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The connection between competitive walking and osteoarthrosis in the knee and hip joints

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The purpose of the study presented here was to investigate a possible long-term correlation between intensive sports activity and the later development of degenerative changes in the hip and knee joints. Race walking was selected as a basis for this study because it is asserted that the movements of a race walker are cultured rather than natural and exert high loads on the hip and knee joints. 14 male competitive walkers, aged between 50 and 70, were examined; none of them showed any sign of osteoarthrosis in hip or knee joints.

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Translated from the original Swedish by Bill Glad

Introduction

Many factors are thought to be significant in the pathology of osteoarthrosis of the hip and knee joints.

Malalignment, for example, or other congenital biomechanical factors may be contributors, as may trauma, metabolic factors and stress from work-related loads imposed by sports or fitness training.

Two principal theories have been proposed on the subject of connection between sport and osteoarthrosis. The first, put forward by Radin[1] in 1976, asserts that *microtrauma*, caused by the repetitive impact of *heel-strike* in physical work and sports activity, can give rise to degenerative effects in movement apparatus, especially in the hip and knee joints.

The other theory postulates that repetitive heel-strike in a practised sports activity does not lead to degenerative joint changes because the affected organs adapt themselves structurally to every change, as defined by Wolff's Law. The theory goes on to argue that any increased prevalence of osteoarthrosis in hips and knees amongst athletes is more likely to be a reflection of macrotrauma in the form of ligament and joint injuries. Furthermore, in the absence of such macrotrauma, sport and fitness

Coxarthrosis: Degeneration, specifically of the hip bone or joint.

Osteoarthritis: A chronic inflammation of the joints, especially those which bear weight, with pain and stiffness. Also called *degenerative joint desease*.

Osteoarthrosis: Degeneration of joints, with some loss of the almost frictionless cartilage linings and formation of rough bone deposits. Unlike osteoarthritis, the condition is not accompanied by inflammation. It is generally accepted as one of the symptoms of ageing.

Osteophytes: Small abnormal bony outgrowths associated with degeneration of the joints.

Pes cavus: A condition of the foot in which the arches are abnormally high.

Pes valgus: A condition of the foot in which the arches are abnormally flattened - commonly know as "flat foot".

Pes planus: Congenital deformity of the foot in which the sole is splayed outwards (pes varus describes the opposite condition, with the foot turned in; pes planovalgus refers to the foot both abnormally flattened and splayed out, etc.)

Sclerosis: A hardening or thickening of organs, tissues or vessels due to chronic inflammation.

Wolff's Law: "Every change in the form and function of bones is followed by certain definitive changes in their internal architecture and equally definitive secondary alterations in their external configuration in accordance with mathematical laws."

activities are themselves more likely to result in a lowered incidence of osteoarthrosis.

Heel-strike in competitive walking certainly exerts high loads on the lower extremities. A competitive walker can, during his active career, cover 200,000 to 300,000 kilometres, and some have asserted that competitive walking can lead to tendon injuries affecting the pelvis as well as the knee and hip joints.

Background

There are no properly controlled studies of the long-term effects on the muscular-skeletal system resulting from various sports and fitness activities. Those studies which have been completed can be summarized as follows:

In 1987, Andersson and Nilsson[2] from Sweden reported a study of dancers with an increased prevalence of osteoarthrosis in the lower extremities and particularly in the main joint of the big toe.

Adams[3] found osteoarthrosis in the shoulder and elbow joints of baseball pitchers; and a study by Solonen[4] found arthritis in the knee and foot joints, but not in the hip joints, of footballers.

Finally, in a Finnish study, Puranen[5] and his co-workers discovered a higher incidence of coxarthrosis in Finnish elite runners than in a matched control group.

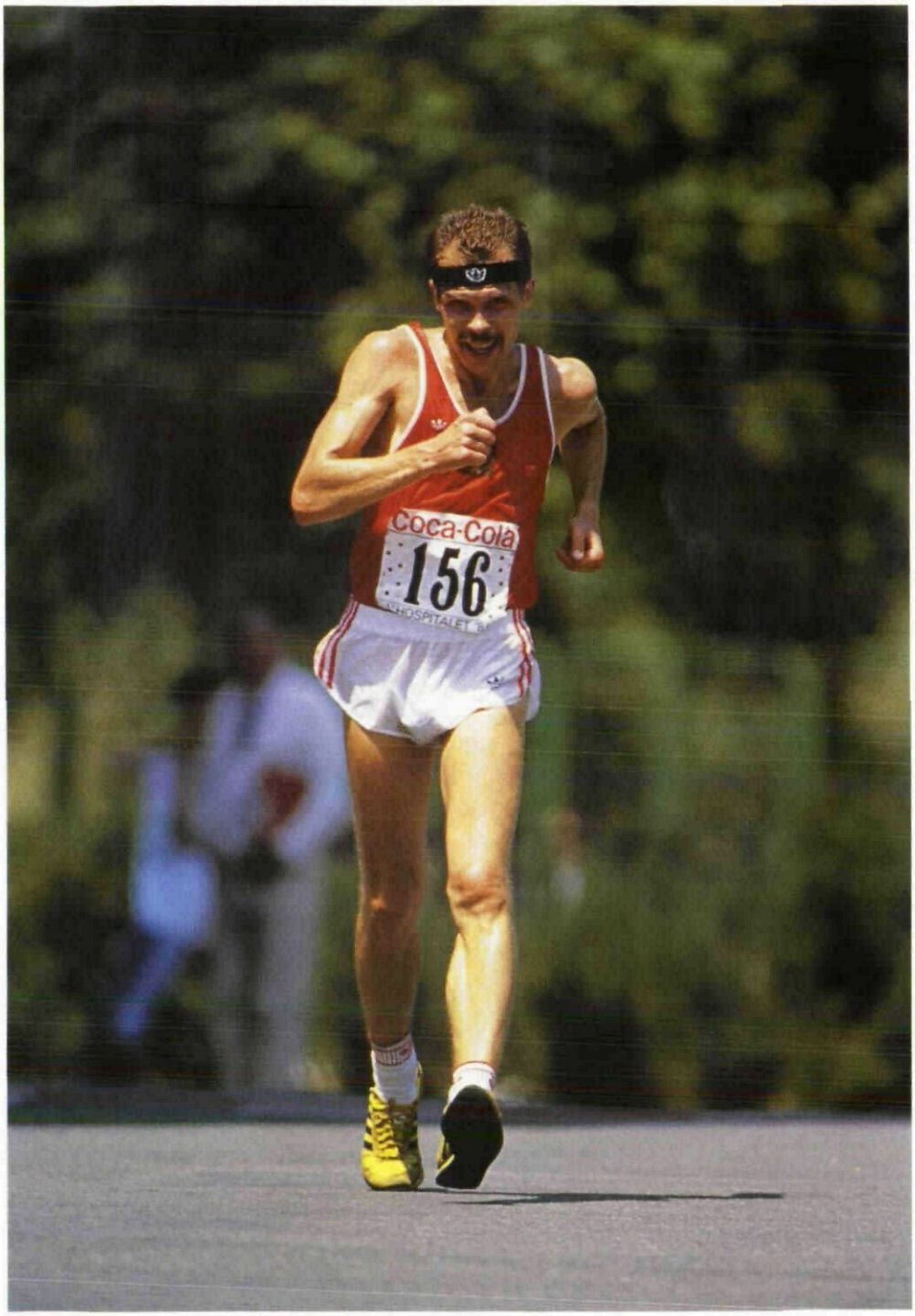
Objective

The purpose of this study was to investigate a possible long-term correlation between intensive sports activity and the later development of degenerative changes in the hip and knee joints. This would include special analyses of the effects of sports, types of work and trauma (injury).

We selected race walking as the basis for our study because it is asserted that the movements of the race walker are cultured rather than natural and exert high loads on the hip and knee joints.

Method

The basis of our study was a group of 14 male competitive walkers between the



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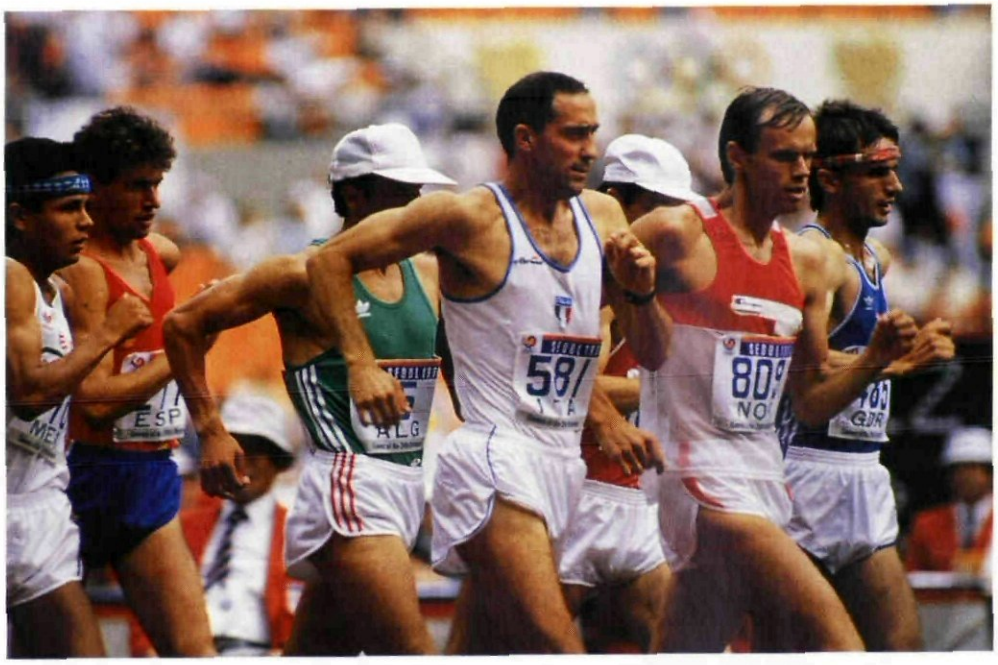

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ages of 50 and 70 years, selected by the Swedish Walking Federation and amongst the Swedish national and international elite during the 1950s.

The walkers had an average age of 62 years. Their average height was 179cm and their average weight 72 kg. All but one had maintained their competition weight.

These walkers supplied information on their training programmes and competitive records, together with details of past and present injuries and complaints.

They were subjected to clinical examinations, including analysis of malalignment of the lower extremities and the occurrence of osteoarthrosis in the knee and hip joints. Finally, radiological examinations, including X-ray photographs of the hip and knee joints, were completed.

Career workload of the sample group

Analysis of the 1950s walkers' careers shows a marked contrast with today's athletes on all significant points.

Of our group of 14, one walker started competition at the age of 10 years; none of the others made their competition debut before the age of 17. One participant started at the age of 32. He was formerly a competitive runner who had been forced to stop running due to over-use injuries. During the 1980s the average age for competition debut was 11 years.

The group of 14 had very long competitive careers. The average was 28 years in duration and the longest was 53 years. This indicates that they continued to compete long after their period amongst the elite.

11 out of 14 had competitive careers of longer than 15 years. All had continued with regular fitness training after the end of their competitive careers. In the 1980s, however, walkers had an average career duration of 12 years. Even this is long in comparison with other competitive sports such as swimming, gymnastics and football, all of which have early competitive debuts, short careers and abrupt ends.

Like most elite athletes, our group of 14 kept competition and training diaries; this enabled us to make exact calculations of their training loads.

Their total distance covered in training and competition averaged 130,000 km, and varied between 40,000 and 280,000 km. This represented an average of approximately 15 km or 1.5 hours per day of training time. In the 1980s, elite walkers' training constituted around 2.5 hours per day.

Of the group of 14, 10 were involved in physical activity of more than 4 hours per day in their work; for example, one was a postman. In today's Swedish national team only 1 out of 15 athletes is involved in physical labour.

Heel-strike impact

In the 1950s, walking shoes had thin rubber soles without any shock absorption, and were used on rough surfaces such as gravel, ashphalt and crushed coal roads. Today's footwear is vastly improved, and athletes no longer train on rough or gravel surfaces.

To complete these comparisons we measured the impact force F_z of walking on a force plate. We found that F_z at heel-strike is 1.5 times body weight at a walking speed of 3.5 metres per second (m/s), which was the average competition speed for elite walkers in the 1950s.

Today's elite competitive walkers have increased the speed to 3.9 m/s, which produces a force F_z at heel-strike of 2.5 times body weight.

We attempted to estimate the average total career impact for the group of 14. 130,000 km of walking, with a stride length of 1.1 metres, gives 118 million heel-strikes. This, multiplied by 1.5 times average body weight, results in a total cumulative impact of 125 million tons. To put this in context we can compare it with running, during which F_z is greater (running is actually a mini-hop). Running at competition speed gives a force F_z of 5 - 7 times body weight, and this is a probable explanation for the high rate of over-use injuries amongst runners.

Findings

The results of our investigations can be summarized as follows:

Coxarthrosis

To establish a benchmark for the prevalence of coxarthrosis in the age group, we used the work of Håken Lindberg[6] and his team in Malmö; they found 16 cases per 1000 individuals. In analysing our X-ray results we used the same criteria as used by Lindberg, and earlier by Danielsson[7]: i.e. that a joint gap of less than 4 mm would constitute arthrosis.

Our study found no cases of this in the hip joints of any of the participants. One patient was on the borderline, with a joint gap of between 3 and 4 mm, but there were no osteophytes, sclerosis or other sign of arthritis. Clinical examinations also failed to discover any cases of osteoarthrosis.

Thus we found no self-defined, clinical or radiological evidence of osteoarthrosis in the knee or hip joints of this group.

Malalignments

We also studied the occurrence of malalignment in the lower extremities. We found that 12 out of 14 had showed some form of malalignment. This is a very high proportion for an elite sports group.

50% had conditions affecting the arch of the foot; 6 *pes planus* or *pes planovalgus;* and 1 *pes cavus.* 10 out of 14 had soft heel pads which, according to Jörgensen[8] and others, is regarded as a predisposition to over-use injuries.

Trauma

Analysis of past injuries to the lower extremities revealed that 8 out of 14 had no trauma at all. Of the rest, some had suffered work or training injuries of a minor kind, such as injuries to the menisci.

Conclusions

When using the group of 14 to prognosticate possible future effects for today's walkers, we need to take into account that the latter spend more training hours, cover more training distance, at faster speeds and

with greater heel-strike force than the elite of the 1950s.

However, their careers are of much shorter overall duration, and their walking is done on smoother surfaces with greatly improved shock absorption in their shoes. They also do not do any occupational work on their feet.

We have found that these 14 competitors showed no signs of osteoarthrosis in hip or knee joints in spite of heavy training loads during long careers and in spite of malalignment in several of the subjects.

We see this as encouragement to do further biomechanical studies of joint-loading in walking as well as in running and other fitness activities. The indications of this report are that race walking and fast promenading can be, for many people, a more pleasant and a safer way to get fit than running.

Postscript

Readers may be interested to learn that one of our participants had such a pronounced *pes planovalgus* that on inspection as an 18 year old he was declared unfit for military service for the reason that he would not be able to tolerate marching.

He subsequently completed 280,000 km in walking sports, including competitive race walking; took part in 5 Olympic Games; took 3 Olympic medals and set 6 World Records. □

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