with greater incidence of lower-limb osteoarthritis (OA) as a result of

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http://dx.doi.org/10.1016/j.rehab.2016.02.007
1877-0657/

accelerated "wear and tear" of the major joints [5]. Sport participation may increase the risk of OA. Whether this observation is specific to the type of sport, sport volume, sport-related injury or other factors is unclear [6]. Therefore, evidence-based recommendations are needed to help people choose the appropriate PA or sports [7]. However, most systematic reviews have focused on recreational or competitive sport and the development of OA.

Here, we wondered whether risk of OA is increased with participation in the entire component of physical activity recommended in primary prevention for health benefits. Some activities are believed to be beneficial for the joint because they increase the circulation of synovial fluid, which bathes the articular cartilage with nutrients and maintains peri-articular muscle strength [8]. Regular moderate exercises may be beneficial to the joint, but too-strenuous exercises may not be [9,10]. Some cross-sectional and longitudinal MRI studies suggest that PA benefits articular cartilage with increased tibial cartilage volume at the knee [11–15].

In this review, we critically analyzed evidence for PA and sport as risk factors of lower-limb OA. The process of article selection was unsystematic. Articles were selected on the basis of the authors' expertise, self-knowledge, and reflective practice. We qualitatively examined the role of PA, recreational and elite sports in the development of knee and/or hip OA lesions, taking into account the role of injury in this relationship.

2. Physical activity as a risk factor for knee and/or hip OA in the general population

2.1. Self-reported physician-diagnosed hip/knee OA

Nine prospective studies (Table 1), from general-population cohorts, examined the level of PA as a risk factor of incident knee/hip OA. The primary outcome was self-reported physician-diagnosed hip/knee OA in 4 of the studies. Low, moderate or high levels of PA were not associated with self-reported diagnosis of knee/hip OA [16–19]. Hootman et al. [16], in a longitudinal study of 5283 adults followed up for a median of 12.8 years, found that PA in leisure time, such as walking, running, jogging, bicycling, swimming, racquet sports and other strenuous sports, stretching exercises, calisthenics, and weight training, did not increase hip/knee OA frequency, whatever the type and volume of PA (intensity, time, frequency and type of strain). Three other prospective studies found no association between usual or leisure PA and knee/hip OA incidence [17–19]. Toivanen et al. [18] performed a prospective survey of 8000 subjects representative of the Finnish population aged 53 years; 823 subjects without knee OA at baseline were re-assessed after 22 years. Regular leisure PA was associated with a reduced rate of clinically diagnosed knee OA [18]. Mork et al. [19] included 15,191 women and 14,766 men without pain or physical impairment at baseline from the Norwegian HUNT Study. At 11-year follow-up, exercise, whatever the amount, was not associated with increased risk of clinical OA. Cheng et al. found that only high levels of PA (running 20 or more miles per week) among men under age 50 were associated with self-reported physician-diagnosed OA after controlling for body mass index (BMI), smoking, and use of alcohol or caffeine, but not knee injury. No relationship was found among women or older men [17].

2.2. Radiographic knee/hip OA

Five studies used radiographic knee/hip OA as a primary outcome and found the incidence of asymptomatic radiographic OA greater for subjects with the highest quartile of usual PA than the least-active subjects [20–24]. Three prospective studies used data collected as part of the Framingham Surveys, and 2 found risk of incident asymptomatic radiographic knee osteophytes greater for subjects with the highest quartile of usual PA than the least-active subjects [20,22]. Hart et al. [24], in a prospective population-based study (715 women) from the Chingford cohort who were followed up with knee radiographs for 4 years, found no association between PA and OA. In the longitudinal study of the Melbourne Women's Mid-life Health Project, a population-based prospective study, 257 Australian women were followed up yearly over 11 years and 224 had knee radiography. Osteophytes were detected in 65 (29%) cases and joint space narrowing in 95 (42%) [23]. On multivariate analysis, the mean amount of exercise performed over the study period was associated with only patello-femoral narrowing but not tibio-femoral osteophytes. Moreover, history of knee injury was not accounted for in the multivariate analysis.

2.3. PA and knee/hip joint replacement

In a prospective population-based cohort addressing the effect of leisure time PA on severe knee or hip OA, defined as knee/hip replacement [25], leisure time PA was reported by 28,320 participants (mean age 58 ± 7.6 years) at baseline. Risk of knee/hip replacement was not associated with leisure time PA over the 11-year follow-up. The most commonly reported PAs were walking, bicycling, using the stairs, and gardening. Walking reduced the risk of hip replacement [25].

2.4. PA and self-reported knee OA

Only one retrospective case–control matched study investigated the relation between usual PA and self-reported knee OA [5]. Among 4316 subjects screened from the Allied Dunbar National Fitness Survey (1990–91), 216 (150 women) were eligible (mean age 57.1). Each case was matched to 4 controls. The only strong association found for increased risk of self-reported knee OA was a history of knee injury.

3. Sport as a risk factor of knee and/or hip OA in non-elite general adults

3.1. Any type of sports (Table 2)

One prospective study examined the relationship between regular sports participation and risk of radiographic knee OA [26]. In a population-based longitudinal study examining a cohort of 354 adults with knee radiography performed 5 years apart, the risk of incident radiographic knee OA features was increased for subjects with a history of regular sports participation for osteophyte formation only but not joint space narrowing [26]. The odds ratios were not adjusted for history of injury as a potentially confounding variable in the expanded regression model.

Several case–control studies found that OA risk may depend on the type and volume (intensity, frequency and duration) of sport practiced. Nine case–control studies evaluated the risk of knee/hip OA among the general adult population by different types of sport. Risk of OA was increased with certain types of sport and high sport exposure [8,27–32]. In 5 studies, the sports associated with increased prevalence of radiographic knee/hip OA [8,27–30] or joint replacement rate [28,31] were soccer, ice hockey, tennis, ball games (handball, volleyball, basketball), sport cycling, gymnastics and kung-fu. Risk of radiographic knee/hip OA was not increased with endurance sports such as track and field, cross-country skiing, orienteering and running. In 4 studies, sport intensity (total hours