Accident prevention among adolescents in winter.

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In 1990, almost 1600 children and young Canadians one year of age and older died as a result of accidents. Moreover, for each child who died, more than fifty were injured, some of them seriously. Injuries remain the main cause of death among youth (1).

This article presents the epidemiology of accidents in which young people are most frequently involved as well as preventive measures related to winter sports. It is important to review these preventive measures and to discuss them with adolescents and parents.

It is the accidents related to horseback riding, hockey, ice skating, sledding, skiing (cross-country and downhill) and snowboarding that catch our attention in winter.

Horseback riding

The risk of injury to horseback riders has been known since antiquity. According to the *National Electronic Injury Surveillance System - USA*, more than 2300 people under the age of 25 are hospitalized each year as a result riding accidents (2).

The current literature shows that riding injuries among young people under 19 are more frequent among women than among men. However the man/woman ratio among riders is unknown. Accidents most often occur when riders fall from the horse. Fractures of the upper limbs especially and of the lower limbs, followed by head injuries are the most frequent injuries (3). In most cases, head injuries lead to hospitalization (55%-100% of all cases) or to death (72%-74% of all cases) (2).

Wearing a helmet when riding reduces the incidence and the gravity of head injuries. As a matter of fact, the rate of hospitalization is three to five times higher among those who wore no protective helmet at the time of the accident than the ones who did. Aesthetically, wearing a helmet is more acceptable with English saddles than with western-type mounts; that explains why the rate of injury is higher among riders who use western saddles (3).

For the main medical contraindications and factors which should be considered for riders at risk see Table 1 (2).

TABLE 1

Contraindications : for Riding

1. Previous history of fracture or cervical dislocation.
2. Congenital absence of the axis of the odontoï de.
3. Temporary paralysis, whatever the cause.
4. Previous head injury with permanent after-effects.
5. Congenital stricture of the spinal canal.

Possible Restrictions for Riding (to be analysed case by case) :

1. Repeated trauma (concussion).
2. Traumatism of the brachial plexus.
3. Lumbar trauma.
4. Hernia of the intervertebral discs.
5. Repeated injuries to muscles or to lumbar and cervical ligaments.

N.B. *Epilepsy and insulino-dependent diabetes, when controlled, are not contraindications for riding.*

Some safety tips when handling and riding horses:

1. Always wear a protective helmet that fits and is lined with polystyrene or a similar material. A 1976 study shows that the loss of the protective helmet occurs in 59% of accidents associated with concussions (4).

2. Riders should take courses on riding safety. If not, they should only ride under the close supervision of an experienced rider/instructor. Young riders should be warned to be careful and alert around horses. Horses can bite, kick or crush people.

3. Riding equipment should be inspected regularly and replaced if broken. English saddles have a safety mechanism that allows for the release of the stirrup in case of accidents. All riders should wear shoes with flexible soles to avoid getting the foot stuck in the stirrup during a fall. Bulky clothes should be avoided. Wearing a safety jacket is advisable but not obligatory at the moment.

Hockey

Hockey is one of the most popular sports in Quebec, with more than 400 000 players (5). According to recent American data, one adolescent in three between the ages of five and fifteen was injured while playing hockey during the 1990-1991 season. These injuries occurred following body contact (mostly illegal) (6).

In Quebec, hockey is responsible for 14% of sports or recreation-related accidents. The incidence varies according to the category of game and the age of players. However, statistics indicate that there are between 0.5 and 2.5 injuries per game. Only 3% of these injuries which are examined in emergency rooms require hospitalization. Most of the injuries reported are to the head and to the lower limbs (5). Now that wearing the protective helmet and mask has become obligatory since 1976, the prevalence of ocular and facial injuries has been reduced in a significant way. However, this practice does not prevent cervical injury with trauma to the medulla. Adolescents think that such equipment makes them invicible (7).

The main risk factors associated with playing hockey are related to the players' behaviour. One injury in three is the result of an illegal play. The unauthorized use of the stick and cross-checking at the boards are the incidents most often reported, the most frequent causes of cervical injury (8). Moreover, Quebec is the first province to prohibit checking among players aged 13 and younger (5).

Hockey can be a high-risk sport; Table 2 presents the elements of prevention to keep in mind (9).

TABLE 2

Safety Recommendations for Hockey

Coach

1. Teach good techniques to players.
2. Know rules and dangers of the game and teach them to the players.
3. Promote sportmanship.
4. Insist that players wear protective equipment at all times. That is:
    - approved helmet and mask
    - shoulder pads with abdominal protection
    - jock strap
    - neck protector, elbows and shin pads
    - hockey gloves
    - hockey pants, with rib & kidney protection if possible
    - appropriate skates: boots reinforced above the heel to

- protect Achilles' tendon, well-sharpened blades covered with
- plastic at both ends.

N.B. *Each piece of equipment must fit the player and be inspected periodically.*

5. At each practice check that there is a telephone and a complete first-aid kit available. Begin every practice with a warm-up period.

Player

1. Hold your head up when skating; learn to handle the stick and the puck without looking down at them.
2. Always attach the helmet strap.
3. Do not lean on the stick while skating.

Referee

1. Know the rules and put them firmly into practice. Penalize a move for its illegal nature, not for its consequence.
2. Stop the game immediately when a player is injured.
3. Before a game, make sure that there is first-aid personnel / equipment available.
4. Know the emergency procedures in force on the premises.
5. Have basic training in first-aid.

Indoor or outdoor ice rink

1. Access doors to the ice rink must be shut once the game has begun.
2. Access zones to the ice rink must be safe (not sloping or slippery).
3. The rink must be equipped with protective grill/windows to keep pucks from landing in the spectator area.
4. The ice conditions must be adequate and checked before each game.
5. Avoid any objects inlaid in the ice which might be dangerous.
6. Goalposts should be shock-absorbant.

7. Goalposts should be equipped with a device that allows them to move in case of a violent shock.

Hockey is an entertaining and stimulating game. It improves agility, speed, oculo-motor coordination and the intellectual process in young people. Fights and excessive body contact causing injuries are not necessary in this sport. It is therefore important for health professionals and those who work with young people to enforce these safety measures and make hockey an enriching sport.

Ice skating

At the moment, there is little literature on this sport. Nevertheless, the statistics for Quebec between April 1993 and March 1994 show that 259 adolescent girls and 137 adolescent boys were injured while skating (10). Of this number, 26% had fractures, 20%, sprains, 17%, lacerations and 27%, ecchymosis/oedema/hematoma. According to a study done in Toulouse, ice skating causes twice as many injuries to upper limbs as to lower limbs, in comparison with skiing (11).
Injuries associated with ice skating seems minor. It is important to distinguish between the skating of beginners who have bad falls and hurt their wrists and figure skating that causes knee injuries (11). The only medical contraindication for this sport is the progressive illness, Scheuermann's disease (idiopathic cyphosis) (11).

Safety tips for ice skating are more or less the same as those for hockey as far as rinks conditions are concerned. As for the equipment, wearing a helmet is ideal. Simple, warm clothes are highly recommended as is a warm-up before going onto the ice.

Sledding

Sledding is a popular winter sport. Sledding accidents are common; 33 000 injuries are reported each year in the United States. 4.2% of injured people are hospitalized (12). In Ontario, there is one sledding death per year (13). Speeds of 16 to 32 kilometres per hour can easily be reached (14). Injuries to extremities are more often reported among older children and adolescents.

In Ontario, a team of doctors from the Sudbury General Hospital conducted a prospective study on the injuries related to this sport (December 1992-March 1993) (13). Of a total of 109 patients between 4 to 46 years of age (average 16), men were more often victims of injuries. Wearing a helmet at the time of the accident was not common. Most of the injured people were "drivers", but passengers did not escape injury. Of the different types of sleds used, for example, toboggan, GT-racer, crazy carpet or rubber tube, the most popular (44%) was the GT-racer, a rigid plastic vehicle equipped with three skis and designed for one passenger. In second and third place were toboggans (19%) and crazy carpets (15%). Most accidents occurred when lighting was not optimal, that is, between 4:00 P.M. and 8:00 A.M. Accidents were also more frequent on weekends. Most accidents happened on private property (backyard, schoolyard, hillside) instead of in supervised places or on hills designed for this sport. Limb injuries (type most often reported) constituted 49% of all injuries. In second position were spinal injuries (17%) (cervical,

thoracic, lumbo-sacral or coccygeal). Toboggan accidents, responsible for only 19% of incidents, were most often responsible for spinal injuries. In third and fourth position were injuries to the head or face (a total of 25%), for which 7% required hospitalization. Among the injured, all were under 20 years of age. On average 3.7 school or work days were missed (0 to 80 days).

Thus, sledding is not without risks but most accidents can be avoided. The main safety recommendations can be found in Table 4 (13).

TABLE 4

Safety Recommendations for Sledding

Operator:

1. Wear a protective helmet.
2. Do not go sledding under the influence of alcohol or medication.
3. Wear waterproof and well-insulated clothings.

Vehicule:

1. Avoid sleds that make the driver think he is in control and safe (eg. with steering)
2. Avoid sleds that go too fast.
3. Install padded cushions on toboggans; they will help to reduce spinal injury.

Environment:

1. Spacious, well-lit areas for sledding.
2. Specially designated places (local park, recreational site) which are free of dangerous obstacles and far away from traffic.
3. Go sledding in appropriate weather; do not go sledding in snowstorms or in fog, or when it is too cold - avoid chilblains.

Skiing and snowboarding

Cross-country skiing

Even if injuries to cross-country skiers seem less frequent and severe, serious injuries can occur all the same. Studies show that fractures of the pelvis and femur do happen.
About 50% of injuries affect the lower limbs, 40% the upper limbs and 10% the head, face and trunk. Most accidents occur during the descent; again beginners are the most vulnerable. Moreover, some types of bindings with an edge in the sole of the boot seem to increase certain types of injuries (9).

The main safety recommendations can be found in Table 5 (9).

TABLE 5

Safety Recommendations for Cross-Country Skiing

1. Get into good physical condition before the season begins.
2. If you have cardiac, respiratory or circulatory problems, consult a doctor.
3. Wear clothing suitable for skiing (no one-piece suits, it is not a fashion show!)
4. Wear several layers of thin clothing (preferably made of wool which remains relatively warm when wet or polypropylene which does not absorb humidity).
5. Cover the head, hands and feet adequately (woollen hats, gloves, socks).
6. Take along (non-alcoholic) beverages; drink to avoid dehydration.
7. Avoid alcohol; it increases the loss of heat and dehydration.
8. Check equipment before each ski run.
9. Choose trails according to your ability.
10. Keep your distance from the skiers ahead of you.
11. If the trail is frozen or too steep, do not hesitate to remove your skis and walk beside the trail.
12. Follow the code of ethics proposed by the International Ski Federation:
    - Always use marked trails.

- Stop when someone needs help.
- Let faster skiers pass you when they yell "Trail".
- Do the same to pass others.

N.B. *Young diabetics and asthmatics should be supervised. Cyanotic cardiopathy is a contraindication. Haemophiliacs should be very careful and choose cross-country skiing rather than downhill sking. The same rules apply to epileptics. (11)*

Ownhill skiing

Downhill skiing is very popular in Quebec. Between 1986 and 1991, ten skiers died on the slopes of Quebec. According to American studies and confirmed by Quebec data, cranial and internal injuries were the main causes of death (5).

According to studies conducted in Europe, the United States and Quebec, risks of injuries are higher among people younger than 18. The prevalence is more or less equal for both sexes. However, it is mostly men who suffer serious injury leading to death. Injuries are four times more frequent among beginners. Most injuries are the result of bad falls on snow-covered surfaces or sprains to lower limbs. Other injuries occur during collisions (with ski, another skier, a tree, a pylon or other obstacles). Deaths are especially linked to collisions with a tree. According to a study done for the Régie de la Sécurité dans les Sports du Québec (RSSQ) in 1986, 24% of injuries happen when skiers descend too fast (5).

Some studies show that poorly adjusted bindings and irresponsible behaviour on the part of skiers constitute the major risk factors. Since 1989, there are regulations defining a code of behaviour for skiers. Some environmental factors can also contribute to the risks of injury. For instance, a 1990 study done in the Laurentians reported that half of the injuries happened on hard or frozen surfaces (15). There are, however, fewer ski injuries now thanks to better equipment (bindings, boots and skis) (16).

Safety principles for downhill skiing are found in Table 6 (9).

TABLE 6

Safety Recommendations for Downhill Skiing

Equipment

1. Choose good quality bindings which are correctly installed and appropriate for weight, age and ability of the skier.
2. Choose poles, boots and skis to fit the skier.
3. Avoid clothing made of smooth material; it increases speed when sliding after a bad fall.

Before the ski season begins:

1. Get into good physical condition at least six weeks before the season begins.
2. Check your equipment.

Once the season begins:

1. Beginners should take lessons from a qualified instructor.
2. To avoid fatigue (one cause of accidents), take breaks. Make sure that you stop in a safe place, that you are visible to other skiers.
3. Use trails that suit your ability.
4. Do not use damaged poles.
5. Keep your distance from other skiiers.

Transporting equipment:

1. Do not transport skis, boots or poles inside the car; put them on the roof rack or in the trunk.
2. Do not wear ski boots to drive.
3. Cover skis to protect the bindings from salt and bad weather.

N.B. *Obviously, ski resorts owners must make sure that their safety measures are appropriate; that is, that trails are well-maintained and well-lit, that instructors*

are competent and that well-trained ski patrols are available at all times.

Snowboarding

In the last ten years, snowboarding has become a very popular winter sport. The range of injury is different from that of downhill skiing. This has important implications for manufacturers, ski resorts owners and the medical professionals who must cope with the various incidents.

A review of the work of Drs. Bladin and McCrory (University of Melbourne, Australia), published in May 1995, shows that the man/woman ratio of snowboarders is about three to one, most of them in their early twenties. The rate of injuries is 4 to 6 per 1000, which can be compared to the rate for downhill skiing (17).

60% of snowboarders who get injured are beginners compared to 34% of skiers. Moreover, 57% of injuries reported are to lower limbs and 30% to upper limbs. The most common injuries are simple sprains (31 to 53%), especially sprains of the ankle (23 to 26%) and of the knee (12 to 23%). 24 to 27% of injuries are fractures and 12% are contusions.

In comparison with incidents in downhill skiing, snowboarders have 2.4 as many fractures; upper limb fractures (21% of the fractures for snowboarders vs 35% for skiers), and knee fractures (23% vs 44% of injuries to lower limbs); and ankles (23% vs 6%). Knee injuries among snowboarders are less serious than among skiers. Fracture of the lateral process of the talus is an uncommon fracture typical of snowboarders; it can easily be mistaken for a severely sprained ankle. Ankle injuries are more common among intermediate and advanced snowboarders who often wear supple boots. Knee injuries and distal tibia fractures are more often caused by the rigid boots beginners wear. In conclusion, bad falls and twisting movements are the major cause of injury.

There is no doubt that additional research is necessary to better understand and prevent injuries in snowboarding. It is all the more important since this sport is gaining popularity among adolescents.

Recommendations based on the latest studies:

1. Beginners should wear supple or "hybrid" boots with ankle support (eg. Sorel), helmet and protectors to reduce risks of impact injuries.
2. Take lessons from qualified instructors.
3. Keep equipment in good condition and check it regularly.

Conclusion

In conclusion, we again stress the importance of prevention and the promotion of health among young people. Here is Dr. Barry Goldberg's (19) excellent check list for accident prevention:

1. Keep in good physical condition.
2. Do NOT train excessively.
3. Always do sports in a safe environment.
4. Make sure that previous injuries are healed.
5. Make sure good supervision is available.
6. Ensure safety rules.
7. Teach good technique for each sport.
8. Maintain equipment.
9. Do appropriate medical pre-evaluation.
10. Establish a standard of competition according to age, weight, ability and stage of development.

References

1. Santé Infantile- Le bulletin de l'Institut Canadien de la Santé Infantile, numéro 4, volume 16, hiver 1994.
2. Nelson, DE, Bixby-Hammett, D: Equestrian Injuries in Children and Young Adults.AJDC 146: 611-613, may 1992.
3. Bixby-Hammett,D: Pediatric Equestrian Injuries. Pediatrics 89:1174-1175, June 1992.
4. Mahaley, MS, Seaber, AV: Accident and Safety Considerations of horse back riding. In: Proceedings of the 18 th American Medical Association Conference on the Medical Aspects of Sports; June 26, 1976; Dallas, TX; 37-45.
5. Beaulme G, & coll.:Les traumatismes au Québec: Comprendre pour prévenir, 204-207, Publications du Québec,1991.
6. Rome, ES: Sports-related Injuries Among Adolescents: When Do They Occur, and How Can We Prevent Them? Pediatrics in Review 16:185-186, May 1995.
7. Murray, TM, Livingston, B&LA: Hockey Helmets, Face Masks, and Injurious Behavior.Pediatrics 99: 419-421, March 1995
8. Brust, JD, Leonard, BJ, Pheley, A, Roberts, WO: Children's Ice Hockey Injuries.
9. AJDC 146: 741, June 1992.
10. D'Amours, Y, Thériault, G: La Sécurité dans les sports, Prévention des blessures et premiers soins. Gouvernement du Québec, 45-47 & 54-57, 1985.
11. Le Bulletin du SCHIRPT, page 8, Novembre 1994.
12. Gaubert, J, Bortolaso, J: Traumatologie sportive et ludique de l'enfant: Collection de monographies de médecine du sport, pages 90-92 & 114-115, 1990.
13. Consumer Product Safety Commission: Directorate of Epidemiology. MEISS Data Highlights a1986: 10,1985.
14. Wynne, AD, Bota, GW, Rowe, BH: Sledding Trauma in a Northeastern Ontario Community. Journal of Trauma 37 (5): 820-825, November 1994.
15. Manary, MJ, Hollifield, WC Jr: Childhood Sledding Injuries in 1990-1991. Pediatric Emergency Care 9(3): 155-158, June 1993.
16. Sévigny,D, Cousineau, D: Les Accidents en ski alpin dans la région des Laurentides. St-Jérôme, Département de Santé Communautaire, Hôtel-Dieu de St-Jérôme. 1990.
17. Johnson, RJ, Ettlinger, CF, Shealy, JE:"Skier Injury Trends." In skiing Trauma and Safety: Seventh International Symposium. Baltimore, American Society for Testing and Materials, p 25-31,1989.
18. Bladin, C, McCrory, P: Snowboarding Injuries, An Overview. Sports Medicine 19.(6): 360-364, May 1995.
19. Bladin,C , Giddings, P, Robinson, M: Australian Snowboard Injury Data Base Study, a four-year prospective study. The American Journal of Sports Medicine 21(5), 701-704, Sept-Oct 1993.
20. Risser,WL:Epidemiology of Sports Injuries in Adolescents.Adolescent Medicine:State of the Art Reviews 2(1):121-122, February 1991.

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