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Musculoskeletal Injuries in Jogging

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and

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• The effects of running-jogging on the musculoskeletal system were studied in 120 middle-aged adults. Two hundred forty-one injuries of various types occurred: 43 per cent were muscle strains, mostly of the triceps surae group; 20 per cent were joint sprains of the knee and ankle; and 18 per cent were various foot ailments. Two fatigue fractures, both in the distal shaft of the fibula, occurred in the same individual. Rest was the major treatment. From an orthopedic view, running-jogging is a relatively safe activity for middle-aged adults.

The popular and professional notion that exercise is essential to healthful living invites the attention of investigators on the physiologic and medical implications of specific programs.

Recently jogging has become a desirable form of exercise, however despite its widespread popularity the orthopedic and related literature is sparse or conflicting as to the beneficial or detrimental effects of this practice. Knowledge of the effects of jogging on the musculoskeletal organs is of interest since the physician may be called on for advice or treatment.

Data were obtained from two groups who participated voluntarily in an 11-week jogging program: one group was comprised of students and faculty members of the University of California at Berkeley, the other of persons in the San Francisco area.

Methods

Questionnaires were distributed during the first and last weeks of an 11-week jogging program to 72 participants of the Berkeley group and to 48 from the San Francisco group. The age range of the Berkeley group was from 19 to 65 years (mean, 34 years); that of the San Francisco group from 24 to 70 years (mean, 40 years). Eight of the 120 joggers were women from 24 to 45 years of age (mean, 30 years).

The questionnaires included specific questions concerning medical history, description, location and complete explanation of all discomforts thought to arise from jogging, style of running shoes used, and typical running surfaces. During the exercise period all the joggers were seen by one of the investigators, or by a knowledgeable physician. Of the 120 individuals who returned questionnaires, 86 were novice joggers and 34 had been jogging from 1 to 10 years. (Not included in the preceding statistics is a 102-year-old man who stated that he had been jogging for 93 years.)

Results

As might be expected from a survey of this type, many of the reported injuries had to be interpreted for appropriate classification. The injuries were classified as follows:

- (1) muscle strains in lower extremities,
- (2) joint sprains in lower extremities,
- (3) tendon injuries in lower extremities,
- (4) foot problems,
- (5) fatigue fractures,
- (6) back pain,
- (7) costochondral sprains, and
- (8) miscellaneous, nonrelated injuries.

Sprains and strains are defined according to the terminology suggested in the Standard Nomenclature of Athletic Injuries of the American Medical Association.¹

In total, 241 injuries were reported. If injuries were bilateral but occurring at the same time, they were counted as one. If similar injuries occurred at different times in the same person during the course

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Fig. 1—Example of toenail injury that occurred in several joggers. Note the ecchymotic line across the nail and the nail deformity.

of the 11 weeks, these injuries were counted separately.

Table 1 illustrates the injury pattern of the 120 joggers. Forty-three per cent of the injuries were muscle strains, 20 per cent were joint sprains, and 18 per cent were foot problems. Sixty-three per cent of the muscle strains were located in the triceps surae group, and 21 per cent in the hamstring muscles. True anterior compartment syndrome was neither reported nor diagnosed. However, 11 joggers were diagnosed as having "shin

Table 1: Number and Types of Injuries Reported by 108 of 120 Joggers*

Types of injuries	Number of injuries
Muscular strains	
Triceps surae	63
Anterior compartment	12
Hamstring	21
Quadriceps	5
Hip adductors	2
Joint sprains	
Knees	27
Ankles	20
Tendon injuries	
Achilles tendinitis	12
Pes anserinus bursitis	1
Plantaris tendon rupture	1
Foot problems	
Blisters	14
Arch strain	13
Sore heels	5
Heel bursitis	3
Toenail injuries	3
Bruises	2
Metatarsalgia	2
Corns	1
Fatigue fractures	
Fibulae	2 (bilateral)
Back pain	11
Costochondral sprains	4
Nonrelated musculoskeletal ailments	17
Headaches	
Sinus drainage	
Abdominal pain	
Skin rash (thighs)	
Arm pain	
Venous distention in the lower extremities	
No reported injuries	12 persons

*Included are one or more injuries per jogger.

splints." One jogger, due to a previous herniation of the musculature through the fascia, reported bilateral bulging of the anterior compartments while running.

Achilles tendinitis accounted for all but two of the reported tendon injuries. Pes anserinus bursitis, because of the close association of this condition with stresses placed on the overlying tendons,² was included in the section on tendon injuries.

Blisters and arch strains accounted for most of the foot ailments. The sore heels reported were similar to those described by Siegel³ as "jogger's heel." The toenail injuries consisted of painful subungual hematomas (fig. 1). They occurred in the second and third toes of the runners and did not appear to be associated with the type of shoes worn.

Two fatigue fractures were diagnosed. They occurred bilaterally in one jogger, in the distal third of the fibulae, at different times (fig. 2).

It was possible to categorize the injuries as to early or late onset in 86 persons who were followed from the initiation of their jogging program (table 2). Injuries of early onset include those that occurred 4 weeks into the program, and those of late onset after 4 weeks of training. As was expected, most of the injuries appeared early in the training program. It was interesting to note that the two fatigue fractures appeared late in training.

Table 3 shows that three runners dropped out of the jogging program permanently due to injuries. One stopped jogging because he could not tolerate the muscle cramps in his calves. Another developed Achilles tendinitis which was be-

Table 2: Frequency of Early and Late Onset* of Injury in the 86 Joggers Who Were Followed From the Time They Commenced Jogging

Type of injury	Early onset Number of injuries	Late onset Number of injuries
Muscle strain	47	3
Joint sprain	19	5
Tendon injuries	7	0
Foot problems	13	2
Fatigue fractures	0	2
Back pain	4	1
Costochondral sprain	2	0
Total	92	13

*In this study, *early onset* is defined as an injury occurring during the first 4 weeks of the jogging program, and *late onset* as that occurring after the first 4 weeks.

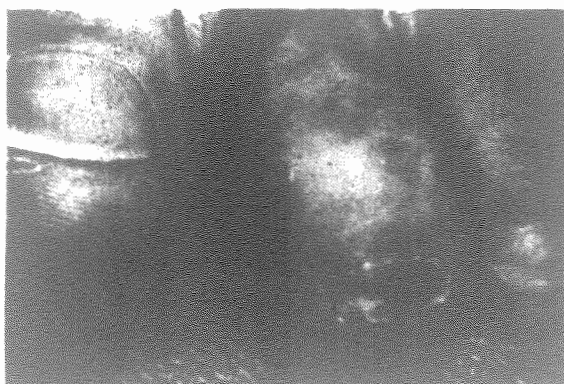


Fig. 1—Example of toenail injury that occurred in several joggers. Note the ecchymotic line across the nail and the nail deformity.

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Muscular strains	
Triceps surae . . .	43
Anterior compartment . . .	2
Hamstring . . .	11
Quadriceps . . .	1
Hip adductor . . .	1
Joint sprains	
Knees . . .	1
Ankles . . .	6
Tendon injuries	
Achilles tendinitis . . .	1
Pes anserinus bursitis . . .	1
Plantaris tendon rupture . . .	1
Foot problems	
Blisters . . .	21
Arch strain . . .	13
Sore heels . . .	2
Heel bursitis . . .	2
Toenail injuries . . .	3
Bruises . . .	1
Metatarsalgia . . .	1
Corns . . .	1
Fatigue fractures	
Fibulae . . .	2 (bilateral)
Back pain . . .	11
Costochondral sprains	1
Nonrelated musculoskeletal ailments	17
Headaches . . .	1
Sinus drainage . . .	1
Abdominal pain . . .	1
Skin rash (hives) . . .	1
Arm pain . . .	1
Venous distention in the lower extremities . . .	1
No reported injuries	11 persons

*Included are one or more injuries per jogger.

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Back pain . . .	4	1
Costochondral sprain	2	0
Total	92	13

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lieved to be the result of slight tightness of that tendon due to a preexisting ankle fracture. The third had partially corrected club feet, and although he wanted to continue running was unable to because of extreme ankle soreness.

Discussion

To explain the pattern of the injuries reported it is useful to consider some mechanical and physical aspects of running. Slocum and Bowerman⁴ have described running as a series of smoothly coordinated jumps rather than an acceleration of walking. Therefore, a runner may increase his speed by applying a more forceful thrust on push-off without increasing his cadence. Although it has not been definitely determined whether more work is placed on the muscles of deceleration (the gluteus maximus, the hamstrings and the muscles of the anterior tibial compartment), as in walking,⁵ or on the muscles of acceleration (the triceps surae and the intrinsic foot flexors),^{6,7} it would seem that, in running, the muscles of acceleration are called upon to work harder. Apparently this is true since the analysis of total injuries reveals that the majority of ailments were located in the triceps surae group. Thus, it is suspected that the ratio of energy expenditure of deceleration to acceleration would be reversed in running.

Slocum and Bowerman⁴ have also shown that the position of the pelvis is the key to postural control in running. Therefore, any style of running such as in a swayback posture which places the pelvis in an anatomically undesirable position may cause concomitant stresses on

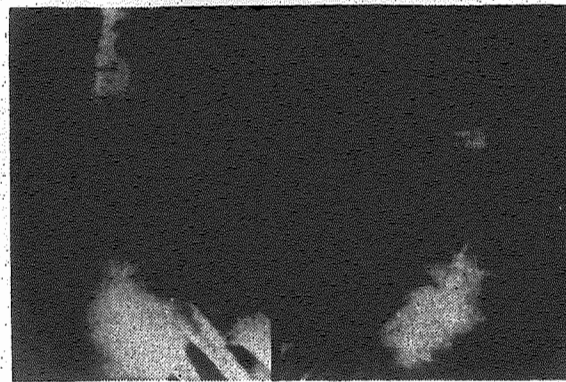


Fig. 2—Roentgenograms of both fibulae of a 36-year-old man who first experienced pain in his right ankle while jogging. Running was terminated for 4 weeks but he did not seek medical advice. On resuming jogging he experienced pain in the left ankle. In October x-rays were taken of both ankles for the first time. The healed fatigue fracture of the right fibula is shown on the left. Pictured on the right is the healed fatigue fracture of the left fibula after 3 weeks of plaster immobilization. Note the difference in callus formation between the two fractures.

various parts of the body. Since most of the joggers were novice runners, it is likely that improper running techniques may have caused episodes of pain in the back, the hips, and the feet which otherwise might not have occurred.

The interpretation of these injuries was relatively simple as pain was generally the presenting symptom. The only condition not associated with pain was in those cases reporting venous distention in the lower extremities.

In most cases the injuries were treated by the joggers themselves. Muscle and tendon strains were treated by rest and temporary abstention from running with satisfactory results. Heel lifts were recom-

Table 3: Injuries That Resulted in Termination of Jogging and/or Work

Type of injury	Temporarily terminated jogging	Permanently terminated jogging No. of injuries	Temporarily terminated work
Muscle strain	12	1	0
Joint sprain	11	1	2
Tendon injury	4	1	0
Foot problems	2	0	0
Fatigue fractures	2	0	0
Back pain	1	0	0
Costochondral sprain	0	0	0
Total	32	3	2

beaved to be the result of slight tightness of that tendon due to a preexisting ankle fracture. The third had partially corrected club feet, and although he wanted to continue running was unable to because of extreme ankle soreness.

Discussion

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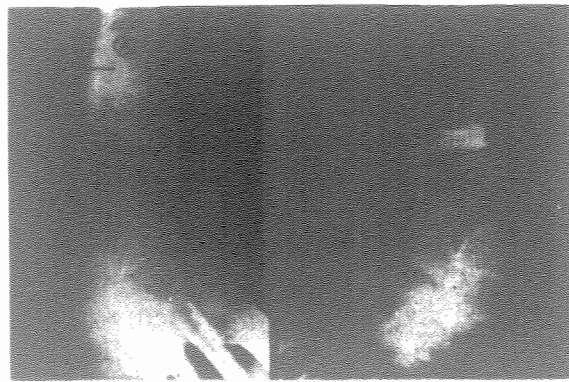


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Type of injury	Temporarily terminated jogging	Permanently terminated jogging No. of injuries	Temporarily terminated work
Muscle strain	17	1	0
Joint sprain	11	1	0
Tendon injury	4	1	0
Foot problems	2	0	0
Extremity fracture	2	0	0
Back pain	3	0	0
Orthopedic disorder	0	0	0
Total	37	2	0

mended for Achilles tendinitis and were found to relieve the pain. It is interesting to note that neither the type of running surface nor the type of shoe worn seemed to be an important factor in the injuries other than the joint ailments. Twenty-nine per cent of the joggers with joint sprains thought their conditions were aggravated by running on hard surfaces. Therefore a soft-soled or ripple-soled shoe would appear to be a satisfactory way to help a jogger with sore joints, but not necessarily sore muscles or feet. Many of these runners tried the various new jogging shoes and found them to provide greater comfort and support. In a few cases, it was helpful to raise or lower the heel counters to relieve calcaneal bursitis. For blistering, either wearing thicker socks or placing petroleum jelly on top of and between the toes seemed to yield the best results.

Each fatigue fracture of the distal fibula was treated differently: the first was treated by 4 weeks of rest and the second by 3 weeks of plaster immobilization. As was expected, less callus formed in the part which was immobilized in plaster (fig. 2). However, the functional results of both treatments were the same. Devas and Sweetnam⁸ have reported on 50 fatigue fractures of the fibulae in athletes of whom 46 were runners. McBryde and Bassett⁹ have reported on three fatigue fractures of the distal fibulae in people who ran "periodically." Both articles stated that the fibular fractures occurred in the distal thirds. Thus the bilateral fatigue fractures reported do not seem excessive or unusual.

It is the opinion of the present authors that the injuries were not directly related to age. It is hazardous to try relating injuries to age without considering the intensity of training or an individual predisposition to physical activity. From our observations it appears that sedentary individuals who begin jogging are apt to get related injuries regardless of age. Of course, those individuals who attempt to exert themselves beyond their capacities are more prone to severe ailments. In our opinion older individuals should enter a jogging program cautiously and only after consulting a physician.

Summary

Two hundred forty-one musculoskeletal injuries were reported in 108 of 120 middle-aged joggers. The majority of ailments were mild strains of the triceps surae muscle group (calf muscles). The injury pattern suggested that the major amount of stress is located in those muscles associated with acceleration. The quadriceps muscle group received few injuries and so did not appear to be a major accelerator in running. The major treatment modality used in this series was rest of the injured part with other measures being used to alleviate discomfort. From an orthopedic standpoint, jogging appears to be a relatively safe form of exercise resulting in only slight injuries to the musculoskeletal system.

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References

1. Standard Nomenclature of Athletic Injuries: Prepared by the Subcommittee on Classification of Sports Injuries, Committee on the Medical Aspects of Sports of the American Medical Association, 1966, pp. 99-101.
2. Brash, J. C.: *Cunningham's Text Book of Anatomy*. London, Oxford University Press, Ed. 9, 1951, p. 387.
3. Siegel, I. W.: Jogger Heel. (Letter to the Editor.) *JAMA* 206:2899 (Dec.) 1968.
4. Slocum, D. B., and Bowerman, W.: Biomechanics of Running. *Clin Orthop* 23: 39-45, 1962.
5. Inman, V. T.: Conservation of Energy in Ambulation. *Arch Phys Med* 48:484-488 (Sept.) 1967.
6. Mann, R., and Inman, V. T.: Phasic Activity of Intrinsic Muscles of the Foot. *J Bone Joint Surg* 46:469-481 (Apr.) 1964.
7. Sutherland, D. H.: An Electromyographic Study of the Plantar Flexors of the Ankle in Normal Walking on the Level. *J Bone Joint Surg* 48-A:66-71 (Jan.) 1966.
8. Devas, M. B., and Sweetnam, R.: Stress Fractures of the Fibula: Review of Fifty Cases in Athletes. *J Bone Joint Surg* 38-B: 818-829 (Nov.) 1956.
9. McBryde, A., and Bassett, I. H.: Stress Fracture of the Fibula. *GP* 38:120-123 (Oct.) 1968.