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Dietary Supplementation Practices in Canadian High-Performance Athletes

Victor Lun, Kelly A. Erdman, Tak S. Fung, and Raylene A. Reimer

Dietary supplementation is a common practice in athletes with a desire to enhance performance, training, exercise recovery, and health. Supplementation habits of elite athletes in western Canada have been documented, but research is lacking on supplement use by athletes across Canada. The purpose of this descriptive study was to evaluate the dietary supplementation practices and perspectives of high-performance Canadian athletes affiliated with each of the country's eight Canadian Sport Centres. Dietitians administered a validated survey to 440 athletes (63% women, 37% men; M =19.99 ± 5.20 yr) representing 34 sports who predominantly trained ≥16 hr/wk, most competing in "power" based sports. Within the previous 6 months, 87% declared having taken ≥3 dietary supplements, with sports drinks, multivitamin and mineral preparations, carbohydrate sports bars, protein powder, and meal-replacement products the most prevalent supplements reported. Primary sources of information on supplementation, supplementation justification, and preferred means of supplementation education were identified. Fifty-nine percent reported awareness of current World Anti-Doping Agency legislation, and 83% subjectively believed they were in compliance with such antidoping regulations. It was concluded that supplementation rates are not declining in Canada, current advisors on supplementation for this athletic population are not credible, and sports medicine physicians and dietitians need to consider proactive strategies to improve their influence on supplementation practices in these elite athletes.

Keywords*:* supplements, nutritional, sports, habits, elite, Canada

Over the past few decades it has been well documented internationally that most high-performance athletes elect to supplement their diets (Baylis, Cameron-Smith, & Burke, 2001; Braun et al., 2009; Dascombe, Karunaratna, Cartoon, Fergie, & Goodman, 2010; Erdman, Fung, & Reimer, 2006; Krumbach, Ellis, & Driskell, 1999; Schröder et al., 2002; Slater, Tan, & Teh, 2003; Sobal & Marquart, 1994; Sundgot-Borgen, Berglund, & Torstveit, 2003; Suzic Lazic et al., 2009; Tian, Ong, & Tan, 2009). Although there are differences in what is considered a dietary supplement, the 1994 Dietary Supplement Health and Education Act defined a dietary supplement as an orally consumed product intended to supplement one's diet. This includes vitamins, minerals, herbs or botanicals, amino acids, enzymes, organ tissues, glandulars, metabolites, extracts, or concentrates in the form of tablets, capsules, liquids, powders, bars, soft gels, or gel caps (U.S. Food and Drug Administration, 2009).

There have been inconsistent methodologies used to collect supplementation data from athletes, such as the reporting periods—ranging from use in the past 3 days (Suzic Lazic et al., 2009; Ziegler, Nelson, & Jonnalagadda, 2003) to the past 12 months (Tian et al., 2009); variations with supplement definitions, for example, including intake of coffee (Kristiansen, Levy-Milne, Barr, & Flint, 2005) and essence of chicken (Slater et al., 2003; Tian et al., 2009); and differences in the form of data collection, for example, mailed-in surveys (Baylis et al., 2001) versus athletes' immediate recollection (Erdman et al., 2006; Striegel, Simon, Surster, Niess, & Ulrich, 2006; Suzic Lazic et al., 2009). Some studies have explored the athletes' opinions related to their supplementation habits (Braun et al., 2009; Burns, Schiller, Merrick, & Wolf, 2004; Crowley & Wall, 2004; Erdman et al., 2006; Froiland, Koszewski, Hingst, & Kopecky, 2004; Herbold, Visconti, Frates, & Bandini, 2004; Kristiansen et al., 2005; Malinauskas, Overson, Carraway, & Cash, 2007; Tian et al., 2009). However, few studies have analyzed the preferred means and topics for educating elite athletes about their supplement use (Erdman et al., 2006; Malinauskas et al., 2007; Molinero & Marquez, 2009; Petróczi, Naughton, Mazanov, Holloway, & Bingham, 2007; Suzic Lazic et al., 2009; Tian et al., 2009).

Previous investigations have reported that the prevalence of sport supplementation among high-performance athletes falls in the range of 62–80% for athletes under 20 years of age (Braun et al., 2009; Crowley & Wall, 2004; Erdman, Fung, Doyle-Baker, Verhoef, & Reimer, 2007; Nieper, 2005), 65–99% for varsity athletes (Burns et al., 2004; Froiland et al., 2004; Herbold et al., 2004; Kristiansen et al., 2005; Malinauskas et al., 2007; Tian et al., 2009), and 51–99% for elite athletes (Baylis et al., 2001; Braun et al., 2009; Dascombe et al., 2010; Erdman

Lun and Erdman are with the University of Calgary Sport Medicine Centre, Calgary, Alberta, Canada. Fung is with the Faculty of Science, and Reimer, the Faculty of Kinesiology, University of Calgary, Calgary, Alberta, Canada.

et al., 2006; Huang, Johnson, & Pipe, 2006; Schröder et al., 2002; Slater et al., 2003; Sundgot-Borgen et al., 2003; Suzic Lazic et al., 2009).

Experts continue to be concerned about the lack of awareness of high-performance athletes regarding the effectiveness and potential risks of taking dietary supplements, such as possible health concerns (Maughan, 2005), negative nutrient interactions (Maughan, 2005), misinformation (Froiland et al., 2004; Malinauskas et al., 2007; Petróczi et al., 2007), and the possibility of inadvertent product contamination (Ayotte et al., 2001; Geyer et al., 2008; Maughan, Depiesse, Geyer & International Association of Athletics Federations, 2007; Van Thuyne, Van Eenoo, & Delbeke, 2006), especially for athletes who are subject to doping control.

In Canada, previous studies have examined the supplementation practices of western Canadian high-performance athletes (Erdman et al., 2006), university-level athletes (Kristiansen et al., 2005), and Canadian athletes in the Summer Olympics (Huang et al., 2006). However, knowledge of dietary supplement use from elite athletes in training and competition throughout Canada is lacking.

Therefore, the purpose of this study was to evaluate the dietary supplementation practices and perspectives of high-performance athletes from across Canada. Aspects of dietary supplementation that were evaluated included supplement use, reasons for supplementation, sources of supplementation information, concerns with inherent risks, attitudes regarding the most desirable means of supplementation education, and athletes' attitudes and knowledge regarding the Canadian Anti-Doping Program (Canadian Centre for Ethics in Sport) and the World Anti-Doping Agency (WADA) prohibited list.

Methods

This study received ethical approval of the Conjoint Health Research Ethics Board of the University of Calgary, Calgary, Alberta, Canada.

Registered dietitians from eight Canadian Sport Centres (Victoria, Vancouver, Calgary, Saskatchewan, Manitoba, Ontario, Quebec, and Atlantic) were trained to administer a validated sport-supplementation questionnaire. This survey had been previously used to evaluate the supplementation practices of Calgary-based high-performance athletes (Erdman et al., 2007; Erdman et al., 2006).

Elite athletes were recruited from participants of group workshops or one-on-one counseling sessions being conducted by a dietitian. Subjects were given an explanation of the study, and their completion of the supplement questionnaire was assumed to be consent to participate in the study. The supplement questionnaire was completed at the beginning of the workshop or one-on-one counseling session. Subjects could respond to the questions from a list of options, as well as providing an open-ended alternative response. Athletes recalled on the spot their supplementation practices and opinions within the previous 6 months. Data were collected from all Canadian Sport Centres from November 2006 through April 2007.

Results were analyzed using the Statistical Package for Social Sciences version 19.0 (SPSS Inc., Chicago IL). Chi-square tests were used for all the statistical tests except independent-sample *t* tests for gender by age and one-way analysis of variance for analysis of age differences compared with sport groups, competitive events, and top competitive-performance levels. Post hoc testing of subsets for the age analyses included Student-Newman-Keuls. An alpha level of .05 was used for all the statistical tests. The open-ended responses were summarized descriptively.

Results

Subject Demographics and Supplementation Practices

Four hundred forty athletes (mean age 19.99 ± 5.20 years; 63% female, 37% male) completed the survey based on a convenience sample of athletes with whom the Sport Centre dietitians were working during the period of data collection, without intentional bias of gender. There was no significant age difference by gender, with females on average 20.00 years and males 20.25 years. Overall, 87% of athletes declared having taken dietary supplements within the previous 6 months, with an average of three supplements per athlete. Most athletes came from the Sport Centres in Ontario and Calgary, Alberta, and indicated similar supplementation use of 81–100% relative to particular Sport Centres (Table 1). Subjects participated in 34 different sports; Table 2 shows the 10 most frequently reported sports. Fifty-seven percent of respondents indicated that they trained at least 16 hr/week (Table 3). Furthermore, the greater the weekly training hours the significantly greater the prevalence of dietary supplement use, which increased from 66.6% for <5 weekly training hours to 95.1% by those training >25 hr/week (Table 3). Seventy-six percent competed at a high

Table 1 Number of Subjects and Percentage Using Supplements by Canadian Sport Centre, *N* = 440

Sport Centre	Subjects, *n* (%)	Percentage of subjects using supplements
Victoria	12 (2.7)	91.7
Vancouver	57 (13.0)	87.7
Calgary	109 (24.8)	91.7
Saskatchewan	21 (4.8)	81.0
Manitoba	7 (1.6)	100.0
Ontario	145 (33)	83.4
Quebec	59 (13.4)	81.4
Atlantic	30 (6.8)	96.7

Note. $p = .192$.

Table 2 Top 10 Sports Represented, *N* = 438

Sport	*n* (%) of all sports
Soccer	78 (17.8%)
Ice hockey	75 (17.1%)
Tae kwon do	46 (10.5%)
Speed skating	31 (7.1%)
Volleyball	26 (5.9%)
Figure skating	24 (5.5%)
Athletics	21 (4.8%)
Alpine skiing	14 (3.2%)
Luge	11 (2.5%)
Basketball	11 (2.5%)

Table 3 Weekly Training Hours and Corresponding Supplement Use, *N* = 431

Weekly training hours	*n* (%) of total athletes	*n* (%) using supplements
0–5 hr	6 (1.4%)	4 (66.6%)
6–10 hr	78 (18.1%)	63 (80.8%)
11–15 hr	101 (23.4%)	83 (82.2%)
16–20 hr	114 (26.5%)	104 (91.2%)
21–25 hr	91 (21.1%)	85 (93.4%)
>25 hr	41 (9.5%)	39 (95.1%)

Note. $p = .011$.

Table 4 Sport Classifications and Corresponding Supplement Use

Sport type	*n* (%) of total athletes	Percentage using supplements
Power	241 (55.0%)	90.5
Intermittent	109 (24.9%)	78.9
Judged	66 (15.1%)	86.4
Endurance	22 (5.0%)	90.9

Note. $p = .027$.

level (nationally, internationally, and in North America). The sports were classified as power, intermittent, judged, or endurance-type events (Table 4). Power sports were those with a significant rest interval between efforts (e.g., sprinting, ice hockey), and intermittent sports (e.g., basketball, volleyball) were defined as more continuous stop–start activities. Endurance events were at least 3 min nonstop in nature. Athletes in the intermittent types of sports were the least likely to declare taking supplements (78.9%), whereas endurance- and power-trained athletes were the most likely to (Table 4).

Seventy-six different dietary supplements were reported, with sport drinks, multivitamin and mineral preparations, carbohydrate sport bars, protein powders, and meal-replacement products the five most frequently used (Table 5). Relative to training hours there was a consistent trend that regardless of the hours of training each week the same pattern of use for the top five dietary supplements was reported, with sport drinks consumed most often (Table 6).

Table 5 Top 15 Most Frequently Reported Dietary Supplements

Dietary supplement	Supplement frequency, *n* (%)
Sport drinks	278 (24.1%)
Multivitamin and mineral	185 (16.1%)
Carbohydrate sport bar	127 (11.0%)
Protein powder	113 (9.8%)
Meal-replacement products	56 (4.9%)
Vitamin C	50 (4.3%)
Ginseng	34 (3.0%)
Protein bar	34 (3.0%)
Sports gel	33 (2.9%)
Iron	32 (2.8%)
Essential fatty acids	28 (2.4%)
Calcium	26 (2.3%)
Echinacea	22 (1.9%)
L-glutamine	13 (1.1%)
Energy drink	11 (1.0%)

Table 6 Top 5 Dietary Supplements Reported Relative to Weekly Training Hours, *n* (%)

Weekly training hours	Sport drink	Multivitamin and mineral	Carbohydrate sport bar	Protein powder	Meal replacement
0–5	3 (50)	2 (33)	1 (17)	1 (17)	1 (17)
6–10	46 (59)	16 (21)	14 (18)	9 (12)	3 (4)
11–15	62 (61)	31 (31)	28 (28)	29 (29)	14 (14)
16–20	70 (61)	50 (44)	35 (31)	33 (29)	16 (14)
21–25	61 (67)	57 (63)	31 (34)	28 (31)	13 (14)
>25	30 (73)	24 (59)	16 (39)	12 (29)	8 (20)

Most athletes reported taking their supplements on a daily basis (Table 7). Family and friends, strength trainers, and teammates were their primary sources of supplementation advice. Physicians were ranked as their eighth choice and dietitians as their 16th choice as sources of supplementation information (Table 8). The reasons for taking dietary supplements are shown in Table 9; to clarify, it was explained to the subjects that the reason "to maintain health" differed from the response "medical indication," such that the medical indication implied treating a condition such as low iron levels. Further examination relative to gender determined that females and males chose "maintain health" as their primary justification to take supplements and to "enhance exercise recovery" as their third preference. However, there were slight variations in the respondents' prioritized reasons to take dietary supplements (Table 10). Similarly, slight yet significant differences in ranked reasons to take dietary supplements were also evident based on sport type (Table 11). Additional analysis of subjects' weekly training hours compared with their prioritized reasons for taking dietary supplements failed to find a significant difference, such that health maintenance, increased energy, and support of exercise recovery were the three consistent justifications to take dietary supplements regardless of hours trained each week.

Dietary Supplementation Education

Overall, only 29% of respondents had previously attended a workshop on supplementation. Instead, the athletes

Table 7 Frequency of Taking Dietary Supplements

Description	Frequency
Daily	58.0%
A few times weekly	21.6%
Weekly	17.0%
Monthly	3.1%
Occasionally	0.3%

Table 8 Overall Top-10-Ranked Sources of Information on Dietary Supplements, *N* = 440

Source of information	Frequency, *n* (%)
Family and friends	75 (19.8%)
Strength trainer	51 (13.5%)
Teammates	41 (10.8%)
Coach	36 (9.5%)
Internet	36 (9.5%)
Exercise physiologist	35 (9.2%)
Athletic trainer	23 (6.1%)
Physician	15 (4.0%)
Naturopath	8 (2.1%)
Health-food store	7 (1.8%)

Table 9 Overall Primary Reason to Take Dietary Supplements

Reason	Frequency, *n* (%)
Health maintenance/prevent nutritional deficiency	112 (30.2%)
Increase energy	76 (20.5%)
Exercise recovery	58 (15.6%)
Increase lean body mass or strength	52 (14.0%)
Enhance immunity	32 (8.6%)
Medical indications	20 (5.4%)

Table 10 Primary Reason to Take Dietary Supplements by Gender, *n* (%)

Reason	Females	Males
Health maintenance/ prevent nutritional deficiency	71 (31.1%)	39 (28.3%)
Increase energy	55 (24.1%)	21 (15.2%)
Exercise recovery	34 (14.9%)	23 (16.7%)
Increase lean body mass or strength	20 (8.8%)	32 (23.2%)
Enhance immunity	21 (9.2%)	10 (7.2%)
Medical indications	17 (7.4%)	2 (1.4%)

Note. $p = .002$.

Table 11 Primary Reason to Take Dietary Supplements by Type of Sport, *n* (%)

	Type of Sport			
Reason	Power	Intermittent	Judged	Endurance
Health maintenance/prevent nutritional deficiency	66 (31.0%)	18 (21.7%)	18 (33.3%)	8 (42.1%)
Increase energy	42 (19.7%)	21 (25.3%)	11 (20.4%)	2 (10.5%)
Exercise recovery	38 (17.8%)	8 (9.6%)	6 (11.1%)	6 (31.6%)
Increase lean body mass or strength	34 (16.0%)	15 (18.1%)	3 (5.6%)	0 (0%)
Enhance immunity	16 (7.5%)	7 (8.4%)	8 (14.8%)	1 (5.3%)
Medical indications	4 (1.9%)	2 (2.4%)	2 (3.7%)	2 (10.5%)

Note. $p = .045$.

indicated a preference for individual interviews (44.7%) regarding supplementation advice, with an interest in learning about efficacy, reading labels, and safety (Table 12). Presentations, desired by 27.2%; pamphlets, by 10.0%; and the Internet, by 9.5% were also observed to be effective means to educate athletes on dietary supplementation. In addition, Table 13 illustrates that those in power and endurance sports were most likely to have attended a workshop on dietary supplements. However, the overall majority in all sport types indicated that they had not attended such workshops, even though 76% of the subjects reported that they were competing at national or international levels.

Fifty-nine percent reported being aware of the current WADA list of banned and prohibited substances, and 83% believed that they were in compliance with this legislation. Only 14.8% found the WADA list to be difficult to very difficult to understand. Surprisingly, 58.9% reported that if they discontinued taking their dietary supplements that their sport performances would not be negatively affected.

Discussion

Prevalence of Dietary Supplementation

The findings of this study further confirm the high prevalence of dietary supplementation among high-performance athletes across Canada on a regular, daily basis. This finding is similar to the 88% reported previously in athletes from the Canadian Sport Centre–Calgary (Erdman et al., 2006). However, this finding is higher than what was previously reported by other elite athletes: 69–74% in Canadian Olympians (Huang et al., 2006), 51–54% in elite Norwegian athletes (Sundgot-Borgen et al., 2003), 59% in British athletes (Petróczi & Naughton, 2008), 77% in high-performance Singaporean competitors (Slater et al., 2003; Tian et al., 2009), 80% in young elite German athletes (Braun et al., 2009), and 87.5% in elite Australian athletes (Dascombe et al., 2010). The current finding is lower than the 99% incidence observed among western Canadian varsity athletes (Kristiansen et al., 2005).

Table 12 Information Sought Regarding Supplementation

Information sought	Frequency, *n* (%)
Effective supplements	135 (36.3%)
Understanding labels	68 (18.3%)
Safety and/or risks	53 (14.2%)
Reliable sources of information	25 (6.7%)
Athletic requirements	25 (6.7%)
Benefits	17 (4.6%)

Table 13 Attendance at Supplement Workshop by Type of Sport

Type of sport	Frequency, *n* (%)
Power	94 (39.5%)
Intermittent	13 (12.4%)
Judged	9 (14.1%)
Endurance	8 (36.4%)

Note. $p = .0001$.

Although there may be real differences in the incidence of dietary supplementation internationally, in part the observed differences could be a result of methodological variations between studies, including duration of reporting periods, supplement definitions, and data-collection protocols. Other nonmethodological reasons for the differences in the reported use of supplements could include unavailability of supplements, difficulty recalling intake, misunderstanding of defined supplements (e.g., sports drinks), and reluctance to declare use.

There were no significant differences observed relative to prevalence of supplementation and gender; however, the athletes in intermittent sports were significantly less likely to report supplementation than those from the other sport types. It is possible that intermittent sports may have a tendency to be team sports, and team athletes may choose not to take dietary supplements because of the risk of inadvertent doping.

From this research we determined that subjects who trained the greatest weekly volume (>25 hr/week) were the most likely to declare using dietary supplements, potentially to support their physiological training demands.

Unfortunately, insufficient data were collected from each of the eight Canadian Sport Centres to be able to draw comparisons of supplementation practices between athletes from the different geographical regions of Canada.

Types of Dietary Supplements

Seventy-six different dietary supplements were consumed by athletes in this study. The most frequently used (in descending order) were sport drinks, multivitamins, carbohydrate/sport bars, protein powder, and meal-replacement products. This finding is similar to the results reported by other investigators (Baylis et al., 2001; Braun et al., 2009; Erdman et al., 2006; Kristiansen et al., 2005; Sundgot-Borgen et al., 2003; Suzic Lazic et al., 2009; Tian et al., 2009). Because most of the athletes in this study were categorized as power-sport participants it is not surprising to see the higher use of supplemental protein. However, there was no difference in the types of dietary supplements consumed based on training volume in weekly hours.

Most of the supplements reported in this research are unlikely to pose health risks. Nonetheless, there is always a risk of cross-contamination or undeclared ingredients with any form of dietary supplementation, so it can never be assumed that supplementation is without doping risk (Ayotte et al., 2001; Maughan et al., 2007; Van Thuyne et al., 2006).

Sources of Dietary Supplementation Information

Similar to the findings of a previous study (Erdman et al., 2006), it was surprising to discover the number of subjects who had never attended a dietary supplementation information session, yet most believed that they were in compliance with antidoping protocols and were competing at elite levels. Furthermore, the declared information sources observed in this research regarding supplementation practices continue to be a concern with high-performance athletic populations (Braun et al., 2009; Erdman et al., 2006; Froiland et al., 2004; Malinauskas et al., 2007; Petróczi et al., 2007; Tian et al., 2009). Sport medicine physicians and dietitians should be particularly concerned by their low ratings as sources of information on dietary supplements and may want to consider proactive strategies to improve their credibility as educators on this topic.

Reasons for Supplementation

With the exception of the subset of endurance athletes, the top five reasons to take dietary supplements overall, by gender, and by competitive event were for health maintenance, to increase energy, for exercise recovery, to gain or maintain muscle mass, and to enhance immunity. These reasons could directly and indirectly enhance physical performance in training or competition.

Supplementation Education

Consistent with the findings of previous studies (Braun et al., 2009; Dascombe et al., 2010; Erdman et al., 2006; Kristiansen et al., 2005; Malinauskas et al., 2007, Maughan, 2005; Petróczi et al., 2007; Tian et al., 2009), it appears that athletes are in need of enhanced education about their use of nutritional ergogenic aids, and most respondents from this investigation preferred individualized advice regarding the efficacy of supplementation. In particular, intermittent- and judged-sport athletes seem to be the least likely to be educated about dietary supplements in a workshop setting.

Limitations

Because of the differences in the methodologies between studies that have examined the dietary supplementation habits and opinions of athletes, it is challenging to compare study outcomes. In particular there are variations in the definition of supplements between studies. The limitations of this study include the athletes' accuracy and honesty in reporting their supplement use from recall. Furthermore, athletes may have underreported their supplement use by not fully acknowledging their consumption of readily available sports drinks and bars, which they may construe as snack foods and fluids rather than dietary supplements. In addition, greater athlete representation from the Canadian Sport Centres, especially from endurance and judged sports, would have further substantiated this research.

In conclusion, many of the findings from this national study of dietary supplementation practices and opinions of high-performance Canadian athletes were similar to the original work with elite athletes from the Canadian Sport Centre–Calgary in western Canada (Erdman et al., 2006). From this current study, it appears that most Canadian Sport Centre–affiliated athletes across Canada regularly take dietary supplements. However, it is concerning that athletes' sources of dietary supplementation information may be unreliable. Elite athletes would probably benefit from individual interviews regarding the use of sport supplements. Sport-medicine- and sport-science-service providers such as physicians, dietitians, and physiologists need to be familiarized with dietary supplementation practices to promote themselves as credible sources of dietary supplementation information among athlete populations, because it is unlikely that the use of dietary supplements by athletes is going to diminish. This study's findings will be useful for dietitians, medical professionals, and the Canadian Anti-Doping Program in developing the most effective means to educate athletes about dietary supplement practices and related concerns. Supplement producers may also find this information helpful to identify specific products that may require testing for quality, purity, and the presence of prohibited substances.

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References

Ayotte, C., Lévesque, J.F., Clé Roux, M., Lajeunesse, A., Goudreault, D., & Fakirian, A. (2001). Sport nutritional supplements: Quality and doping controls. *Canadian Journal of Applied Physiology, 26*(Suppl.), S120–S129.

Baylis, A., Cameron-Smith, D., & Burke, L.M. (2001). Inadvertent doping through supplement use by athletes: Assessment and management of the risk in Australia. *International Journal of Sport Nutrition and Exercise Metabolism, 11*(3), 365–383.

Braun, H., Koehler, K., Geyer, H., Kleiner, J., Mester, J., & Schanzer, W. (2009). Dietary supplement use among elite young German athletes. *International Journal of Sport Nutrition and Exercise Metabolism, 19*(1), 97–109.

Burns, R.D., Schiller, M.R., Merrick, M.A., & Wolf, K.N. (2004). Intercollegiate student athlete use of nutritional supplements and the role of athletic trainers and dietitians in nutrition counseling. *Journal of the American Dietetic Association, 104*(2), 246–249.

Crowley, J.J., & Wall, C. (2004). The use of dietary supplements in a group of potentially elite secondary school athletes. *Asia Pacific Journal of Clinical Nutrition, 13*(Suppl.), S39.

Dascombe, B.J., Karunaratna, M., Cartoon, J., Fergie, B., & Goodman, C. (2010). Nutritional supplementation habits and perceptions of elite athletes within a state-based sporting institute. *Journal of Science and Medicine in Sport, 13*(2), 274–280.

Erdman, K.A., Fung, T.S., Doyle-Baker, P.K., Verhoef, M.J., & Reimer, R.A. (2007). Dietary supplementation of high-performance Canadian athletes by age and gender. *Clinical Journal of Sport Medicine, 17*(6), 458–464.

Erdman, K.A., Fung, T.S., & Reimer, R.A. (2006). Influence of performance level on dietary supplementation in elite Canadian athletes. *Medicine and Science in Sports and Exercise, 38*(2), 349–356.

Froiland, K., Koszewski, W., Hingst, J., & Kopecky, L. (2004). Nutritional supplement use among college athletes and their sources of information. *International Journal of Sport Nutrition and Exercise Metabolism, 14*(1), 104–120.

Geyer, H., Parr, M.K., Koehler, K., Mareck, U., Schänzer, W., & Thevis, M. (2008). Nutritional supplements cross-contaminated and faked with doping substances. *Journal of Mass Spectrometry, 43*(7), 892–902.

Herbold, N.H., Visconti, B.K., Frates, S., & Bandini, L. (2004). Traditional and nontraditional supplement use by collegiate female varsity athletes. *International Journal of Sport Nutrition and Exercise Metabolism, 14*(5), 586–593.

Huang, S.H., Johnson, K., & Pipe, A.L. (2006). The use of dietary supplements and medications by Canadian athletes at the Atlanta and Sydney Olympic Games. *Clinical Journal of Sport Medicine, 16*(1), 27–33.

Kristiansen, M., Levy-Milne, R., Barr, S., & Flint, A. (2005). Dietary supplement use by varsity athletes at a Canadian university. *International Journal of Sport Nutrition and Exercise Metabolism, 15*(2), 195–210.

Krumbach, C.J., Ellis, D.R., & Driskell, J.A. (1999). A report of vitamin and supplement use among university athletes in a Division I institution. *International Journal of Sport Nutrition, 9*(4), 416–425.

Malinauskas, B.M., Overton, R.F., Carraway, V.G., & Cash, B.C. (2007). Supplements of interest for sport-related injury and sources of supplement information among college athletes. *Advances in Medical Sciences, 52,* 50–54.

Maughan, R.J. (2005). Contamination of dietary supplements and positive drug tests in sport. *Journal of Sports Sciences, 23*(9), 883–889.

Maughan, R.J., Depiesse, F., Geyer, H., & International Association of Athletics Federations. (2007). The use of dietary supplements by athletes. *Journal of Sports Sciences, 25*(Suppl. 1), S103–S113.

Molinero, O., & Marquez, S. (2009). Use of nutritional supplements in sports: risks, knowledge, and behavioural-related factors. *Nutricion Hospitalaria, 24*(2), 128–134.

Nieper, A. (2005). Nutritional supplement practices in UK junior national track and field athletes. *British Journal of Sports Medicine, 39*(9), 645–649.

Petróczi, A., & Naughton, D.P. (2008). The age-gender-status profile of high performing athletes in the UK taking nutritional supplements: Lessons for the future. *Journal of the International Society of Sports Nutrition, 5,* 22–30.

Petróczi, A., Naughton, D.P., Mazanov, J., Holloway, A., & Bingham, J. (2007). Performance enhancement with supplements: Incongruence between rationale and practice. *Journal of the International Society of Sports Nutrition, 4,* 19–28.

Schröder, H., Navarro, E., Mora, J., Seco, J., Torregrosa, J.M., & Tramullas, A. (2002). The type, amount, frequency and timing of dietary supplement use by elite players in the First Spanish Basketball League. *Journal of Sports Sciences, 20*(4), 353–358.

Slater, G., Tan, B., & Teh, K.C. (2003). Dietary supplementation practices in Singaporean athletes. *International Journal of Sport Nutrition and Exercise Metabolism, 13*(3), 320–332.

Sobal, J., & Marquart, L.F. (1994). Vitamin/mineral supplement use among high school athletes. *Adolescence, 29,* 835–843.

Striegel, H., Simon, P., Surster, C., Niess, A.M., & Ulrich, R. (2006). The use of nutritional supplements among master athletes. *International Journal of Sports Medicine, 27*(3), 236–241.

Sundgot-Borgen, J., Berglund, B., & Torstveit, M.K. (2003). Nutritional supplements in Norwegian elite athletes—Impact of international ranking and advisors. *Scandinavian Journal of Medicine & Science in Sports, 13,* 138–144.

Suzic Lazic, J., Dikic, N., Radivojevic, N., Mazic, S., Radovanovic, D., Mitrovic, N., . . . Suzic, S. (2009). Dietary supplements and medications in elite sport—Polypharmacy or real need? *Scandinavian Journal of Medicine & Science in Sports, 21*(2), 260–267.

Tian, H.H., Ong, W.S., & Tan, C.L. (2009). Nutritional supplement use among university athletes in Singapore. *Singapore Medical Journal, 50*(2), 165–172.

U.S. Food and Drug Administration. (2009). *Consumer information on dietary supplements*. Retrieved from http://www.fda.gov/Food/DietarySupplements/ConsumerInformation

Van Thuyne, W., Van Eenoo, P., & Delbeke, F.T. (2006). Nutritional supplements: prevalence of use and contamination with doping agents. *Nutrition Research Reviews, 19*(1), 147–158.

Ziegler, P.J., Nelson, J.A., & Jonnalagadda, S.S. (2003). Use of dietary supplements by elite figure skaters. *International Journal of Sport Nutrition and Exercise Metabolism, 13*(3), 266–276.