Physical Characteristics and Incidence of Injuries in Adult Figure Skaters

Cynthia M. Ferrara and Emily Hollingsworth

Purpose: To examine relationships between physical characteristics and injuries in adult figure skaters. Methods: One hundred thirty adult figure skaters (113 women and 17 men, 43 ± 9 and 55 ± 10 y old, respectively) completed study questionnaires concerning health, height and weight, exercise habits, and injuries in the preceding year. Results: The men were older and taller and weighed more than the women (P < .05). Approximately 80% had normal body-mass index (BMI, weight [kg]/height [m]^2), and the other 20% were overweight or obese based on BMI. Study participants had been skating for 12 ± 10 y (range 1 to 68 y). Most skate 4 to 5 h/wk (competitive > recreational skaters, P < .05). Although approximately 50% of competitive skaters always warm up or stretch before skating, less than 30% of the recreational skaters always do so (P < .05). Seventy-two skaters (56%) reported at least 1 injury in the preceding year. Most of the injuries were acute injuries to the lower extremity and were related to skating (76%). There were no differences in the incidence of stretching or warm-up activities or the number of hours per week spent skating in those who had incurred a skating-related injury compared with those who had not been injured (P > .05). Conclusions: The results suggest that adult skaters have training and exercise habits that might increase their risk of injury and impair athletic performance. This suggests the importance of educational programming for adult skaters designed to address injury prevention and basic exercise-training principles.

Key Words: figure skating, sport-related injuries

Figure skating is an increasingly popular sport in the United States, enjoyed by active people of all ages. Skating combines elements of athleticism and artistry, requiring strength, flexibility, power, endurance, and grace.

In recent years, the number of adults (those 25 years and older) who enjoy skating as a recreational or competitive sport has increased significantly, with many competing in local, regional, national, and international competitions. In 1995, the first US Adult Figure Skating Championships were held in Wilmington, Del, with 421 skaters competing. In 2004, the 10th US Adult Figure Skating Championships at the Lake Placid Olympic Arena began with more than 600 skaters competing. The event continues to grow, with many adult skaters initially coming for the
competition but returning year after year for the camaraderie and friendships. International competitions for adults also continue to draw many competitors. In recent years, more than 100 skaters have gathered in Villard-de-Lans, France, for one of the largest international adult competitions, the Mountain Cup. In June 2005, adult skaters from all over the world participated in the first International Skating Union–sanctioned adult figure-skating competition in Oberstdorf, Germany.

Previous reports have examined training habits and injuries in young elite skaters.\textsuperscript{1-5} Many successful young skaters begin skating by 6 years of age. By adolescence, they are spending 15 to 30 h/wk in on-ice training and an additional 5 to 15 hours in off-ice conditioning activities.\textsuperscript{3,4} Training continues year-round in preparation for the competitive season. Musculoskeletal injuries occur frequently in young competitive figure skaters, with 50% of the injuries being acute and 50% being overuse injuries.\textsuperscript{4} Although lower extremity injuries are common in single skaters, skaters involved in pairs, dance, and synchronized skating have an increased risk of trunk, shoulder, and upper extremity injuries, in addition to a higher incidence of concussions and lacerations. Although reduced flexibility, muscle strength, and body alignment and inappropriate warm-up or cool-down might contribute to the musculoskeletal injuries, many think that the rigidity of the skating boot and the skating blade contribute significantly to musculoskeletal injuries in young skaters.\textsuperscript{1,4,5}

To our knowledge, no studies have examined the training habits and injuries of adult skaters. This information is important for injury prevention, lifelong participation in figure skating and other sports, and overall good health. We examined demographic information, physical characteristics, training habits, and recent injuries in competitive and serious recreational adult skaters.

**Methods**

One hundred thirty adult skaters (113 women and 17 men) voluntarily completed a health-history and a study questionnaire about skating and exercise habits, usual daily diet, and general demographic information. Participants were recruited from competitors at the 2005 US Adult Nationals, postings on United States Figure Skating Association national and club Web sites, and articles and announcements in club newsletters. The study was approved by the University of Massachusetts Lowell institutional review board.

As part of the health-history questionnaire, skaters reported any diagnosed medical conditions, prescription and nonprescription medications, age, height, and weight. As part of the study questionnaire, skaters answered questions about their weekly work and school schedule, marital status, and number of children, as well as questions related to usual dietary and nutritional habits, usual exercise habits, and any injuries they had sustained in the preceding year.

**Statistical Analyses**

Data were analyzed by using descriptive statistics, Mann–Whitney U-test comparisons, chi-square analysis, and Spearman rank correlations when appropriate. Results were accepted as significant at the level of \( P < .05 \). For questions related to the number of days and hours per week that study participants spent skating, a
numerical value (1 to 5) was assigned to each answer: (1) 1 to 3 hours, (2) 4 to 5 hours, (3) 6 to 10 hours, (4) 10 to 15 hours, or (5), more than 15 hours. Differences between recreational and competitive skaters were analyzed using Mann–Whitney U-comparisons. Differences in the incidence of stretching and warm-up activities between skaters who had had a skating-related injury in the preceding year compared with those who had not been injured while skating were analyzed using chi-square analyses. Results are expressed as mean ± SD.

Results

Subject Characteristics

Study participants represented most skating disciplines and often participated in more than 1 discipline: dance 38%, freestyle 90%, synchronized skating 6%, and pairs 3%. Most participants (n = 88) competed in local (n = 38), regional (n = 9), national (n = 36), or international (n = 5) adult skating competitions. The other participants (n = 42) were classified as recreational skaters, although 63% of these individuals were advancing through the Ice Skating Institute (n = 7) or United States Figure Skating Association (n = 19) test systems. Seventy-four percent of study participants were married or had a domestic partner (n = 96), and 15% were single (n = 20), with the remainder engaged or involved in a serious relationship (n = 4), separated (n = 2), or divorced (n = 8). Most did not have any children (n = 70, 55%); 36% had 1 (n = 23) or 2 children (n = 24), and 8% had 3 (n = 9) or 4 children (n = 1). Fifty-five percent of the study participants (n = 71) worked 40 or more hours per week, 26% worked between 20 and 39 h/wk (n = 34), and 18% worked less than 20 h/wk (n = 23).

Medical Conditions

Thirty-eight percent of study participants (n = 50) reported being diagnosed with 1 or more specific medical conditions (Table 1). In 67% of the medical conditions (41 of 61), participants were taking prescription medications as part of their treatment regimen. In addition, 53 participants reported having nonspecific joint pain or arthritislike symptoms. Five of these individuals were taking prescription medication for their joint-pain symptoms.

Physical Characteristics

The average age of study participants was 55 ± 10 and 43 ± 9 years for men and women, respectively (P < 0.0001, men vs women). The men were taller (1.76 ± 0.06 vs 1.63 ± 0.07 m, P < .0001) and weighed more than the women (78.9 ± 9.4 vs 60.4 ± 10.9 kg, P < .0001), and body-mass index (BMI; body weight in kg/[height in m]²) was significantly higher in the men than in the women (25.4 ± 3.2 vs 22.6 ± 3.4 kg/m², P < .005). The average BMI for both the men and the women was in or close to the normal weight range (18.5 kg/m² ≤ BMI < 25 kg/m²), with the BMI value of 80% of the participants within the normal range. Twenty study participants (15%, 11 women and 9 men) had a BMI in the overweight range (25 kg/m² ≤ BMI < 30 kg/m²), and 7 participants (5%, 6 women and 1 man) had a BMI in the obese
range (BMI ≥ 30 kg/m²). Nineteen of these individuals considered themselves competitive skaters. BMI was not different based on competitive status (competitive vs recreational) and was not related to age in either the men (r = –.105, P > .05) or the women (r = .06, P > .05).

**Dietary and Nutritional Habits**

Study participants were asked about their intake of fruit and vegetables in the preceding 24 hours. The average number of fruit and vegetable servings in the preceding 24 hours was 5.3 ± 2.3 for all skaters. Sixty-three percent (n = 82) of skaters had eaten 5 to 9 servings of fruits and vegetables during the preceding 24 hours, as recommended by the American Cancer Society. Forty-six percent (n = 60) reported taking a multivitamin on a regular basis, and 43% (n = 56) reported taking vitamin (A, B, C, D, E), mineral (calcium, selenium, magnesium, zinc, iron), or other supplements (glucosamine and chondroitin, omega 3 amino acids, and flaxseed oil were most common) on a regular basis.

**Exercise Habits**

Study participants had been skating for an average of 12 ± 10 years (range 1 to 68). Most skated 3 or 4 d/wk (45%, n = 58) for approximately 4 or 5 h/wk (44%, n = 57) during a usual week. Overall, competitive skaters spent more time per week skating than recreational skaters (P < .05). Many participated in other forms of exercise on a regular basis, including aerobic conditioning (running, walking, swimming, biking), strength and core-stability training, ballet, yoga, and Pilates. Approximately 41% participated in vigorous aerobic exercise for at least 20 minutes or moderate aerobic exercise for at least 30 minutes 1 or 2 d/wk, with 18%, 10%, and 7% participating in vigorous or moderate aerobic exercise 3 or 4 days, 5 days, or more than 5 days per week, respectively (time spent skating not included in these

<table>
<thead>
<tr>
<th>Medical condition</th>
<th>Number of skaters</th>
<th>Number taking prescription medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Exercise-induced asthma</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Hypertension</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Coronary artery bypass graft surgery, pacemaker</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Hypothyroid</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Arthritis</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Systemic lupus erythematosus</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Multiple sclerosis</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Anemia</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Nonspecific joint pain, arthrituslike symptoms</td>
<td>53</td>
<td>5</td>
</tr>
</tbody>
</table>
values). In addition, approximately 48% participated in some type of strengthening exercise 1 or 2 d/wk, and 21%, 3%, and 5% participated in strengthening exercises 3 or 4 days, 5 days, and more than 5 days per week, respectively. Approximately 24% of the adult skaters did not participate in any type of aerobic exercise other than skating, and 23% did not participate in any type of strengthening exercise. Although most competitive skaters always warmed up or stretched before skating or exercise (47%, n = 38 out of 81 for the women, and 55%, n = 5 out of 9 for the men), only 30% (9 out of 30) of the women and none of the men recreational skaters always did so (P < .05, competitive vs recreational, Figure 1). Only 15% of all skaters always stretched after skating, with no difference between competitive and recreational skaters.

Injuries

Seventy-two skaters (56%, 53 competitive and 19 recreational) reported having had at least 1 injury in the preceding year (Table 2). Fifty-eight skaters reported having had 1 injury, 9 reported having had 2 injuries, and 5 reported having had 3 injuries (91 injuries total), with 69 of the injuries related to skating. The most

![Figure 1](image-url) — Percentage of skaters who stretch or warm up before skating or exercise. Results are presented based on gender and competition status. Rec indicates recreational, and Comp, competitive.
common injuries related to skating were bruises to the hip or knee related to a fall (acute injury); arthritis-type pain of the knee, hip, or ankle (chronic injury); or a chronic back injury. The most common injuries not related to skating were acute and chronic back and knee injuries. Of the injuries related to skating, 53 were sustained by competitive skaters and 16 were sustained by recreational skaters. Fifty-one of all injuries were classified as serious (missed 7 or more consecutive days of skating or related activities), and 40 were classified as less serious (missed fewer than 7 days of skating or related activities). Forty-two of the serious injuries were related to skating, and the other 9 serious injuries were work- or other-sport-related injuries or chronic medical issues (degenerative disk disease or sciatica, degenerative joint disease, multiple sclerosis). Table 2 indicates respective anatomical locations for each of the injuries related or not related to skating, grouped by serious versus less serious, as well as acute versus chronic. Skaters might have sustained injuries at more than 1 anatomical location for each reported injury occurrence (ie, ankle and knee or lower back and hip), so the total number of anatomical regions affected by injury (n = 102) is not be equal to the total number of injuries (n = 91).

The incidence of stretching and warm-up activities before skating in skaters who had had a skating-related injury in the preceding year compared with those who had not been injured is reported in Table 3. The competitive and recreational skaters who had sustained a skating-related injury in the preceding year were no more likely to stretch or warm up before skating or exercise than those who reported no injuries or a non-skating-related injury. In addition, there were no differences in the number of hours spent skating per week in those who had had a skating-related injury in either the competitive or recreational skaters (P > .05).
Discussion

Figure skating is an increasingly popular sport as a recreational or competitive pursuit for men and women over the age of 25. This study is the first to examine the physical characteristics, exercise and dietary habits, and incidence of injuries in adult figure skaters. The results suggest that adult skaters have training and exercise habits that might increase their risk of injury and impair performance. This suggests the importance of educational programming for adult skaters, addressing injury prevention and exercise-training principles.

In the current study, the BMI value of 80% of participants was in the normal range, with approximately 20% of study participants having BMI values in the overweight or obese range. These values, which reflect a lower incidence of overweight and obesity than that reported for the US adult population, suggest that those participating in figure skating, even as adults, might have a lower BMI and percentage body fat than other adults. This difference is most likely because overweight and obese individuals are less inclined to participate in figure skating than individuals with a normal BMI. The current study did not measure percentage body fat in study participants, which would have provided a more accurate assessment of body composition in the adult skaters. Future studies should measure percentage body fat in adult skaters to determine the contribution of body composition to athletic performance and risk of injury, as well as the influence of long-term participation in sport and exercise on body composition and overall health in adult men and women.

The current study did not measure daily nutritional intake of the adult skaters, but we did ask about daily fruit and vegetable servings and vitamin and nutritional supplements. The average number of servings of fruits and vegetables per day was similar to published values for US adults. The percentage of skaters who had consumed 5 to 9 servings of fruits and vegetables during the preceding day was much higher than that reported for the US adult population; approximately 60% of study participants, compared with 25% of the US adult population. In addition, close to half the study participants reported taking a daily multivitamin. These results suggest

<table>
<thead>
<tr>
<th>How often do you warm up and/or stretch before getting on the ice to skate?</th>
<th>Never</th>
<th>Sometimes</th>
<th>Almost always</th>
<th>Every time I skate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive, skating-related injury</td>
<td>2 (5%)</td>
<td>6 (15%)</td>
<td>8 (20%)</td>
<td>24 (60%)</td>
</tr>
<tr>
<td>Competitive, no injury</td>
<td>8 (17%)</td>
<td>11 (23%)</td>
<td>10 (20%)</td>
<td>19 (40%)</td>
</tr>
<tr>
<td>Recreational, skating-related injury</td>
<td>2 (13%)</td>
<td>5 (31%)</td>
<td>4 (25%)</td>
<td>5 (31%)</td>
</tr>
<tr>
<td>Recreational, no injury</td>
<td>5 (26%)</td>
<td>9 (47%)</td>
<td>2 (11%)</td>
<td>3 (16%)</td>
</tr>
</tbody>
</table>
that adult skaters might be more conscientious about their diet and daily nutrition than many adults. Future studies should assess dietary intake (carbohydrates, fat, protein, and total calories) to more clearly determine the influence of diet on overall health, body composition, and athletic performance in these individuals.

Most of the adult skaters in the current study skated approximately 4 to 5 h/wk, much less than the 15 to 30 h/wk reported by competitive young skaters. There were no differences in the number of hours spent skating per week by the skaters who had sustained a skating-related injury and those who had not been injured while skating in the preceding year, which is different from data in competitive young skaters. This discrepancy might be because of the significantly lower number of hours spent skating per week compared with competitive young skaters, as well as differences in the volume and repetition of jumps, time spent learning a new jump or skill, and other factors contributing to increased stress on muscle and joint structures that might differ between the adult skaters and competitive young skaters. Similar to their younger counterparts, many adult skaters participated in off-ice training programs and other physical activities, but one-quarter of the adult skaters surveyed did not participate in any aerobic exercise other than skating or in any strength training. Of concern to exercise professionals is the number of skaters who did not warm up or stretch before exercise (approximately 50% and 70% of competitive and recreational skaters, respectively) and who did not stretch after exercise (approximately 85% of all skaters). Warm-up and stretching activities before any type of exercise are important to protect the body against injury and to improve overall flexibility. The current study did not evaluate flexibility, so we cannot determine whether a lack of flexibility is associated with stretching before or after exercise or with an increased risk of injury.

We failed to observe any substantial difference in the incidence of warm-up or stretching activities in competitive and recreational skaters who had had a skating-related injury in the preceding year and those who had not. This finding appears to contradict the results of Smith et al, who observed a strong relationship between anterior knee pain and reduced quadriceps flexibility in elite junior female skaters. In addition, improvements in quadriceps flexibility were associated with reduced or eliminated anterior knee pain. The current study did not evaluate flexibility, so it is difficult to determine whether those who stretched before skating or exercise had better flexibility than those who did not stretch. This information would be important in comparing injury incidence and flexibility in adult skaters with those of the young elite skaters. In addition, because the current study was retrospective and the information was self-reported, it is difficult to determine whether warm-up and stretching activities were associated with a lower or higher incidence of injury. It is also possible that the individuals who had been injured in the past might be more likely to stretch because of instruction on the importance of stretching and flexibility as part of injury rehabilitation and physical therapy. Future studies will need to monitor warm-up and stretching activities, evaluate flexibility, and monitor injuries when they occur to best determine the relationship between these variables in adult skaters.

The current study provides the first peer-reviewed information on the incidence of injuries in adult figure skaters. Approximately 50% of the study participants reported having had an injury during the preceding year, with approximately 50% of these injuries being classified as serious, affecting their ability to skate or exercise.
for 7 or more days. These percentages are similar to results reported for elite ice dancers and pairs skaters. Most of the injuries in the current study resulted from an acute trauma (60%), whereas investigations in younger skaters have observed an equal number of acute trauma and overuse injuries, and a higher number of acute injuries, and a higher number of overuse injuries. Dubravcic-Simunjak et al suggest that the particular skating discipline might affect whether the skater is at a higher risk for acute or overuse injuries; overuse injuries might be more common in singles skaters, whereas acute injuries might be more common in pairs skaters and ice dancers. Although most skating disciplines were represented in the current study, many of the adult skaters indicated that they participated in more than 1 discipline (ie, singles, ice dancing, or synchronized skating). Thus, it would be difficult to determine whether a specific type of injury (acute or overuse) was related to skating discipline, as was done by Dubravcic-Simunjak et al. The higher incidence of acute than chronic overuse injuries in the study participants might be related to the average number of hours spent skating each week, which was lower in the adult skaters than previously reported values in young elite skaters (4 to 5 h/wk compared with 15 to 30 h/wk), as well as other training-related factors that might differ between the adult skaters and competitive young skaters. Similar to reports on injuries in young elite skaters, most of the injuries in the adult skaters were to the lower extremity (foot/ankle, knee, or hip). As is the case with younger skaters, many of the lower extremity injuries might be related to strength imbalance, reduced flexibility, and possible skating-boot-related issues. Future studies will need to evaluate the influence of exercise and skating habits, flexibility, strength, boot-related issues, and other factors on the incidence of injuries and injury prevention in adult skaters.

The current study relied on self-reported medical information, incidence of injuries during the preceding year, exercise and dietary habits, and height and body weight. Although it is possible that study participants misreported information because of recall bias, we believe that their recall of this information is likely to be accurate because of the importance of overall health, training and exercise habits, diet, and injuries to these athletes and the influence of these factors on their ability to exercise. Any questionable information reported on the survey forms was confirmed for accuracy with the individual study participant.

**Practical Applications and Conclusions**

The current study is the first to examine general characteristics, training and dietary habits, and incidence and type of injuries in adult competitive and serious recreational figure skaters age 25 years and older. The results suggest that adult skaters have training and exercise habits that might increase their risk of injury, as well as impair athletic performance. These findings highlight the importance of educational programming for adult skaters designed to address injury prevention and basic exercise-training principles. Future studies will need to examine these older athletes and factors that might be important to optimal athletic performance, reduced risk of injury, and improved overall health compared with US adults.
Acknowledgments

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References