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Snow skiing injuries in physically disabled skiers

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ABSTRACT

This study, through retrospective review, examines the injury rate of selected disable skiing populations in general and as compared to able-bodied skiers in areas where comparison was possible. Data on disabled skiers gathered from instructional programs at multiple sites indicate that the disabled skier had a very low rate of injury occurrence. Where comparison could be make, it was found that there was no significant difference in overall injury rates between able-bodied and physically disabled skiers. Disabled skiers appear to sustain less severe injuries, and they do not show the trend in increasing injury rates that able-bodied skiers in this study show. In addition, the uphill transport of skiers with a disability who use sit- or mono-skis was examined in one large program and found to be efficient and exceedingly safe, with no injuries reported. A major limitation of this study is the inconsistency in methods of data collection and reporting. There is a need for further prospective studies in the general able-bodied and disabled skiing populations with direct comparisons of rate, location and severity of injury, type of disability, and experience level of the skier. We hope that this study will stimulate more ski areas to allow disabled skiers on their slopes, even it limited to participation in supervised, instructional programs.

The sport of snow skiing for the physically disabled has seen tremendous growth in recent years. Skiing has been called "the most successful of rehabilitation sports and recreation programs available to people with disabilities."[1] Winter Park, Colorado, the leading center in the world in regards to instructing the physically challenged individual in snow skiing, has seen a 27% increase in lessons taught from the 1985–1986 season to the 1988–1989 season.[14] The 1990 World Disabled Ski Championships, also held in Winter Park, featured almost 200 participants from 19 nations competing in slalom, giant slalom, super G, and downhill events.

Although popularity of the sport is increasing, there are many ski areas that are reluctant or unwilling to let disabled skiers ski on their slopes. They fear they are "not as safe" as able-bodied skiers. There have been many studies addressing able-bodied ski injuries and trends, but few addressing the disabled population specifically. Ferrara et al.[2] and McCormick[7,8] have examined the injury experience of competitive skiers with a disability. Both found injury rates approximating or below those of skiers without a disability. The injury experience of the learning or noncompetitive disabled skier, however, has not been addressed.

This study will examine, through retrospective review, the injury rate of selected disabled skiing populations in general and as compared to able-bodied skiers in the same areas. The types, severity, and location of injuries will also be examined.

Skiing is often assumed to be a hazardous sport. In fact, skiing compares very favorably to other sports when comparing the number of accidents per participant that are treated in hospital emergency departments per year (Table 1).[10] Studies show that the overall mortality rate is approximately one death per 1.5 million skier days.[9,10] Advances in equipment design and ski area grooming have helped to reduce the rate of ski injuries from 7.7 per 1000 skier visits in 1950 to a range of 3.4 to 3.8 per 1000 skier visits today.[5,11,13]

Many studies have been undertaken in the past 15 years to examine trends in able-bodied skier injuries, with most studies showing a decline in lower-leg injuries (especially fractures and ankle sprains), but an increase in severe knee injuries (especially those involving the ACL).[3,4,6,10] Many think that these trends reflect advances in equipment design, such as the advent of rigid, high-top, foot-conforming boots and multidirectional release bindings. However, additional

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studies are necessary to delineate which factors (i.e., skier, equipment, or environment) have created those trends. A thorough review of the disabled skier population is needed to determine whether concerns regarding this special and growing population of skiers are valid.

MATERIALS AND METHODS

Thirteen US ski areas with the largest disabled-skiing programs were solicited, with the help of National Handicapped Sports, for information specific to disabled skier injuries. They were surveyed regarding total number of injuries (disabled and able-bodied); age and sex of participants; type of disability (as applicable); type, location, and severity of injury; mechanism of injury (method of occurrence); snow conditions at the time of injury; experience level of the skier; whether the injury was alcohol related; and if the injured skier was involved in ski school at the time of the injury. Four areas (31%) responded with information relative to the above. Since there is, as yet, no uniform method of data collection by these programs, the type of data supplied varied considerably. Also, while most areas have good information on participants in their disabled instructional programs, there is no data at the present time on physically disabled individuals who are allowed to ski independently at these resorts. The data from all of the areas surveyed were tabulated only for those enrolled in instructional programs. The vast majority of disabled skier visits and injuries can be assumed to occur in the context of the ski school since the disabled skier can receive one-on-one instruction at all ability levels and also pay a reduced fee, including adaptive equipment use (such as outriggers, mono-ski, and ski bra) and lift tickets. Thus, important inferences can still be made from the available data.

RESULTS

Colorado

Between 1985 and 1989, we evaluated all skier-injury data compiled by a major ski area in Colorado with a large program of physically challenged skier instruction. Disabled skiers at this area are formally instructed on a one-to-one basis by an instructor trained in adaptive-skiing techniques. Approximately 3.4 million skier visits were estimated to have occurred over that period. The data were collected from computerized summaries of disabled and able-bodied skier incident reports. The information on these reports was collected by members of the National Ski Patrol working in the area and analyzed with respect to type of injuries sustained, body part injured (location of injury), and rate of injury per skier visit. The initial categorization of type of injury was made by the ski patrol and was corrected if the skier was evaluated at the base medical clinic (physician staffed) and a different diagnosis was obtained. As in previous ski injury rate studies, a skier visit was defined as one person purchasing one lift ticket for 1 day of skiing. Over 45 different disabilities were represented in this program, including amputation, hemiplegia, vision and hearing impairment, spinal cord injuries, multiple sclerosis, and muscular dystrophy.

TABLE 1
Percent of all sports participants treated in hospital emergency rooms per year by sport[a]

Sport	Participants injured (%)
Handball	0.19
Racquetball	0.27
Snow skiing	0.29
Ice skating	0.38
Bicycle riding	1.17
Soccer	1.25
Basketball	1.97
Hockey	2.19
Tennis	2.70
Baseball	2.84
Football	3.01

[a] From *Accident Facts*, 1987 edition, published by the National Safety Council using information from the National Sporting Goods Association and the Consumer Product Safety Commission. Itasca, Illinois.

Total disabled-skier visits over the 4-year period numbered over 64,000, and the injury rate during this time averaged 3.7 per 1000 skier visits (range of annual rates, 2.9 to 4.3). This is close to the able-bodied rate over the same time span of 3.5 per 1000 skier visits (range of annual rates, 3.3 to 3.9). There is no significant difference in overall injury rates between the two groups (Pearson chi-square test on 4-year totals, $P = 0.36$) (Table 2). It is worth noting that injury rates for both able-bodied and disabled skiers appear to be increasing with time. This trend is statistically significant for able-bodied skiers (chi-square test, $P < 0.0001$), but not for disabled skiers ($P = 0.13$).

The types of injuries sustained do tend to differ between able-bodied and disabled skiers (chi-square test, $P = 0.007$). In specific, disabled skiers appear to have fewer fractures and lacerations and more abrasions and bruises than able-bodied skiers (Table 3). The most common type of injury in both groups was knee sprain. The location of injuries sustained was similar in both groups, with no significant difference between able-bodied and disabled skiers (Table 4). Of note, there were no fatalities among disabled skiers. Two deaths, both resulting from collisions with natural obstacles, occurred over the 4-year period among able-bodied skiers. An average of 86% of able-bodied skier injuries occurred outside of the area's ski school, and 61% of able-bodied skiers injured had never before taken a lesson. As stated previously, the disabled skier injuries that were reported were sustained in a supervised setting, either in individual, group, or program lessons in the disabled skier school or while using the chair lift facilities during lesson time.

The above data suggest that the rates and severity of injury among disabled skiers in a supervised setting are similar to those in the able-bodied population. Locations of injury were remarkably similar between groups, with the bulk of injuries occurring in the lower extremity, especially the knee. This pattern was similar to the findings of Ferrara et al.[2] and McCormick[7] in their studies of disabled skiers. It

TABLE 2
Injury rate of able-bodied and disabled skiers at a large Colorado ski area ($P = 0.36$ for grouped analysis)

Group	Season				Total
	1985–86	1986–87	1987–88	1988–89	
Disabled					
Injuries	40	48	70	82	240
Visits	13,729	14,498	17,206	18,840	64,273
Injuries/1000 visits	2.9	3.3	4.1	4.4	3.7
Able-bodied					
Injuries	2,636	2,684	3,030	3,546	11,896
Visits	808,579	796,026	869,231	905,911	3,379,747
Injuries/1000 visits	3.3	3.4	3.5	3.9	3.5

TABLE 3
Frequency of different types of injuries at a large Colorado ski area (1985–1989)[a]

Injury	Able-bodied (%)	Disabled (%)
Fracture	1797 (15.1)	24 (10.9)
Laceration	1079 (9.1)	15 (6.8)
Abrasion	153 (1.3)	7 (3.2)
Sprain	5001 (42.1)	97 (44.1)
Strain	1119 (9.4)	20 (9.1)
Dislocation	483 (4.1)	7 (3.2)
Bruise	1402 (11.8)	40 (18.2)
Other	831 (7.0)	10 (4.5)

[a] Excludes 50 skiers (31 able-bodied, 20 disabled) with injuries of an unknown nature ($P = 0.007$).

TABLE 4
Location of injuries at a large Colorado ski area (1985–1989)[a]

Location of injury	Able-bodied (%)	Disabled (%)
Upper extremity	2706 (22.8)	46 (20.0)
Lower extremity	6593 (55.5)	132 (57.4)
Head/neck	1501 (12.6)	33 (14.3)
Trunk/back	569 (4.8)	13 (5.7)
Other	518 (4.4)	6 (2.6)

[a] Excludes 19 skiers (10 disabled, 9 able-bodied) with injuries of an unknown nature ($P = 0.50$).

is also similar to that in other studies of able-bodied skiers, although in other studies there seems to be a trend toward increasing upper extremity injury (up to 36% of total injuries).[9,11] In regard to severity of injury, disabled skiers had fewer fractures and more bruises than able-bodied skiers.

California

A similar population of disabled skiers from a large program in a California ski resort (Lake Tahoe) was also examined. Incident reports of the disabled-skiing program were reviewed over a 3-year period, from the 1986–1987 season to the 1988–1989 season. Incident report data was gathered by the ski patrol and broken down into age, sex, disability, ability level, location and severity of injury, mechanism of injury, snow conditions, and whether or not the injury occurred in a class. Over that time period, a total of 27 injuries to physically challenged individuals were reported from a total of 1970 disabled skier visits. This translates to an injury rate of 14 per 1000 disabled skier visits (Table 5).

Able-bodied data over this same time period were unavailable for comparison. Although this rate is higher than in the Colorado program, an analysis of the data provides some interesting results. As in the Colorado resort analysis, almost all (25 of 27 or 92.6%) of these skiers were injured while participating on the ski hill in a disabled instructional program (two injuries occurred at the ski base area). Paraplegic skiers constituted the largest injury group, with 37% of the injuries (Table 6).

TABLE 5
Injury rate of disabled skiers at Lake Tahoe

Disabled skier	1986–87	1987–88	1988–89	Total
Injuries	4	15	8	27
Visits	369	722	879	1970
Injuries/1000 visits	11	21	9	14

TABLE 6
Distribution of injuries by disabilities

Disability	No. injuries
Paraplegic	10
Unknown	6
Blind/vision impaired	5
Quadriplegic	2
Cerebral palsy	1
Polio	1
Amputee	1
TBI	1

In contrast to the Colorado data, over half (15 or 55.6%) of the injuries involved the head and neck region, with the remainder equally divided among the upper extremity, lower extremity, trunk, and back. Ninety percent (9 of 10) of the injuries in the paraplegic group were located in the head and neck region.

Almost all of the injuries sustained were considered "minor" and did not require medical attention. The vast majority consisted of bruises, and none of the unclassified (others/not known) injuries required medical aid. There were no fractures in this population, except for a possible fractured clavicle in a sit-skier who was transported from the ski area before the diagnosis was confirmed. There were no serious knee injuries; in fact, no knee sprains were reported (Table 7).

Although the actual rate may seem higher, the type and severity of injury appears to be more benign in nature at this area. The rate may also be inflated because of more complete reporting of less severe injuries. For example, only 6 of the 21 injuries reported in the 1987–1988 season warranted contact with a first-aid station or qualified patroller.

TABLE 7
Type of injury sustained

Type of injury	No.
Fracture	1[a]
Laceration	2
Abrasion	2
Sprain	0
Strain	3
Dislocation	0
Bruise	12
Other	4[b]
Unknown	3[c]

[a] Unconfirmed.
[b] All minor, no treatment.
[c] Did not seek aid.

TABLE 8
Sit- and mono-ski uphill transport at Breckenridge, Colorado

	1986–87	1987–88	1988–89	Total (%)
Total chair lift rides	1512	2010	1601	5123 (100)
Clean loads	1482	1970	1579	5031 (97.9)
Misloads	30	40	22	92 (1.8)
Clean unloads	1486	1970	1573	5029 (98.2)
Misunloads	26	40	28	94 (1.8)

Washington

The Skiforall Foundation in Seattle, Washington, also provided information related to their disabled instructional program at Snoqualmie Pass ski area. During their 1988–1989 season there was 1 injury (humerus fracture) of 1680 disabled skier visits. For 1989–1990 there were no injuries in 2100 visits.

Skier visits in this program were determined from the number of disabled instructional lessons given (one lesson per day). Again, we find a very low occurrence of injury in a instructional disabled skier program.

Colorado

The Breckenridge Outdoor Education Center was unable to supply data on disabled skiing injuries sustained while in an instructional class or while skiing independently, but information was collected regarding injuries related to disabled skier use of lift services. At present, there are two methods by which a person requiring the use of a wheelchair can downhill ski: the sit-ski and the mono-ski. A prime safety concern for this group has been fear of injury during chair lift loading and unloading. Two lifters are necessary to lift the sit-skier into the chair lift and help with unloading, while the latest mono-ski designs use a crank or lever that permits the skier to use the ski lift unassisted.

Data from the Breckenridge sit- and mono-ski programs were obtained for the 3-year period 1986–1987 to 1988–1989 (Table 8).

Chair lift rides were categorized into "clean loads" and "clean unloads," in which there was no problem with either the loading or unloading of the chair lifts, and "misloads" and "misunloads," in which there was a problem causing either a fall or chair lift stoppage. Over the 3-year period, there were over 5000 chair lift rides given to sit- and mono-skiers, with more than 96% resulting in clean loads and unloads. In less than 4% there was difficulty with either loading or unloading the chair lift; no injury occurred in any of these cases. Similar studies of the able-bodied population have not been performed, but the above is strong support for allowing the sit-ski and mono-ski to be used in areas with hills serviced by chair lifts.

DISCUSSION

The data obtained thus far have raised interesting comparisons and, we hope, will provide the impetus for future, more complete, prospective studies. Although the data for disabled skiers have been gathered from instructional programs, they nevertheless suggest that the disabled skier is at no greater risk of injury, both in terms of actual incidence rate and severity, than able-bodied skiers. The disabled skier may, in fact, be at less risk for serious injury and more likely to sustain only minor bruises.

A major limitation of this study is the inconsistency in methods of data collection and reporting used by the disabled-skiing programs and the resorts themselves. Many ski areas that we solicited were eliminated from the study because of insufficient or unrecorded information. A uniform method of data collection, for both disabled and able-bodied skiers, should be used to ensure that injury rates can be meaningfully compared between the two groups. Many areas are converting to computerization of incident reports and accident summaries, creating a prime opportunity for standardization of data.

There is a need for prospective studies with direct comparisons of rate, location, and severity of injury; type of disability; and experience of skier in the able-bodied and disabled populations. With an increasing amount of disabled skiers skiing independently, a method of tracking this population, both in terms of skier visits and injuries sustained, should be integrated into the study design. Skiing can be a wonderful therapeutic outlet for individuals with a myriad of physical disabilities and provide a recreational and social outlet to those in cold-weather climates. We hope that this study will stimulate more areas to allow disabled skiers on their slopes, even if limited to participation in supervised instructional programs.

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