Dietary Supplement Use by Varsity Athletes at a Canadian University

Martin Kristiansen, Ryna Levy-Milne, Susan Barr, and Anne Flint

The purpose of this study was to assess reasons for and prevalence of supplement use among varsity athletes and nonvarsity athlete students (controls) at a Canadian university. A questionnaire, distributed to 247 varsity athletes and 204 controls, included variables regarding sports participation, supplements used, reasons for usage, perceived effects, and areas of interest about supplements. Response rates were 85.5% among varsity athletes and 44.6% among controls. Supplements were used by 98.6% of varsity athletes and 94.3% of controls. Varsity men most often reported using sports drinks, and used these (and carbohydrate gels, protein powder, and creatine) more than varsity women. Caffeine products were most often reported by other groups. Health professionals and the Internet were the most reported information sources, while friends most often recommended supplements. Many subjects indicated knowing little about supplements and wanting to learn more. Results indicate a need for nutrition education among both varsity athletes and university students.

Key Words: creatine, protein, carbohydrate, vitamins, ergogenic aids, students

There is no doubt that talent and hard work are the main factors that contribute to the success of an athlete. Yet athletes of all levels use dietary supplements in an effort to maximize their performance (1, 2). Surveys have found that more than 50% of varsity athletes use supplements (1, 3-5), with prevalence of supplement use up to 100% in some sports (4). Female athletes are more likely to use supplements for general health benefits, whereas male athletes mostly use supplements to improve performance and increase strength (3). Previous studies have found carbohydrate and vitamin/mineral supplements (1, 5) to be the most popular among university athletes, followed closely by creatine and protein supplements (1, 5, 6). At this point, relatively little well-controlled research exists to demonstrate the efficacy of dietary supplements in sport. The market, however, is booming with a large variety of supplements, most of which hold little or no scientific support (7). Accordingly, it is not surprising that athletes are confused and show poor knowledge about the use of supplements (1, 8, 9).
It has been shown that supplement use among athletes often begins in high school, with the greatest prevalence among athletes who expect to compete in collegiate sports (10), possibly because of the pressure of receiving sports scholarships for universities. In Canada, varsity sports are not sponsored to the same extent as in the United States, where most surveys on supplement use have been conducted; this might result in a smaller prevalence of supplement use, because of less financial interest connected to performing. Canadian athletes, however, have expressed to the Canadian Centre for Ethics in Sport that gaining credible and reliable information on supplements is a high priority for them (11). Since no research has been done on dietary supplement use among Canadian varsity athletes, information about supplement use in this group is necessary to direct accurate information and to provide education on the use of these products.

The objectives of this study were to assess 1) the prevalence of supplement use among varsity athletes, 2) the differences in supplement use between genders and between varsity athlete students and nonvarsity student athletes, 3) the reasons for using supplements, 4) any negative effects experienced when using supplements, 5) whether athletes find their knowledge sufficient, and 6) what athletes would like to learn about supplements.

Subjects and Methods

Subjects were all university students, and included a varsity athlete group and a control group of students who were not varsity athletes. Inclusion criteria were: students over age 19, and able to read and write in English. For the varsity athlete group, an additional criterion was current membership on one or more varsity athletic teams. The study was approved by the University of British Columbia Behavioural Research Ethics Board.

Sample Size Estimation

Approximately 40,000 students (most ≥ 19 y) were enrolled at the surveyed university, including 536 varsity athletes. Using the Sample Size Calculator (Creative Research Systems, Petaluma, CA), it was determined that 118 varsity athletes and 150 students who were not varsity athletes were needed to characterize the population. Based on similar studies with response rates between 55.8% and 90% (1, 3, 6, 12), a response rate of 70% was anticipated, and it was calculated that the questionnaire needed to be distributed to 169 varsity athletes and 214 controls.

Questionnaire

A questionnaire was adapted and further developed based on a questionnaire recently developed by Team Danmark to assess the use of dietary supplements by elite athletes in Denmark (2). This questionnaire was reviewed and pilot tested twice to close open-ended questions and to ensure clarity among students and athletes attending the surveyed university. The questionnaire included variables regarding sports participation, supplements used and frequency, reasons for using supplements, as well as demographic data. Three open-ended questions were included to clarify any negative effects experienced with supplements, supplements the subjects would like to learn more about, and what they would like to learn about
them. Questions regarding supplements included whether subjects had consumed a given supplement in the last month, and response options were: No, 1 to 5 times, 6 to 10 times, 11 to 15 times, more than 15 times, every day, or more than once a day in the last month. Those who consumed a given supplement were also asked when it was consumed, with the possibility of selecting all responses that applied (i.e., just before exercise, during exercise, after exercise, just before competition, after competition, other times). With regard to nonvitamin mineral supplements, subjects were asked to write down the names and frequencies of use.

**Distribution**

**Varsity Group.** The head coach of each varsity team was informed of the study and asked to approve of their team members being approached to participate. Positive responses were received from coaches of the men’s and women’s hockey, soccer, basketball, rugby, volleyball, track and field, swimming, and alpine skiing teams. Coaches of the women’s field hockey and golf teams and the men’s baseball and football teams also responded positively. Men’s and women’s rowing and cross country ski teams and men’s field hockey and golf did not participate in the survey. Athletes were contacted before a training session and given the questionnaire. Depending on their training schedules, some completed the questionnaire during their training session, while others took them home to complete. For retrieval of questionnaires, athletes were approached at the beginning of training sessions for 3 consecutive weeks, subsequent to the distribution. All questionnaires were returned in sealed envelopes to ensure anonymity.

**Control Group.** To collect data from the students who were not varsity athletes, random courses were selected, until 300 students would be present in the chosen courses. The instructors of the chosen courses were contacted by e-mail and asked for their consent to conduct the study in their classes. All but 1 course instructor responded positively. Accordingly, students in 6 different classes in 6 different departments were approached at the beginning of a class and given a brief introduction to the study. It was stressed that all data were completely anonymous and that participation was optional. Students who agreed to take part were given a questionnaire and asked to return it during the same class the following week in a sealed envelope provided with the questionnaire. For retrieval of questionnaires, students were approached during the same class for 3 consecutive weeks.

**Statistical Analysis**

All returned questionnaires were coded and entered into a data file for analysis using SPSS version 11.0 (SPSS, Inc., Chicago, IL). Data analysis was primarily descriptive (frequency distributions and cross tabulations); however, data were evaluated with regard to gender and varsity/control group using $\chi^2$-square analysis. Differences were considered significant at $P < 0.05$.

**Results**

The varsity group represented athletes from 17 varsity teams, with response rates varying between 26 to 100% within the teams. Two-hundred-eighty varsity athletes and 204 controls received the questionnaire during February 2004. The response
rate was 85.5% \((n = 211)\) for the varsity athlete group and 44.6% \((n = 91)\) for the control group.

Subject characteristics are shown in Table 1. Both men and women varsity athletes were significantly younger, taller, and heavier than the control group. Male athletes had a significantly higher body-mass index (BMI) than their controls, while BMI did not differ between female varsity athletes and controls. Men and women varsity athletes spent significantly more time exercising than their control group counterparts. There was no difference in the time spent exercising between men and women varsity athletes.

Table 2 shows the distribution of the types of sports participated in by varsity athletes and controls. Varsity athletes mainly participated in team sports, whereas students in the control group mainly participated in individual sports. Controls, 72% of whom took part in one or more sports, participated in a larger diversity of sport types with fewer participating in each sport compared to varsity athletes. All varsity athletes and 50% of the controls who participated in sport, competed in their sport.

Table 3 shows supplement use in the varsity and control groups. There were no significant differences in the use of any supplements between men and women in the control group. The prevalence of supplement use by male controls was lower compared to varsity males. A higher percentage of females in the control group, however, reported using caffeine products compared to the female varsity group.

In the varsity group, men were significantly more likely than women to use sports drinks or carbohydrate gels, and both women and men were more likely to use sports drinks, carbohydrate gels or carbohydrate bars than women and men.

### Table 1  Characteristics of Participants in the Varsity and Control Group

<table>
<thead>
<tr>
<th></th>
<th>Male Athletes ((n = 120))</th>
<th>Male Controls ((n = 30))</th>
<th>(P)-value</th>
<th>Female Athletes ((n = 89))</th>
<th>Female Controls ((n = 60))</th>
<th>(P)-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>21.3 (2.0)</td>
<td>22.7 (4.5)</td>
<td>&lt; 0.02</td>
<td>20.7 (1.6)</td>
<td>21.9 (2.8)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>185.5 (9.0)</td>
<td>180.8 (8.7)</td>
<td>&lt; 0.02</td>
<td>170.6 (7.9)</td>
<td>165.3 (7.5)</td>
<td>0.001</td>
</tr>
<tr>
<td>Body weight (kg)</td>
<td>87.3 (13.7)</td>
<td>75.9 (12.1)</td>
<td>&lt; 0.001</td>
<td>65.3 (7.0)</td>
<td>59.7 (10.5)</td>
<td>0.001</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25.3 (3.4)</td>
<td>23.2 (2.7)</td>
<td>0.001</td>
<td>22.4 (1.9)</td>
<td>21.9 (3.8)</td>
<td>ns</td>
</tr>
<tr>
<td>Exercise (h/wk)</td>
<td>9.8 (4.2)</td>
<td>1.6 (2.3)</td>
<td>&lt; 0.001</td>
<td>9.1 (3.9)</td>
<td>2.2 (3.2)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

*Note.* Values are means ± standard deviation. ns, not significant; BMI, body-mass index. One control participant and two varsity athletes did not specify anthropometric data; these are not included in results where these data are used.
### Table 2  Main Sport Categorized by Subgroups

<table>
<thead>
<tr>
<th></th>
<th>Male Athlete, $n = 120$</th>
<th>Control, $n = 30$</th>
<th>Female Athlete, $n = 89$</th>
<th>Control, $n = 60$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$N$ (%)</td>
<td>$N$ (%)</td>
<td>$N$ (%)</td>
<td>$N$ (%)</td>
</tr>
<tr>
<td>Soccer</td>
<td>7 (5.8)</td>
<td>5 (16.6)</td>
<td>17 (19.1)</td>
<td>3 (5.0)</td>
</tr>
<tr>
<td>Football</td>
<td>16 (13.3)</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Basketball</td>
<td>11 (9.2)</td>
<td>–</td>
<td>13 (14.6)</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td>Golf</td>
<td>–</td>
<td>1 (3.3)</td>
<td>7 (9.9)</td>
<td>–</td>
</tr>
<tr>
<td>Baseball</td>
<td>23 (19.2)</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Rugby</td>
<td>14 (11.7)</td>
<td>–</td>
<td>9 (10.1)</td>
<td>–</td>
</tr>
<tr>
<td>Track and field</td>
<td>4 (3.3)</td>
<td>2 (6.6)</td>
<td>1 (1.1)</td>
<td>5 (8.3)</td>
</tr>
<tr>
<td>Fitness center</td>
<td>–</td>
<td>4 (13.3)</td>
<td>–</td>
<td>10 (16.6)</td>
</tr>
<tr>
<td>Ice hockey</td>
<td>19 (15.8)</td>
<td>4 (13.3)</td>
<td>9 (10.1)</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td>Alpine skiing</td>
<td>6 (5.0)</td>
<td>–</td>
<td>5 (5.6)</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td>Volleyball</td>
<td>12 (10.0)</td>
<td>–</td>
<td>9 (10.1)</td>
<td>3 (5.0)</td>
</tr>
<tr>
<td>Swimming</td>
<td>8 (6.7)</td>
<td>2 (6.6)</td>
<td>7 (7.9)</td>
<td>2 (3.3)</td>
</tr>
<tr>
<td>Field hockey</td>
<td>–</td>
<td>–</td>
<td>12 (13.5)</td>
<td>–</td>
</tr>
<tr>
<td>Other sports*</td>
<td>–</td>
<td>4 (13.3)</td>
<td>–</td>
<td>17 (28.3)</td>
</tr>
<tr>
<td>No sports</td>
<td>–</td>
<td>8 (26.6)</td>
<td>–</td>
<td>17 (28.3)</td>
</tr>
</tbody>
</table>

*Note.* *Sports with $\leq 2$ respondents: fencing, frisbee, snow boarding, aerobics, horseback riding, dancing, tennis, triathlon, dragon boating, softball, rock climbing, badminton, walking and biking.

### Table 3  Supplement Use Among Male and Female Varsity Athletes and Controls

<table>
<thead>
<tr>
<th>Classification of supplement</th>
<th>Male Varsity $N$ (%)</th>
<th>Male Control $N$ (%)</th>
<th>Female Varsity $N$ (%)</th>
<th>Female Control $N$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sports drinks</td>
<td>104 (86.7)$^{a,c}$</td>
<td>13 (43.3)$^c$</td>
<td>56 (63.6)$^{a,c}$</td>
<td>19 (31.7)$^c$</td>
</tr>
<tr>
<td>Carbohydrate gels</td>
<td>47 (39.2)$^{a,c}$</td>
<td>0$^c$</td>
<td>18 (20.2)$^{a,c}$</td>
<td>0$^c$</td>
</tr>
<tr>
<td>Carbohydrate bars</td>
<td>77 (64.7)$^c$</td>
<td>6 (20.0)$^c$</td>
<td>57 (64.0)$^c$</td>
<td>14 (23.3)$^c$</td>
</tr>
<tr>
<td>Protein powder</td>
<td>43 (35.8)$^{b,d}$</td>
<td>5 (16.7)$^d$</td>
<td>18 (20.2)$^b$</td>
<td>6 (10)</td>
</tr>
<tr>
<td>Protein bars</td>
<td>40 (33.3)$^d$</td>
<td>3 (10.0)$^d$</td>
<td>29 (32.6)$^c$</td>
<td>5 (8.3)$^c$</td>
</tr>
<tr>
<td>Creatine</td>
<td>11 (9.2)$^a$</td>
<td>1 (3.3)</td>
<td>0 (0)$^a$</td>
<td>0</td>
</tr>
<tr>
<td>Caffeine</td>
<td>87 (73.1)</td>
<td>27 (90)</td>
<td>71 (79.8)$^d$</td>
<td>57 (95)$^d$</td>
</tr>
<tr>
<td>Vitamins/minerals</td>
<td>62 (51.7)</td>
<td>17 (56.7)</td>
<td>56 (62.9)</td>
<td>40 (66.7)</td>
</tr>
<tr>
<td>Iron</td>
<td>3 (2.5)$^a$</td>
<td>0</td>
<td>22 (24.7)$^{a,d}$</td>
<td>5 (8.3)$^d$</td>
</tr>
<tr>
<td>Nonvitamin mineral supplements</td>
<td>36 (30)</td>
<td>5 (16.7)</td>
<td>23 (25.8)$^d$</td>
<td>9 (15)$^d$</td>
</tr>
</tbody>
</table>

$^aP < 0.01$ within group difference between male and female
$^bP < 0.05$ within group difference between male and female
$^cP < 0.01$ within gender difference between varsity and control group
$^dP < 0.05$ within gender difference between varsity and control group
The use of any carbohydrate supplement was highest among varsity men (91.6%) followed by varsity women (81%), while in the control group, 46.6% of the men and 43.3% of the women used carbohydrate supplements.

Fifty-one percent of the male varsity athletes and 42.7% of varsity females used a protein supplement, compared to only 23.3% of the males and 16.6% of the females in the control group. A higher proportion of men in the varsity group used both protein powder and protein bars than their controls, whereas a significant difference was found only for protein bars among the women. Varsity men were significantly more likely to use creatine than varsity women. Varsity women were more likely than varsity men to use iron supplements, and, compared to control females, they used more iron and nonvitamin mineral supplements (e.g., herbal supplements, glucosamine).

The average amount of money per month spent on supplements was Can$31, independent of gender and varsity/control group. A large variation was observed, however, in both groups, ranging from zero to Can$150 in the varsity group and zero to Can$300 in the control group.

Table 4 shows the frequency of use of supplements among varsity athletes. Varsity men used sports drinks, carbohydrate gels, protein powder, and creatine more frequently than did varsity women. Varsity women used iron supplements more frequently than did varsity men. Frequency did not differ between gender for energy bars, caffeine, and vitamins/minerals. Many different nonvitamin mineral supplements were reported, the most common of which was echinacea (used by 19 men and 18 women, mostly 1 to 10 times per month). Glutamine, the second most used nonvitamin mineral supplement, was used on a daily basis by 3 male athletes and less than 15 times a month by 4 male and 4 female athletes. Other reported nonvitamin mineral supplements were ginseng, tea tree oil, gingko biloba, Q10, guarana, glucosamine, omega3, and omega6 sources, and chondroitin. Most were used by only 1 or 2 athletes, generally 1 to 10 times a month.

When starting to use a new supplement, about one-third of the varsity group reported that they would seek information about products, with no significant differences between male (37.5%) and female (32.6%) athletes. In the control group, 36.7% of men and 22% of women reported seeking further information. For both groups, health professionals and the Internet were the most frequently used information sources, followed by magazines. Coaches were reported to be the least used source of information by both groups.

More varsity athletes than controls had products recommended to them (57.9% vs. 36.3%). For both varsity and controls, friends were the most frequently cited source, recommending the use of supplements, followed by health professionals and family members. Journals and sales people were the sources least likely reported to recommend the use of a supplement. Sales representatives recommended products in 9% of the cases in the varsity group.

Table 5 displays reasons reported by male and female varsity athletes for using various supplements. For both men and women, “providing more energy” was the most frequently reported reason for using carbohydrate-rich products (sports drinks, carbohydrate bars, carbohydrate gels), followed by enhanced recovery, taste, enhanced performance, and countering tiredness. Enhanced recovery and greater muscle strength were the most common reasons given by varsity men for protein

Table 4  Times Per Month the Varsity Group Reported Using Supplements

<table>
<thead>
<tr>
<th>Frequency of use per month</th>
<th>0 (%)</th>
<th>1–10 (%)</th>
<th>11–15 (%)</th>
<th>&gt; 15 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------</td>
<td>------</td>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>Sports drinks&lt;sup&gt;a&lt;/sup&gt;</td>
<td>13.3</td>
<td>36.6</td>
<td>55.8</td>
<td>56.8</td>
</tr>
<tr>
<td>Carbohydrate gels&lt;sup&gt;b&lt;/sup&gt;</td>
<td>60.8</td>
<td>79.8</td>
<td>34.2</td>
<td>20.2</td>
</tr>
<tr>
<td>Carbohydrate bars</td>
<td>35.3</td>
<td>36.0</td>
<td>47.1</td>
<td>49.4</td>
</tr>
<tr>
<td>Protein powder&lt;sup&gt;b&lt;/sup&gt;</td>
<td>64.2</td>
<td>79.8</td>
<td>20.0</td>
<td>16.9</td>
</tr>
<tr>
<td>Protein bars</td>
<td>66.7</td>
<td>67.4</td>
<td>26.7</td>
<td>30.3</td>
</tr>
<tr>
<td>Creatine&lt;sup&gt;b&lt;/sup&gt;</td>
<td>90.8</td>
<td>100</td>
<td>2.5</td>
<td>0</td>
</tr>
<tr>
<td>Caffeine</td>
<td>26.9</td>
<td>20.2</td>
<td>22.7</td>
<td>30.3</td>
</tr>
<tr>
<td>Vitamins/minerals</td>
<td>48.3</td>
<td>37.1</td>
<td>17.5</td>
<td>24.7</td>
</tr>
<tr>
<td>Iron&lt;sup&gt;a&lt;/sup&gt;</td>
<td>97.5</td>
<td>75.3</td>
<td>1.7</td>
<td>9.0</td>
</tr>
<tr>
<td>Nonvitamin mineral supplements&lt;sup&gt;c&lt;/sup&gt;</td>
<td>70.0</td>
<td>73</td>
<td>24.2</td>
<td>27</td>
</tr>
</tbody>
</table>

<sup>a</sup>P < 0.01 difference in frequency reported by male and female, χ²
<sup>b</sup>P < 0.05 difference in frequency reported by male and female, χ²
<sup>c</sup>Participants could report more than 1 supplement in the nonvitamin mineral category, therefore values do not add to 100%.

Supplement use, whereas varsity women most commonly cited enhanced recovery and taste as their reasons. “Greater muscle strength” was the most frequently cited reason for creatine use by male athletes. Counteracting tiredness, taste enjoyment, and providing more energy were the most common reasons for athletes’ use of caffeine products. To meet nutrient needs was by far the most reported reason for using vitamin/mineral products.

Students in the control group also provided reasons for their use of supplements. “More energy” was the most reported reason for the use of carbohydrate products by both male and female controls, followed by taste and enhanced recovery. Men in the control group reported enhanced recovery most often as a reason for using protein products, followed by increased muscle strength. “To meet nutrient needs” and taste were the most reported reasons by women for the use of protein supplements. Only 3 individuals in the control group reported reasons for the use of creatine: to strengthen bones, to provide more energy, and to enhance performance. Reasons for use of caffeine products and vitamin/mineral supplements by controls were similar to those cited by varsity athletes.
### Table 5  Reasons Given by Varsity Students for Their Consumption of Supplements

<table>
<thead>
<tr>
<th>Classification of supplement</th>
<th>Type of supplement</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrate supplements</td>
<td>Sports drinks</td>
<td>• Provide more energy</td>
<td>• Provide more energy</td>
</tr>
<tr>
<td></td>
<td>Gels</td>
<td>• Enhanced performance</td>
<td>• Enhanced recovery</td>
</tr>
<tr>
<td></td>
<td>Bars</td>
<td>• Enhanced recovery</td>
<td>• Just like the taste</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Just like the taste</td>
<td>• Enhanced performance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Don’t know</td>
<td>• Counteracts tiredness</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Counteracts tiredness</td>
<td>• To meet nutrient needs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Rehydration</td>
<td>• Don’t know</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Greater muscle strength</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No positive effect</td>
<td></td>
</tr>
<tr>
<td>Protein supplements</td>
<td>Powder</td>
<td>• Enhanced recovery</td>
<td>• Enhanced recovery</td>
</tr>
<tr>
<td></td>
<td>Drinks</td>
<td>• Greater muscle strength</td>
<td>• Just like the taste</td>
</tr>
<tr>
<td></td>
<td>Bars</td>
<td>• To meet nutrient needs</td>
<td>• Provide more energy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Don’t know</td>
<td>• To meet nutrient needs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provide more energy</td>
<td>• Enhanced performance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Just like the taste</td>
<td>• Don’t know</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enhanced performance</td>
<td>• Greater muscle strength</td>
</tr>
<tr>
<td>Supplement Type</td>
<td>Description</td>
<td>Benefits</td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td></td>
</tr>
</tbody>
</table>
| Creatine Powder         |                                                                              | • Greater muscle strength  
                          • Enhanced performance  
                          • Don’t know  
                          • Provide more energy  
                          • Enhanced recovery  
                          • Mass gain |
| Caffeine products       | Coffee, cola beverages, caffeine tablets, caffeine-rich bars, chocolate and tea | • Counteracts tiredness  
                          • Just like the taste  
                          • Provide more energy  
                          • Don’t know  
                          • No positive effect  
                          • Enhanced performance |
| Vitamins and minerals   | Multivitamins, calcium, vitamin C, vitamin E                                | • To meet nutrient needs  
                          • Illness prevention  
                          • Don’t know  
                          • Strengthen bones |
|                          |                                                                              | • To meet nutrient needs  
                          • Illness prevention  
                          • Strengthen bones  
                          • Provide more energy  
                          • Counteract tiredness |
Table 6  Common Questions Varsity and Control Participants Had in Regard to Supplement Use

<table>
<thead>
<tr>
<th>Classification of supplement</th>
<th>Participants providing comments</th>
<th>Common questions</th>
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</table>
| General                     | $n = 30$                         | • I know very little, but want to know everything  
                              |                                  | • Do we need supplements—are they healthy  
                              |                                  | • Alternatives to modern medicine  
                              |                                  | • Is it possible to live healthy without taking supplements  
                              |                                  | • Which products are legal, and which are not  
                              |                                  | • How to use them properly, what doses to use  
                              |                                  | • Supplements for vegetarians  
                              |                                  | • Differences between brands  
                              |                                  | • What products truly work and their effects  
                              |                                  | • All sport-related supplements, positive/negative effects  
                              |                                  | • What to look for on labels  
                              |                                  | • Weight loss supplements—risks and benefits  
                              |                                  | • Effectiveness of supplements for muscle building  
| Carbohydrate                | $n = 7$                          | • Which energy bars are useful before, during, and after exercise  
                              |                                  | • What to use and when  
| Protein                     | $n = 22$                         | • Positive/negative effects  
                              |                                  | • Usefulness in gaining lean body mass and losing weight  
                              |                                  | • Whey vs. soy—which is best  
                              |                                  | • Is it bad for the kidneys  
                              |                                  | • Benefits to women  
                              |                                  | • How much should/can an athlete consume a day  
| Creatine                    | $n = 35$                         | • Effects on performance/side effects  
                              |                                  | • Do I get stronger or just bigger  
                              |                                  | • Ethics in use—restrictions by league  
                              |                                  | • Long-term effects  
                              |                                  | • Has it been proven to work in clinical trials  
| Caffeine                    | $n = 4$                          | • Upsides and ethics in use  
                              |                                  | • Coffee vs. tablets  
                              |                                  | • Supplements that can substitute the effect of caffeine on staying awake  
| Vitamins/minerals           | $n = 9$                          | • How do they affect health  
                              |                                  | • How much to take and when to take them  
                              |                                  | • Antioxidants and minerals’ effect on the body  
                              |                                  | • Coenzyme Q10, vitamin B-12  
                              |                                  | • Calcium’s effect on intracellular calcium  

Iron \( n = 6 \)  
- Effect on the body  
- Who needs it  
- What types are best absorbed  
- Benefits for performance

Bicarbonate \( n = 7 \)  
- Uses and effects  
- How can it improve performance  
- Is there an upper limit

Ephedra \( n = 4 \)  
- Why is it banned—how does it work  
- Effectiveness in weight loss  
- In combination with caffeine, effects and hazards

Glucosamine \( n = 5 \)  
- Does it actually work for joint problems  
- Is it better in combination with chondroitin

\( \text{NO}_2 \) \( n = 1 \)  
- Health effects—long term

Glutamine \( n = 5 \)  
- Does it work (scientific studies)

Andro-steroids \( n = 1 \)  
- Side effects and how it works

Gingko biloba \( n = 3 \)  
- Effects—Is there an upper limit—Does it improve memory

Echinacea \( n = 4 \)  
- Positive/negative effects—is it linked to cancer

Valerian \( n = 1 \)  
- Does it help sleep

Fish liver oils \( n = 1 \)  
- Effect on memory

A total of 47 individuals reported having experienced adverse effects after using a supplement. With 30 counts, caffeine was by far the most reported product causing adverse effects, which included nervousness, insomnia, a laxative effect, headache, increased heart rate, etc. Seven subjects reported having adverse effects such as a loss of energy and stomach cramps when using carbohydrate supplements; 5 reported experiencing an upset stomach from using protein supplements; 3 reported water retention and reduced aerobic capacity when using creatine; 2 experienced adverse effects when taking vitamin supplements; and 1 reported stomach aches and cramps when using iron supplements.

Less than half of the subjects (37%) felt that they knew enough about supplements and their use; 46% answered that they did not feel that they knew enough about supplements; and 16% were not sure if they knew enough. There were no differences between athletes and controls, or between men and women. When asked if they would like to know more about certain supplements, 37% indicated that they would, 56% would not, and 7% were not sure. Again, there were no differences between groups or genders.

When further asked about what they would like to learn, common answers given are listed in Table 6. More than once, students added written comments on the questionnaire such as “seriously, I know pretty much nothing” or “I am very
interested” and the most common response was a desire to learn about “all supplements” \((n = 20)\). One subject in the varsity group would like to know more about carbohydrates, since the subject had heard that they were bad, and therefore was specifically avoiding using them.

**Discussion**

We found that most students had used at least 1 supplement in the last month and that varsity athletes used supplements more frequently than did students in the control group. The supplements were used for many reasons, some of which have no scientific support whatsoever. Many students did not feel that they had sufficient knowledge about supplements and indicated that they would like to receive nutritional education.

The reported prevalence of supplement use was higher than what has been reported in previous studies; 98.6% of the varsity athletes and 96.7% of the controls reported using at least 1 supplement. Excluding caffeine, which was the most frequently used supplement (but rarely for performance reasons), 94.3% of varsity athletes and 78.6% of controls reported using one or more supplements at least once a month. In a recent provincial nutrition survey conducted in British Columbia, 52% of men and 62% of women age 19 to 30 y reported using at least 1 supplement during the last month (13). The high percentage of supplement users among our control group can perhaps be explained by the fact that a large proportion participated in sports (men, 73.4%; women, 71.7%), and might have thought that they needed supplements to excel in their sport. It is also possible, however, that the low response rate from the control group has biased the results in this direction.

Previous studies have reported large variations in the prevalence of supplement use among varsity athletes, some of which can be explained by differences in study protocols. For example the largest reported survey among varsity athletes in the United States, including 21,225 responses, found that 29% used nutrient supplements, not counting multivitamins, and 42% had done so in the last year (6). Vitamins were reported as the most frequently used supplement (73.3%) in a study including 236 Division I university athletes, and 88% of the surveyed athletes used 1 or more supplements (1). Froiland et al. found similar results, with a reported overall prevalence of supplement use of 89%, with the most frequently used supplement being sports and energy drinks (72.9%)(5). These results are similar to ours; we found that 76.8% of varsity athletes reported use of sports drinks, and that varsity men reported the use of sports drinks significantly more (86.7%) than all other groups. Providing more energy, increased performance, taste, and increased recovery were the most often reported reasons for using carbohydrate supplements by the varsity group. Providing more energy was also the most common reason given by the control subjects, followed by taste, enhanced recovery, and counteracting tiredness. This could indicate that the supplement industry is turning its focus towards the nonathlete consumers, and competing with other snack items for taste preferences.

Caffeine was the most used supplement by both control groups and female varsity athletes, and the second most used supplement by male varsity athletes. Taste and counteracting tiredness were the most frequently reported reasons for using caffeine products, while the most reported consumption forms were coffee
Supplement Use by University Athletes

and cola beverages. A greater proportion of control women reported using caffeine-ated products than did women varsity athletes. Improved performance, however, was the least reported benefit by the 81.2% who reported using caffeine products. It can therefore be assumed that caffeine is rarely used for its ergogenic benefits, but rather for the pleasure and alertness it produces.

Approximately 50% of athletes in the varsity group reported using protein supplements. Despite the lack of conclusive research regarding athletes’ protein requirements, some research supports recommended intakes for athletes between 1.2 to 1.8 g/kg BM/d (14-18). Most athletes in industrialized nations, however, already obtain these amounts through their everyday diet (19, 20), and do not need supplementation. Furthermore, there seems to be a threshold for protein synthesis at ~ 1.7 g protein/kg BM/d, where intake above this level has no further positive effect and merely increases protein oxidation (14, 21). It is possible that athletes and controls might use a protein supplement without achieving the expected benefit, if they already meet their requirements through their habitual diet.

Creatine was used by 11 men (9.2%) in the varsity group and by 1 man in the control group (3.3%); none of the women in our study used creatine. Other studies have found a higher prevalence of creatine use by varsity athletes. In a study of more than 21,000 varsity athletes, 25.8% reported using creatine (6), and in a more recent study of 236 varsity athletes, it was used by 31.4% (1). Jonnalagadda et al. found that among varsity football players, 36% used creatine (8). As in our study, others found creatine to be more commonly used by athletes than nonathletes (22) and among athletes, more often by men than women (23). The increase in total body mass accompanying creatine supplementation (24, 25), and a questionable effect of creatine among women (26) could contribute to the lower prevalence of usage among women athletes.

Between one-half and two-thirds of male and female varsity athletes and controls reported the use of vitamin/mineral supplements; these findings were slightly higher than what most other studies have found (3-5). Jonnalagadda et al. found that 23% of the football players in their survey reported using multivitamins (8), which is similar to the football players in our study, where almost 19% reported using multivitamins. In the current study, the most common reason for vitamin/mineral supplement use was to meet nutrient needs, followed by prevention of illness and to strengthen bones. Reasons such as increased energy levels (8) and increased muscle strength (9) have been reported as reasons for vitamin/mineral supplementation in other studies.

More subjects in the varsity group reported using nonvitamin mineral supple-ments than in the control group; however, a significant difference was observed only between the female groups. In a recent nutrition survey from British Columbia (13), similar percentages of male and females between the ages of 19 and 30 y, as in our survey, reported using nonvitamin mineral supplements. In our survey, echinacea was the most reported nonvitamin mineral supplement used and the main reason for its use was to prevent illness, which is consistent with the low usage frequency (1 to 5 times a month) reported by most subjects. Echinacea is also among the most used supplements in the general population in both Canada (13, 27) and the United States (28). Of other nonvitamin mineral supplements, ginseng was the only one reported to be used with enhanced performance in mind; however, this is not sup-ported by scientific evidence.
We did not measure nutritional knowledge; however, less than 50% of subjects in all groups reported that they felt they had adequate knowledge about the use of supplements. Some of the reported effects achieved by using certain supplements indicated a lack of knowledge among students in both groups. For example, creatine was used “to strengthen bones,” caffeine “to provide energy and meet nutrient needs,” and vitamins “to provide more energy.” Other studies found similar responses (8, 9). Organized nutrition counseling/education is not provided for varsity athletes at the surveyed university (personal communication, R. Mosher, April 2004), and only 35% of varsity athletes and 25% in the control group reported seeking further information when using supplements. The most reported source of information was health professionals followed by the Internet and magazines, while coaches were the least used information source. Other studies have found that students have limited nutritional knowledge (5, 9, 29, 30), and it can be speculated that they are not competent in deciphering true science from the many scientific-sounding advertisements they come across in magazines and on the Internet. To our knowledge, this is the first study that assesses if and what students would like to learn about with regard to dietary supplements. Thirty-seven percent of all students reported that they would like to learn more about supplements, and “all supplements” and “general nutrition” were the most reported answers to the open-ended question of what they would like to learn about. Furthermore, the most reported single product students would like to learn about was creatine. These results clearly indicate a wish to learn about supplements and it was stated that obtaining information from a reliable source is of high importance.

The results in this survey represent one Canadian university, and, as such, cannot be applied to other Canadian universities, although it is likely that similar tendencies are present. A potential limitation of this survey was a low response rate by the control group (44.6%), which might have biased the results; however, this response rate is similar to what has been achieved in the general Canadian population (13, 27). A higher response rate (85.5%) was achieved among the varsity athletes, which was similar to or higher than what has been achieved in other studies among student athletes (1, 5, 6). The high response rate among the varsity athletes is possibly because of their interest in the study topic, but can also be attributed to methodological differences. For example, some coaches were involved in the distribution of the questionnaires, and in at least 1 case, the athletes filled out the questionnaire during practice; therefore, all present athletes on this team responded.

Our overall results reveal a high prevalence of supplement use, combined with indications of suboptimal nutrition knowledge and a desire to learn more about nutrition. These results, thus, reflect the need for improved access to nutritional education, particularly for varsity athletes. Athletes were found to use supplements to a larger extent than did controls, often doing so for competitive reasons. Without proper knowledge, however, athletes who use supplements face several risks, from ineffective products to adverse performance-inhibiting effects; for instance, some vitamins have negative or even toxic effects when taken in large doses. Furthermore, athletes face the risk of unintentional doping, which can and does happen, even when athletes are using “safe” supplements. This is not uncommon, because of inadequate quality control in the supplement market; supplements such as creatine, vitamins/minerals, herbal supplements, and weight loss products have been found
to be contaminated with illegal substances (31). To reduce these risks, both schools and national organizations such as Canadian Interuniversity Sport and the Canadian Centre for Ethics in Sport could collaborate in the education of varsity athletes.

Supplement use by athletes at other Canadian universities should be surveyed, to obtain a fuller picture of supplement use by varsity athletes in Canada. In addition, future studies should survey nutritional knowledge among coaches; since they are the closest link to athletes and often recommend the use of supplements, it is crucial that they provide accurate nutritional advice, or at the very least, appropriate referrals to sport dietitians.

References