Causes and Prevention of Injury in Downhill Skiing

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In brief: This literature review summarizes the current state of knowledge regarding the causes of injury in downhill skiing and discusses the incidence, distribution, risk factors, and prevention of injuries. The incidence of serious injury ranges from two to four per 1,000 ski days. About 55% of all downhill ski injuries involve the lower extremity; many of these are equipment-related. Potential risk factors fall into categories including personal characteristics, skill level, physical condition, behavior, equipment, and environment. Beginners are at higher risk, but taking lessons probably lowers the risk to some extent. Properly adjusted ski bindings undoubtedly can further lower the incidence of lower extremity injury. Similarly, improvements in the design of boots, bindings, and poles can probably make skiing safer.

Downhill skiing has become enormously popular over the last few decades. Today there are at least 25 to 30 million active skiers around the world. According to one estimate, the total number may be as high as 200 million. Ever since studies on this subject were first published (around the beginning of this century), children (especially between the ages of 11 and 13) and adults over 40 have a higher risk of injury than do other age groups. Instruction probably lowers the risk somewhat.
Table 1. Potential Risk Factors Involved in Downhill Ski Injuries

<table>
<thead>
<tr>
<th>Personal Characteristics</th>
<th>Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Fear</td>
</tr>
<tr>
<td>Gender</td>
<td>Risk taking</td>
</tr>
<tr>
<td>Height</td>
<td>Alcohol consumption</td>
</tr>
<tr>
<td>Weight</td>
<td>Nutrition</td>
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<td>Education</td>
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<table>
<thead>
<tr>
<th>Skill Level</th>
<th>Equipment</th>
</tr>
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<tbody>
<tr>
<td>Self-rated ability</td>
<td>Bindings</td>
</tr>
<tr>
<td>Experience</td>
<td>Boots</td>
</tr>
<tr>
<td>Lessons</td>
<td>Poles</td>
</tr>
<tr>
<td></td>
<td>Brakes</td>
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<table>
<thead>
<tr>
<th>Physical Condition</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitness level</td>
<td>Snow quality</td>
</tr>
<tr>
<td>Sports participation</td>
<td>Visibility</td>
</tr>
<tr>
<td>Ski gymnastics</td>
<td>Weather conditions</td>
</tr>
<tr>
<td>Warm-up</td>
<td>Difficulty of ski run</td>
</tr>
<tr>
<td>Sleep</td>
<td>Time of day</td>
</tr>
<tr>
<td>Menstruation</td>
<td>Duration of exposure</td>
</tr>
</tbody>
</table>

Table 2. Incidence of Downhill Ski Injuries*  

<table>
<thead>
<tr>
<th>Type of Injury</th>
<th>No. of Injuries (per 1,000 Ski Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper body</td>
<td>1.6</td>
</tr>
<tr>
<td>Lower extremity/ equipment related</td>
<td>1.5</td>
</tr>
<tr>
<td>Knee</td>
<td>0.9</td>
</tr>
<tr>
<td>Other than knee</td>
<td>0.6</td>
</tr>
<tr>
<td>Lower extremity/ non-equipment related</td>
<td>0.3</td>
</tr>
<tr>
<td>Total</td>
<td>3.4</td>
</tr>
</tbody>
</table>

*From Johnson et al.*

Sample of skiers or a whole cohort that is at risk.

Prevention of ski injuries requires an understanding of their causes, which means determining the quantitative contribution of the most important risk factors. This requires investigating the occurrence of ski injuries in relation to risk factors. Haddon et al. in 1962 were probably the first to conduct research in which injured and uninjured skiers were compared.

Potential risk factors can be divided into several main categories: personal characteristics, skill level, physical condition, behavior, equipment, and environment (table 1). These main categories can then be subdivided; for example, within the environment category it is useful to distinguish snow quality, visibility, weather conditions, difficulty of the ski run, time of day, and duration of exposure. Many risk factors are interrelated, which makes it difficult to study the contribution of a particular risk factor to injury incidence. Unconcerned by this complexity, some so-called experts offer recommendations for injury prevention that often are based on a mixture of plausibility, case reports, and prejudice. Their claims are frequently “proved” by quasiempirical reasoning based on injury statistics.

Injuries

Incidence. Estimates of injury incidence range from 1 to 10 per 1,000 ski days. Most researchers agree that the incidence of serious injuries (those that require extensive medical treatment) lies in the range of two to four per 1,000 ski days. This measure can also be considered the mean risk percentage for one skier during a vacation that includes 10 days of skiing. This figure is probably much lower than it was a few decades ago. It is generally agreed that the development of modern ski equipment—especially the release binding—has contributed substantially to this decline.

The improved design and maintenance of ski runs may also have contributed to this trend.

Anatomic Site. The location of ski injuries has also changed over the years. Between 1960 and 1980 the proportion of lower extremity injuries declined substantially (from 80% to 55%), especially of the foot and ankle (from 45% to 10%). Similarly, the proportion of tibial fractures declined (from 25% to 15%), while knee injuries...
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support of blood pressure and renal perfusion with the administration of fluids and pressures as appropriate. Problems associated with hypotension are monitored as closely as possible. The most common cause of hypovolemia is hemorrhage, particularly in patients with renal impairment or postoperative anesthesia. The incidence of hypotension is lower in patients with acute heart failure, but it is not clear whether these are isolated events or related to the underlying pathophysiology. Adequate hydration can be achieved by other means, such as exchange transfusion, although there is no experience with the latter procedure. There is no experience with other procedures for removing fluids. The mechanism of the renal adverse effects associated with treatment with ZESTRIL (5.5-6.7, 3.7-4.0, and 0.7-1.0 mg/d, respectively). These adverse effects are more frequent in patients with severe concomitant heart failure, with or without associated renal insufficiency, excessive hypotension, and diabetes mellitus. The use of calcium channel blockers as an additional antihypertensive agent in a mean age of 65 years, the maximum recommended daily dose is 20 mg. Based on weight potential increase has been detected in patients with ZESTRIL, in 7 of 10 patients the improvement was associated with an increase in diastolic blood pressure, which is more common in patients with concomitant renal disease and should be considered before initiation of treatment with ZESTRIL.

The effect of ZESTRIL on blood pressure was evaluated in a meta-analysis of clinical trials in patients treated with ZESTRIL, and the results were consistent with the findings of the present study. The incidence of adverse effects was lower in patients with a lower incidence of hypotension, but it is not clear whether these are isolated events or related to the underlying pathophysiology. Adequate hydration can be achieved by other means, such as exchange transfusion, although there is no experience with the latter procedure. There is no experience with other procedures for removing fluids. The mechanism of the renal adverse effects associated with treatment with ZESTRIL (5.5-6.7, 3.7-4.0, and 0.7-1.0 mg/d, respectively). These adverse effects are more frequent in patients with severe concomitant heart failure, with or without associated renal insufficiency, excessive hypotension, and diabetes mellitus. The use of calcium channel blockers as an additional antihypertensive agent in a mean age of 65 years, the maximum recommended daily dose is 20 mg. Based on weight potential increase has been detected in patients with ZESTRIL, in 7 of 10 patients the improvement was associated with an increase in diastolic blood pressure, which is more common in patients with concomitant renal disease and should be considered before initiation of treatment with ZESTRIL.

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remained approximately the same (20%). Thus it seems that modern ski equipment protects the tibia more effectively than it does the knee.\textsuperscript{6} A consequence of the decline in lower extremity injuries, the proportion of upper extremity injuries increased (from 10% to 25%), as did head and torso injuries (from 10% to 20%).\textsuperscript{6}

Johnson et al.\textsuperscript{8,17} introduced the concept of lower extremity, equipment-related (LEER) injury, "... in which the mechanism is consistent with the ski acting as a lever to bend or twist the leg."\textsuperscript{107} These authors classified 80% of lower extremity injuries as equipment-related. Between 1972 and 1978 the incidence of LEER injuries decreased by 43%, compared with a decrease of only 25% for upper body injuries. The incidence of tibial fracture and ankle sprain declined substantially—each by more than 70%.

Some researchers\textsuperscript{6,15} suggest that the ulnar collateral ligament of the metacarpophalangeal joint of the thumb is the most frequent injury site (as high as 20% of all ski injuries). It is assumed that this injury is severely underreported in most studies because it does not immobilize the skier and thus often goes undocumented. Table 2 lists the incidence of several types of ski injuries based on observations made at a ski area in Vermont.\textsuperscript{9} Hauser and Gläser\textsuperscript{4} reported similar figures based on a sample of more than 200,000 ski days.

**Circumstances.** A number of studies mention self-reported direct causes of accidents that led to injury. It is difficult to compare these studies because they use different categories. They attribute from 11% to 20% of injuries to a collision—6% to 16% with an object and 3% to 8% with another skier.\textsuperscript{5,14,16} Collision injuries usually are relatively serious. It is not surprising that falls (due to several causes) are blamed for most injuries (70% to 90%).\textsuperscript{5,16} Problems with ski lifts (especially T-bar lifts) account for 2% to 9% of injuries.\textsuperscript{16} Most accidents that result in injury (90% to 95%) happen on the ski runs, probably because that is where most skiing is done.\textsuperscript{3,6} About 15% of these skiers reported going very fast just before the accident; about 55% were going moderately fast, 25% were skiing slowly; and 5% were standing still.\textsuperscript{4} The fatality rate is less than one per million ski days; most cases involve a high-speed collision with a tree.\textsuperscript{14,16,18}

Most injuries occur on weekends,\textsuperscript{6} although Monday is also mentioned as a hazardous day.\textsuperscript{19} Danger associated with the third day (usually Monday) of skiing is not supported by the data.\textsuperscript{4,19} Some researchers conclude that accidents occur relatively less frequently during the morning.\textsuperscript{19} Others hypothesize that accident risk remains constant throughout the day.\textsuperscript{5,6,12} On average, injured skiers are on the slopes for about 3 hours before getting hurt.\textsuperscript{5,19}

**Risk Factors**

**Personal Characteristics.** There are proportionately more children (especially between ages 11 and 13) and adults over 40 among injured skiers, indicating a higher risk for these age-groups.\textsuperscript{8,12} The fact that children are less skilled seems to be at least partly responsible for this finding. Injured skiers under age 15 have a high proportion of lower extremity injuries, especially tibial fracture. According to some studies,\textsuperscript{8,10} this indicates that children use poor quality equipment and/or do not adjust their bindings properly.

Some authors\textsuperscript{12,16} report that the injury risk is higher for females than males; others\textsuperscript{3,10} report the same risk for both sexes. Furthermore, females are more likely than males to report their injuries to the local facilities.\textsuperscript{6} Injury to the ligaments of the knee occurs relatively often among females, indicating differences in anatomy and/or in efficacy of binding adjustment\textsuperscript{12,16} between males and females.

Differences in height and weight between injured and noninjured skiers have not been found or have been confounded by age.\textsuperscript{6,11} Some authors mention that more highly educated skiers have a lower risk.\textsuperscript{5,19}

**Skill Level.** Researchers agree that skiers who consider themselves beginners have a risk about twice that of more advanced skiers.\textsuperscript{5,12,14} This also applies to skiing experience (number of seasons),\textsuperscript{5} which correlates highly to self-rated ability. However, a preventive effect from experience still seems to remain when skill level is adjusted for.\textsuperscript{5}

It seems reasonable to expect that formal instruction will increase skill level and thus lower injury risk. However, an overall effect is lacking,\textsuperscript{5} and even an increased risk for those who take ski lessons has been reported.\textsuperscript{21} The latter finding is probably due to the absence of adjustment for differences in ability and/or duration of exposure.\textsuperscript{5,14} One study\textsuperscript{5} adjusted for these factors in a multivariate analysis and reported a preventive effect from lessons, but only during

continued
When he's not coughing, is his antibiotic making him queasy?
Bronchitis is difficult enough without the nausea that may sometimes accompany doxycycline therapy. The pellets of DORYX, however, pass intact through the stomach and dissolve in the small intestine—reducing the potential for GI upset and nausea while providing all the benefits of doxycycline.¹

Mean Nausea Scores as Reported by Subjects²³

<table>
<thead>
<tr>
<th></th>
<th>PLACEBO 0.7</th>
<th>DORYX³ (coated doxycycline hyclate pellets) 1.6</th>
<th>VIBRAMYCIN⁴ Hyclate (doxycycline hyclate) 3.2</th>
</tr>
</thead>
</table>

*Double-blind, three-way crossover study of 98 healthy adult subjects taking either drug (100 mg) or placebo twice the first day, then once daily on three consecutive days. Capsules were taken at least one hour before meals.

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The doxycycline in DORYX is active against such respiratory pathogens as Streptococcus pneumoniae,² Hemophilus influenzae,² Mycoplasma pneumoniae,³ and Chlamydia psittaci.⁴

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Laboratory tests: In venereal disease when coexistent syphilis is suspected, dark-field examination should be done before treatment is started and the blood serology repeated monthly for at least 4 months. In therapy, periodic laboratory evaluation of organ systems, including hemato poetic, renal and hepatic studies should be performed.

Drug interactions: Because tetracyclines have been shown to depress plasma prothrombin activity, patients who are on anticoagulant therapy may require downward adjustment of their anticoagulant dosage.

Since bacterioidal drugs may interfere with the bactericidal action of penicillin, it is advisable to avoid giving tetracyclines in conjunction with penicillin.

For concomitant therapy with anticoagulants or iron containing preparations and food see "Administration" section.

Carcinogenesis, mutagenesis, impairment of fertility: Long term studies are currently being conducted to determine whether tetracycline or related tetracyclines may have a potential genotoxic or carcinogenic potential. The results of these studies have not yet been completed. No positive responses for mutagenic effects have occurred at concentrations of 60 and 10 mg/kg, respectively. In humans no association between tetracyclines and these effects have been made.

Pregnancy: Category D (See Warnings section)

Nursing mothers: Tetracyclines are present in the milk of lactating women who are taking this drug in a class. Because of the potential for serious adverse reactions in nursing infants from the tetracyclines, a decision should be made whether to discontinue nursing or discontinue the drug, taking into account the importance of the drug to the mother (see Warnings section).

Pediatric use: See Warnings and Dosage and Administration sections.

ADVERSE REACTIONS. Due to oral tetracyclines' virtually complete absorption, side effects to the lower bowel, particularly diarrhea, have been infrequent. The following adverse reactions have been observed in patients receiving tetracyclines.

Gastrointestinal: Anorexia, nausea, vomiting, diarrhea, glossitis, dysphagia, enterocolitis, and inflammatory lesions (with monilial overgrowth) in the anogenital region. These reactions have been caused by both the oral and parenteral administration of tetracyclines. Rare instances of esophagitis and esophageal ulcerations have been reported in patients receiving capsule and tablet forms of drugs in the tetracycline class. Most of these patients had concurrent illnesses (See Dosage and Administration section).

Skin: Maculopapular and erythematous rashes. Exfoliative dermatitis has been reported but is uncommon. Photosensitivity is discussed above (See Warnings section).

Hypersensitivity: Reactions, urticaria, angioneurotic edema, anaphylaxis, anaphylactoid purpura, paresthesia, and exacerbation of systemic lupus erythematosus.

Bulging fontanels in infants and benign intracranial hypertension in adults have been reported in infants receiving tetracyclines. These conditions disappeared when the drug was discontinued.

Blood: Hemolytic anemia, thrombocytopenia, neutropenia, and eosinophilia have been reported rare tetracycline.

When given over prolonged periods, tetracyclines have been reported to produce brown-black microscopic discoloration of thyroid glands. No abnormalities of thyroid function are known to occur.

DOSEAGE AND ADMINISTRATION. The usual dosage of TETRACYCLINE HYDROCHLORIDE THAT OF THE OTHER

INCREDIBLE INCREASED SIDE EFFECTS.

Adults: The usual dose of tetracycline hydrochloride is 500 mg on the first day of treatment. (500 mg every 12 hours) followed by a maintenance dose of 100 mg/day. The maintenance dose may be administered as a single dose or as 50 mg every 12 hours. In the management of more severe infections (particularly chronic infections of the urinary tract) 100 mg every 12 hours is recommended.

For children above eight years of age. The recommended dosage schedule for children weighing 100 pounds or less is 2 mg/kg of body weight divided into two doses on the day of treatment, followed by 1 mg/kg of body weight given as a single daily dose or divided into two doses on subsequent days. For more severe infections up to 2 mg/kg of body weight may be given in divided doses every 6 to 8 hours over 100 pounds of the usual adult dose should be used.

Uncomplicated genitourinary infections in adults (except anorectal infections in men), 100 mg, by mouth, twice-a-day for 7 days. As an alternative therapy 500 mg tablets once a day, 300 mg dose. The dose may be administered with food, including milk or carbonated beverage, as required.

Acute epididymitis/orchitis caused by N. gonorrhoeae: 100 mg, by mouth, twice-a-day for at least 10 days.

Primary and secondary syphilis. 300 mg a day in divided doses for at least 10 days.

Uncomplicated urethritis, proctitis, or rectal infection in adults caused by Chlamydia trachomatis: 100 mg, by mouth once-a-day for 7 days. Nongonococcal urethritis caused by C. trachomatis and U. urealyticum: 100 mg, by mouth, twice-a-day for at least 7 days.

Acute epididymitis/orchitis caused by C. trachomatis: 100 mg, by mouth, twice-a-day for at least 10 days.

The therapeutic antibacterial serum activity will usually persist for 24 hours following recommended dosage.

When used in streptococcal infections, therapy should be continued for 10 days. Administration of adequate amounts of fluid along with capsule and tablet forms of drugs in the tetracycline class is recommended to wash down the drugs and reduce the risk of esophageal irritation and ulceration.

If adverse reactions are noted it is recommended that doxycycline be given with food or milk. The absorption of doxycycline is not markedly influenced by simultaneous ingestion of food or milk.

Concomitant therapy: Doxycycline does not influence the absorption of barbiturates, nitrates, and iron containing preparations should not be given to patients taking oral tetracycline.

Patients should be advised that administration of doxycycline at the usual recommended doses does not lead to excessive accumulation of the antibiotic in patients with renal impairment.

Caution: Federal law prohibits dispensing without prescription.

ski injuries continued

the first and second seasons of skiing.

Physical Condition. It has been suggested that good physical condition can prevent exhaustion and thus lower accident risk.22 Despite the physiological plausibility of this hypothesis, empirical evidence is lacking. A recent study3 of Dutch skiers indicates that a self-reported good physical condition was a risk factor. This is consistent with the higher prevalence among injured skiers of participation in other sports. Furthermore, we know of no published empirical evidence that supports the recommendation to prepare for a ski vacation by taking a course in ski gymnastics or by taking lessons on an artificial ski run.5 The same is true for the assumed preventive effect of warm-up exercises.

Skiers seem to get plenty of sleep.19 One study found that injured skiers sleep better and longer than uninjured skiers,4 and another reported no differences between these two groups.11 A possible association between accident risk and menses has been suggested19 but could not be confirmed.5

Behavior. Skiers who report that before a vacation they feel somewhat afraid of having a skiing accident seem to have a lower injury risk.5 Recklessness and risk-taking behavior are often mentioned as risk factors in popular literature on downhill skiing. The personality trait referred to as "sensation seeking" appears to be relatively high among downhill skiers, especially on the subscale that indicates a desire to engage in hazardous activities. But contrary to what might be expected, injured skiers seem to have a lower score than uninjured skiers when tested for this trait.5

Several authors list alcohol consumption as an important risk factor in downhill skiing.19,22,23 Two mechanisms are mentioned in this respect. First, alcohol affects reaction time, accuracy of movements, and perception of risk.19 Stanley23 supposes that alcohol consumption amplifies the effect of hypoxia at high altitudes. Second, Brouns et al22 point out that alcohol often lowers carbohydrate intake, especially immediately after skiing, when glycogen resynthesis is stimulated most strongly. Consequently, the skier will experience glycogen depletion sooner the next day, increasing injury risk because of exhaustion and diminished control of movement.

Little data are available concerning alcohol consumption among downhill skiers. Only 2% of a group of injured skiers were found to have an alcohol permillage of more than 0.8 at the time of injury.19,24 Hauser and Glaser6 found only one skier with alcohol permillage of 0.7 among 39 randomly selected uninjured male skiers. Thus alcohol does not appear to be an important risk factor. According to self-reported drinking behavior, alcohol even seems to have a protective effect, but this finding might be due to selective underreporting by injured skiers.5

Glycogen depletion in the muscle fibers is evident at the end of a day of skiing.22 The resulting fatigue is considered an important risk factor.25 To prevent an increasing glycogen depletion throughout the vacation, skiers are advised to consume frequent, small meals that are rich in carbohydrate.22 Empirical evidence of a relationship between nutrition and injury risk among skiers is lacking.

Equipment. As stated above, studies suggest an important preventive effect from the introduction of modern equipment in the 1970s—especially in the design of the ski binding. The question is whether binding adjustment is still an important risk factor. Bindings seem to release less frequently in accidents that result in LEER injuries than those resulting in non-LEER injuries.5,15 However, it is doubtful that even an optimally adjusted ski binding will always release in time to prevent a LEER injury. The knee is not sufficiently protected by the current binding design.5,26 Studies indicate that binding adjustment generally is more adequate among controls than injured skiers (particularly those with LEER injuries).6,12,20 While the bindings of both controls and skiers with a non-LEER injury are adjusted an average of 50% above the recommended setting, the average deviation is 85% for skis with a knee sprain and 150% for those with a tibial fracture.6 More recently Hauser demonstrated with a randomized controlled trial27 that optimal adjustment can substantially lower the risk for LEER injuries.

Ski boots and bindings form a functional unit, and it is recognized that the properties of the boot can dramatically affect release performance of the binding.26 Early models of the modern plastic ski boot (late 1960s and early 1970s) were associated with a sudden increase in isolated fractures of the fibula at the level of the boot top.1 The stiffness of the boot was modified, but there still seems to be room for further...
Ski injuries continued

Tremendous injuries; particularly, tibial fractures and knee lesions are relatively frequent. There is some doubt concerning the effect of snow quality on overall injury incidence, but the risk is substantially elevated when icy spots are present.

Jaffin found that about 20% of skiers reported problems with visibility. However, no clear relation to injury risk was established. The risk may be greater when the sky is cloudless, even when taking into account the fact that ski runs are more crowded on clear days. Some authors attribute the elevated risk during good weather to a biological or psychological influence of high atmospheric pressure.

Discussion

Despite the problems of selective underreporting, a fair amount of information is available regarding the overall incidence of ski injuries and the frequency of specific injuries. The systems currently used to document injuries seem reliable enough to detect major trends. Also, there is consensus as to the circumstances of accidents that result in injury. Some of these circumstances seem to call for relatively straightforward preventive measures—e.g., removing objects from ski runs, modifying the design of T-bar lifts, creating ski runs that make it impossible to ski at high speeds. Generally, though, the situation is more complex, and although there is agreement with respect to some generally accepted risk factors, uncertainty remains about others.

Both case-control and cohort studies have been conducted to increase our knowledge about the preventable causes of ski injuries. The results of these investigations usually were presented in terms of crude frequencies of the factor at issue, without reports of appropriate measures of association (e.g., odds ratios). Although most researchers agree that risk factors are probably interrelated to some extent, stratified analysis is rare, and an adequate multivariate analysis is almost never performed. Another problem is the fact that many of these studies were based on information collected by questionnaire—a method that is open to imprecision and bias. Future studies should try to avoid these weaknesses and focus more specifically on risk factors that are open to manipulation.

Because of the inherent uncertainty of nonexperimental (associational) studies, it is always continued...
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WAS 50 YEARS IN
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A lifetime of skeletal health may depend on adequate bone development in adolescence. But from ages 11 through 18 when the calcium RDA increases to 1,200 mg/day, many youngsters get considerably less calcium than they need. Therefore, they may not achieve the normal adolescent contribution of 45% to peak adult bone mass.

A 60% reduction in hip fracture incidence has been noted in a recent 14-year prospective study of 531 women and 426 men (ages 50–79) among those in the top third of lifetime dietary calcium intake (primarily from dairy). This is strong evidence that adequate consumption of dairy during adolescence and after can help build and maintain a "bone bank" sufficient to help reduce the risk of geriatric hip fractures.

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ski injuries continued

advisable to try a preventive measure (eg, education) in a well-designed randomized trial before introducing it on a large scale. Unfortunately, only one such trial has been performed.27

Conclusion

Despite the limitations, some conclusions can be drawn from the existing data with acceptable confidence: Beginners are at higher risk, but taking ski lessons can probably lower this risk to some extent. Empirical evidence is lacking with respect to the possible risk-reducing effect of being in good physical condition. Further clarification will depend on studies that measure condition directly (prospectively), or even better, studies that actively manipulate physical condition among a group of randomly chosen skiers. Sound knowledge of behavior factors also is virtually absent. Alcohol is probably not an important risk factor, but nutrition might be; this area has not been thoroughly investigated. Risk-taking behavior seems to play a role, but its impact is uncertain, and effective manipulation of this factor is questionable.

There is little doubt that adequate adjustment of the ski binding can lower the incidence of LEER injury. Moreover, it is plausible that improved design of ski boots and bindings can reduce knee injuries and thus make skiing a safer sport (especially for women and children). The current design of ski poles seems to contribute to the occurrence of thumb injuries. Little is known yet about environmental risk factors.

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References