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The Use of Dietary Supplements Among Elite National Athletes, Varsity Athletes and Non-Athletic University Students

by

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ABSTRACT

This study determined the extent and types of dietary supplements used among elite national athletes and varsity athletes as compared to a control group consisting of a random sample of university students. Patterns of use, reasons and beliefs associated with use, information regarding baseline diet and information sources that influenced the use of dietary supplements were also investigated. This study addressed the lack of existing information concerning supplement use other than vitamins and minerals along with methodological shortcomings in existing literature. The design was a cross-sectional survey of 72 elite national athletes, 101 varsity athletes and a control group of 131 students. Of the elite national athletes 70% used dietary supplements as compared to 64% of varsity athletes and 62% of students ($p<0.05$). Each group used vitamin C, multivitamins, sport drinks and bars most often. Natural health products including echinacea and ginseng were among the most popular dietary supplements. Elite national athletes used significantly more supplements, reported the most balanced diet and utilized the largest number of information sources. Reasons for use between the elite national athletes and varsity athletes include those related to general wellbeing and those related to enhancing performance whereas the control group only reported reasons related to general wellbeing. The benefits and risks associated with the most regularly used dietary supplement provided by each of the groups demonstrate that athletes may be lacking the information necessary to ensure safe and effective use of dietary supplements. This information is important for coaches, physicians, nutritionist and physiologists in terms of monitoring and advising athletes to maintain health and to enhance performance.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Over the past decade the role of nutrition in disease prevention, the promotion of health and the enhancement of athletic performance has become an important area of research. Nutritional links to various types of positive health outcomes have been investigated (Khaw & Woodhouse, 1995; Olson, 1994; Mertz, 1994), and consensus has developed that nutrition affects one's health and well being. Consequently, the proportion of individuals attempting to ensure an adequate nutrient intake is increasing. One may receive nutrients from both a balanced diet and the use of dietary supplements. The use of dietary supplements has become more popular and can contribute a substantial proportion of nutrient intakes (Subar & Block, 1990). The American Dietetic Association has a distinct position on the use of vitamin and mineral supplements and states that vitamin or mineral use is only appropriate when well accepted, peer reviewed, scientific evidence has shown the supplement to be safe and effective (Journal of the American Dietetic Association, 1996). They have also stated that there is no scientific evidence supporting the general use of supplements to improve athletic performance (Journal of the American Dietetic Association, 1996)

In Canada, ten years ago, Health and Welfare Canada made nutritional recommendations through The Ontario Dietetic Association (1989). The Ontario Dietetic Association, as outlined in the Manual of Nutritional Care (1989) has developed Recommended Nutrient Intakes (RNIs). RNIs are specific for age, gender, body weight, energy expenditures, and are expressed as daily rates. The Manual states that, in general,

a balanced diet should provide all of the necessary nutrients, even among athletic populations. They state that vitamin and mineral supplements have not been shown to enhance athletic performance if an individual is nourished by an adequate diet, although special attention should be given to the possibility of low calcium and iron. The Association also alludes to the risk of adverse effects due to the use of large doses of vitamins and minerals (1989).

Dietary supplements, in a broad sense, include vitamins, minerals, herbs, amino acids, weight gain products, weight loss products, carbohydrate supplements and an array of miscellaneous supplements including caffeine, royal jelly and co-enzyme Q10. To date, the literature on the topic of supplements has focussed on vitamins and minerals in both the general population and among athletes. Although increased use of herbs in the general population has been reported (Huxable, 1992; Eisenberg D., Kessler, R., Foster, C., Norlick, F., Calkins, D. & Delbanco, T.,1993), their use has not been studied to the same degree as vitamins and minerals.

Dietary supplements include natural health products, which have been defined in several ways, and which are not licenced in Canada. Natural health products including herbal remedies used as therapeutic agents may be derived from plants and include pure chemical entities available through prescriptions, teas, food plants and other remedies (MMWR, 1995). Recently the importance of a licensing body related to the use of herbs and other natural health products has been explored. This has resulted in the establishment of The Standing Committee on Health in Canada who will research this issue. A licensing body would potentially oversee the production and regulation of

products and/or mandatory reporting in case of toxicity resulting from these products (Shaw, Leon, Kolev & Murray, 1997; Cohen, 1998; Atherton, 1994; De Smet, 1995; Perharic, Shaw & Murry, 1993; Huxtable, 1992; MacGregor, Abernethy, Dahabra, Cobden, Hayes & 1989). Regulation may increase awareness about potential benefits and risks concerning dietary supplements.

The frequent use of dietary supplements in Canada, has been illustrated in the results of a recent survey by the Canada Health Monitor (Survey 16, June-July 1997) which showed that 56% of Canadians reported using one or more natural health products, 47% used vitamins, 22% used mineral supplements and, 20% used herbal remedies and teas during the six months prior to the study. Similar to the Canadian percentages, American studies report that approximately 50% of the general population had used vitamin or mineral supplements during the previous year (Slesinski, Subar & Kahle, 1995). Despite the popularity of dietary supplements, little is known about their use among elite Canadian athletes. Therefore, it is important to determine the extent of use, patterns of use and the reason for dietary supplement use among this group. These data will provide baseline information for further studies assessing safety and efficacy of dietary supplements. The gained knowledge may be particularly important for physicians, dietitians and coaches in terms of monitoring and advising athletes to promote healthy and effective use of dietary supplements.

Elite national athletes and varsity athletes have been chosen as the target groups since they have a vested interest in maintaining health and enhancing physical performance. Williams (1994) explains that at various levels of sport competition,

genetic endowment and training levels may be so well matched that the outcome of the event may be determined by milliseconds or centimetres. This reality influences athletes and coaches to maximize both training and competition events by using ergonomic aids to enhance performance and to gain an edge over competitors. Ergonomic aids, which are a subcategory of dietary supplements, can take several forms including mechanical, physiological, psychological and nutritional aids (Williams, 1994). The attempt to enhance performance in addition to maintaining health and preventing disease makes athletes a group which may use dietary supplements heavily. A limited number of previous studies have found that elite level athletes and varsity athletes use dietary supplements to a greater degree than the general population, however, the extent and nature of the differences has not been well established (Sobal & Marquart, 1994).

The primary objective of this study was to determine the degree of dietary supplement use among Canadian elite national athletes and Canadian varsity athletes and to compare their use with the use of dietary supplements in a random sample of university students. Secondary objectives were to assess the patterns of dietary supplement use, the reasons for use as well as the perceived benefits and risks for regularly used dietary supplements.

CHAPTER II

LITERATURE REVIEW

In this chapter a review will be provided of the literature relevant to this study. First, background information about classification systems of dietary supplements will be provided. This chapter will then address population based estimates of dietary supplement use in Canada and the United States, and the use of dietary supplements among athletic populations. While not of direct importance to this study, the evidence of effectiveness of dietary supplements will then be discussed as it provides the context of this study. Background information will also be provided concerning the current issue of the safety of natural health products and the potential need for their regulation. The literature review will conclude with the identification of some important gaps in the existing literature and the presentation of the objectives of this study.

Although the term dietary supplement has traditionally referred to vitamins and minerals, in this study, the term will also include natural health products, which has been previously defined, along with amino acids, carbohydrate supplements, weight gain and weight loss products, as all are potentially important dietary supplements to athletic populations.

Classification of Dietary Supplements

Some dietary supplements are meant, through a variety of ways, to improve athletic performance and are termed nutritional ergonomic aids. These aids can be divided into four categories. These categories include: metabolic fuels, such as carbohydrates, protein and fat; cellular components that may naturally be found in

limited amounts, such as creatine, carnitine, various vitamins and minerals; anabolic substances such as protein, chromium; and recovery products such as fluid, electrolytes, carbohydrates, protein and herbal products (Butterfield, 1996). This classification system is based on the purpose and not a particular type of dietary supplement, contrary to classification of natural health products where products are classified by type.

Dietary supplements that are natural health products, include a large array of products that, recently, have been receiving national and international attention. The following classification system helps to provide guidelines for determining whether products may or may not be natural health products and is based on five different subgroups. The first subgroup consists of highly purified and concentrated products, such as vitamins and minerals; the second contains natural substances containing ingredients with known effects on health, such as kelp and fatty acids; the third includes natural substances whose compositions and effects may not be fully known, such as Royal Jelly; the fourth has been labelled slimming aids, such as bulking agents, low calorie diets and digestive aids, and the final category consist of homeopathic remedies and essential oils (Shaw et al., 1997).

Generally, natural health products are thought to have three effects on the body: detoxifying, eliminating unhealthy foreign bodies and strengthening the immune system (Trevelyan, 1995). Although the World Health Organization has estimated that herbal remedies are the most frequently used of all therapies (MWRR, 1995), little information is available about the extent of use among Canadian athletes.

Dietary Supplement Use in the General Population

As previously stated, a recent survey of a random sample of 2592 adults, by the Canada Health Monitor showed that 56% of Canadians reported taking one or more natural health products, 47% vitamins, 22% mineral supplements, 20% herbal remedies and teas during the six months prior to the study (Survey 16, June-July 1997).

In the United States, several studies developed population based estimates of vitamin and mineral use, using information from several waves of the National Health Interview Survey (Block, Cocks, Madans, Schreiber, Licitra & Melia 1988; Subar & Block, 1990; Slesinski et al., 1995). Block et al. (1988) found a weak relationship between increased physical activity and increased use of supplements. Block et al. used data collected between 1971-1974 and compared findings to a follow-up survey for the same 11,227 participants during 1983-1984.

Subar & Block's (1990) study was based on the National Health Interview Survey administered in 1987. Women, between the ages of 55-64 years, those with higher education and higher incomes and residence of the western states were most likely to report the use of dietary supplements. Dietary supplement use was also related to health behaviours. For example, heavy users of alcohol and tobacco were less likely to use dietary supplements, as were those with higher body mass index. Respondents who believed that diet affects one's health were highly likely to use dietary supplements.

Most recently in the United States, Slesinski et al. (1995) compared the results of two consecutive National Health Interview Surveys which investigated the use of multivitamins, vitamin A, C, E and Calcium. The questionnaire was administered to a

random sample of 22,080 adults in 1987 and 12,005 in 1992. Multivitamins followed by the use of vitamin C were the most common dietary supplements. The percentage of individuals who reported using one or more vitamins and minerals per year, dropped from 51.1% in 1987 to 46.2% in 1992, although consistent use of daily vitamins and minerals remained the same. A significant decline in use was reported for both white males and females ($P<.001$). No significant changes were noted for Hispanics or African Americans which indicates a difference in the use of dietary supplements associated with ethnic backgrounds. This association may be a result of several variables including varying socioeconomic backgrounds, levels of educational and/or geographic locations. The percentage of regular use of daily vitamin and minerals remained the same in 1987 and 1992. The use of multivitamins, a specific type of dietary supplements increased significantly ($P<.001$).

In a survey conducted by Levy, Raymond and Schucker (1989) the use of dietary supplements was classified as very heavy, heavy, moderate and light. An important finding of this study was a higher level of physical activity among heavy users as compared to those who used supplements less frequently. Further, heavy and very heavy users had a higher level of knowledge concerning specific benefits from dietary supplements as compared to the other groups; used specialized sources for information about dietary supplements more often; were more likely to have an internal locus of control; and sought advice from doctors less often than moderate and light users.

Together, these studies show that dietary supplement use in North America is a common phenomenon and that the use of natural health products has rarely

been included in these investigations. These studies also showed that gender, age, education, income, health behaviours and beliefs are associated with dietary supplement use.

Dietary Supplements in Athletic Populations

In this section 1) the use of dietary supplements by athletes, 2) the reasons for and beliefs associated with dietary supplement use among athletes and 3) effectiveness of popular dietary supplements in enhancing performance will be reviewed.

Use of Dietary Supplements by Athletes

Vitamins and Minerals

Sobal and Marquart did a systematic review of 51 studies, including a total of 10,274 athletes (1994). They reported the percentage, reasons for use and patterns of vitamin and mineral use among athletes. Published papers, chapters and books were compiled using computerized bibliographic searches and were pooled for analysis. Only papers published in English were examined and abstracts and single case studies were excluded. They reported that an average of 54% (ranging from 6%-100%) of all athletes had used vitamins and minerals. Sobal and Marquart (1994) also examined the impact of level of competition on dietary supplement use. A mean of 59% of the elite athletes had used dietary supplements, compared to 49% of college athletes and 47% of high school athletes. Sobal and Marquart (1994) postulated that the higher use among the elite national athletes is due in part to the use of dietary supplements as ergonomic aids. One study, included in the review, compared athletes to non-athletes and found that the athletes were significantly more likely to use dietary supplements

(Bazzarre, Scarpino, Sigmon, Marquart, Wu & Izurieta, 1993).

The most frequently used vitamins and minerals among athletes are similar to those used in the general population and include multivitamins followed by vitamin C, iron, vitamin B, E, calcium and vitamin A. Female athletes reported using these supplements to a slightly greater degree than males (57% as compared to 47%)(Sobal & Marquart, 1994).

An assessment of the quality of the studies included in this review was not provided by the authors. There were few studies that included a control group of non-athletic individuals. Most of the studies were recent as all but four, which were not included in this study, were published after 1980. Studies had a mean of 71 participants, although the majority of studies included less than 50 athletes, therefore limiting the power of the studies.

Several existing studies have focused on sport specific samples when studying the use of dietary supplements among athletic populations. Bond-Brill and Keane (1994) investigated the use of dietary supplements, including frequency of use, amount of money spent and reasons for use among 306 male and female competitive bodybuilders. The study reported 71% of men used dietary supplements regularly, year round as compared to 67% of females. Males and females reported using vitamins, amino acids and protein powders to a similar extent. However women reported using products to lose weight more often than males, and males reported using weight gain products more often than females. The results of this study are limited due to low response rate (306/1251). The authors conclude that although there is little evidence to

support the effectiveness of dietary supplements to improve performance or strength, 90% of respondents reported the use of some type of dietary supplement.

Sigh, Evans, Gallagher & Deuster (1993) assessed the nutritional intake of 17 ultramarathoners using a four day dietary journal for days consisting of normal training and prerace situations. Twelve of the 17 subjects reported using dietary supplements. The vitamins and minerals used most often were vitamin E, vitamin C, vitamin B_{12}, and iron.

A third study assessed the dietary intake of 30 national field athletes using a seven day dietary record and a separate form which outlined any dietary supplement use (Faber and Benade, 1991). This study reported that 35% of the male athletes and 33% of the female athletes took vitamin and/or mineral supplements. The investigators also reported that those respondents whose diet did not meet the recommended daily allowance (RDA) for micro-nutrients (nutrients that are required in relatively small amounts) were those who did not use dietary supplements. Men were found to meet most of the RDA for micro-nutrients whereas the females were lacking in some areas including calcium, iron and magnesium.

The above studies, which involve different types of athletic demands, demonstrate the potential variance in vitamin and mineral use between sport groups. This variance may be associated with demands of different sports, for example, the varying degree of emphasis placed on building muscle, gaining strength and /or decreasing body fat composition.

Use of Herbs, Carbohydrate, Meal Replacements and Protein Powders

Few studies have addressed the extent and patterns of use or beliefs associated with herbs, carbohydrate supplements, meal replacement programs and protein supplements among athletes. Several studies, however, have examined carbohydrate supplementation for athletes before, during and post exercise, whether liquid or solid forms have an effect and whether the type of carbohydrate affects muscle and liver glycogen reserves, muscle glycogen synthesis and/or blood glucose during exercise which is beyond the scope of this study (Adopo, Peronnet, Massicotte, Brison & Marcel, 1994; Coleman, 1994; Zawadzki, Yaspelkis & Ivy, 1992).

The use of protein supplements has not been researched except in reference to muscle gain products. These products are popular among athletes involved with sports emphasizing muscle size and strength. There is also little known concerning the use of meal replacements which are made of a variety of carbohydrates, proteins, fats, vitamins and minerals.

The Reasons and Beliefs Concerning the Use of Dietary Supplements among Athletes

The use of dietary supplements has been related to improved athletic performance through the use of nutritional ergonomic aids (Bazzarre et al., 1993; Singh, Moses & Deuster, 1992; Block et al., 1988; Levy et al., 1997). Common beliefs regarding the potential benefits of dietary supplementation for athletes are summarized by Haymes (1991). She believes that the choice to use dietary supplements may be based on one or more of the following reasons: 1) to supplement deficient areas of one's diet, 2) to provide specific vitamin and minerals that athletes require more of due to their loss during exercise and 3) to add vitamins or minerals to improve performance.

Several studies have assessed the reasons for vitamin and mineral use among athletes (Harvey-Berino, Lamoureux & Johnson, 1995; Bond-Brill & Keane, 1994; Thomsen, Terry & Amos, 1987; Sobal & Marquart, 1994). Sobal & Marquart (1994) identified that, among athletes, the most often reported reasons for the use of dietary supplements were to balance inadequate diets, prevent or cure illness and to enhance performance. Athletes are most often influenced to use dietary supplements by coaches, parents and doctors (Sobal & Marquart, 1994). Harvey-Berino et al. (1995) administered a 115-item questionnaire to 700 University students to investigate the attitudes and beliefs related to supplement use and exercise. They found similar results to Sobal & Marquart (1994). Harvey-Berino et al. (1995) also found that the perception of positive effects associated with the use of dietary supplements and the perceived inconvenience of purchasing supplements were significant predictors of supplement use. To date, no study has assessed the reasons for the use of natural health products among athletes.

In a sport specific example, Bond-Brill & Keane (1994) examined the reasons for dietary supplement use including vitamins, minerals, weight gain and weight loss products among 306 male and female body builders. The most frequent reasons included: meeting the extra demands of heavy training, improving performance and gaining muscle. This population may have different needs than those athletes that de-emphasis muscle development. Given that the type of dietary supplements used vary according to the type of sport individuals participate in, the reasons for use may vary as well.

Thomsen et al. (1987) used a scale consisting of likert type items which included twelve potential reasons for the use of dietary supplements among high school students. The three most important reasons for the use of dietary supplements among this sample of high school students were: to make the respondent healthier, to follow their doctors' suggestions and to give them more energy. Thomsen et al. (1987) also used twelve belief statements to measure the beliefs associated with dietary supplement use. More than half of the participants agreed that natural vitamins and minerals were better than manufactured ones, that most people need vitamin and mineral supplements and that if a person is tired he/she may require more vitamins and minerals. A majority of participants disagreed that vitamins and mineral can be taken in any amount and that it is nearly impossible to get too much vitamins and minerals. This study found that American adolescents' lack information relating to the use of dietary supplements.

This study also found a positive association between those individuals who were physically active and the support of beliefs which promote dietary supplement use. An example of a belief statement was; "People who take vitamin C have fewer and less severe colds". Thomsen et al. (1987) reports that the results of this study indicate misconceptions and uncertainties concerning the use of dietary supplements. She suggests a need for health professionals, such as dieticians, to routinely advise and monitor on the use of dietary supplementation.

Evidence of Effectiveness of Dietary Supplements

Although effectiveness of dietary supplements is not the focus of this study, the following information will provide the context of this study. Several studies

have investigated the potentially positive impact dietary supplements may have on the general health and/or the enhancement of performance for athletes. Claims concerning the benefits of particular dietary supplements likely influence the reasons why athletes are using dietary supplements. However in several cases the beneficial effects of specific dietary supplements are not supported by scientific evidence (Singh et al, 1992; Weight, Myburgh & Noakes, 1988; Faber & Banned, 1991; Williams, 1994; Williams 1995; Clarkson, 1996). There are several potential reasons for the lack of consistent results regarding the beneficial effects of dietary supplement use by athletes. These include the low level of dosages of dietary supplements used in studies, the lack of control over participants' baseline diet and/or the lack of compliance from participants.

The following information concerns the proposed claims regarding often used dietary supplements by athletic populations, such as vitamins, minerals, weight gain/ weight loss products and general health enhancers. Most of the reported information is from review articles pertaining to studies of the use of specific dietary supplements (Singh et al., 1992; Weight et al., 1988; Faber & Banned, 1991; Williams, 1994; Williams 1995; Clarkson, 1996). These studies were primarily descriptive and addressed a wide range of dietary supplements.

Vitamins

The proposed benefits of vitamin B6, B12 and vitamin C, which are frequently used, relate to improved performance and general well-being. Vitamin B complexes are related to coenzyme activity and metabolism of fats and carbohydrates. Two possible benefits of consuming large quantities of vitamin B complexes include

decreased fatigue and increased motor control. It has been suggested that active individuals may require vitamin B complexes above RDA (Haymes, 1994). However, other studies report that if adequate vitamin B is received from diet, additional vitamin B has no effect (Wilmore & Costill, 1992; Bazzarre et al., 1993). Vitamin C has been shown to play several important roles including its influence on the formation of collagen, a protein in connective tissue and assistance of iron absorption (Wilmore & Costill, 1992). Vitamin C has several proposed benefits including its role as an antioxidant, decreasing energy expenditure and decreased muscle soreness (Probart, Bird & Parker, 1993). However, most of the literature supports the need for further research to clarify the efficacy of these vitamins in athletes and the general public as the evidence varies (Haymes, 1991; Williams, 1992; Grunewald & Baily, 1993; Probart et al., 1993).

Minerals

Both sodium phosphate and sodium bicarbonate are often used by athletes to improve performance, as they act as buffers for lactic acid, although further research is needed to determine the most safe and effective dose and frequency (Clarkson, 1996; Williams, 1994). Calcium and iron are supplements used widely by athletes as well as by the general population. There is evidence supporting that calcium increases bone mass (Haymes, 1991). Iron deficiency is one of the major nutritional problems in the United States (Klingshrin, Pate, Bourque, Davis & Sargent, 1992). Iron plays a vital role in circulation and metabolic functions involved with aerobic energy transfer. It has been established that iron deficiency anaemia results in decreased capacity for athletic performance (Klingshrin et al., 1992) In these cases, iron supplementation decreases the

risk of sport anaemia. However, for less serious deficiencies iron supplementation has no positive effects on performance but will raise the plasma levels to the recommended levels.

Weight Gain Products

Several products have been marketed as agents that can promote muscle and strength gain for athletes. The mechanisms by which each dietary supplement promotes weight gain may be different, however the reason for use is the same. These products are more readily used by athletes than the general population (Grunewald & Bailey,1993). One relatively popular dietary supplement used to gain muscle is Arginine. It has been suggested that Arginine promotes the release of growth hormone, although research doesn't support this claim (Grunewald & Baily, 1993). Boron is also popular and has been said to increase testosterone levels, augment strength and promote weight gain. Research has supported an increase of serum testosterone, but not muscle and weight gain (Rossenbloom, Millard-Stafford & Lathrop, 1992). Chromium has become a popular supplement for increasing muscle mass. It is thought that chromium affects insulin, glucose and amino acid utilization by the muscles and stimulates muscle growth. There is some evidence which supports the claim of weight gain, but it may be due to water retention and not muscle (Lukaski, Bolonchuk, Siders & Milne, 1996). Hallmark, Reynolds, Desouz, Dotson, Anderson & Rogers (1996) conducted a randomized, double blind study and found that the supplementation of chromium had no effect on muscle strength or body composition. Last, creatine has become a popular dietary supplement used to enhance performance by regenerating energy to allow greater anaerobic strength

training, thereby indirectly increasing strength and muscle mass. Supplementing creatine may affect the rate of ATP synthesis, delaying muscular fatigue and enhance recovery after bouts of intense exercise. A review by Mujika & Padilla (1997) reports that enhancement of performance is observed only in untrained or moderately trained individuals, no effect was found among endurance athletes or highly trained athletes. Creatine supplementation also did not have any positive effects on swimmers performance (Mujika, Chatard, Lacoste, Barale & Geyssant, 1996).

Supplements Meant to Enhance General Health

A final category of dietary supplements are those which have less tangible benefits and are meant to enhance general well-being. Examples of this type of supplement include bee pollen, Ginseng and coenzyme Q-10. Bee pollen has been suggested to increase recovery among several other claims but further research is needed to study its effects (Williams, 1992); Ginseng which has been thought to increase stamina, mental acuity and physical capacity. Coenzyme Q-10 has been shown to increase oxygen uptake and act as an antioxidant (Probart et al., 1993). However, the literature acknowledges the need for further research into these dietary supplements (William, 1992; Probart et al., 1993; Williams, 1995).

Potential Adverse Effects Related to the Use of Natural Health products

Although there are potential adverse effects related to the use of dietary supplements apart from natural health products, currently natural health products have been receiving a large amount of attention. The national attention reflects the increase in the use of natural health products and the many questions that remain regarding their safe

and effective use. The following section provides some background information regarding this current issue.

Ernst (1998) conducted a review which investigated data on adverse effects of herbal preparations published between 1992 and 1996 based on Medline searches and communications with experts in the field. The purpose of the study was to classify the adverse effects into different types of reactions including allergic reactions, toxic reactions, adverse effects related to the desired pharmacological actions, mutagenic effects, drug interaction, contamination and mistaken plants. The findings reported specified herbal remedies which had been found to have adverse effects falling into one of the above categories. Examples of this are Royal jelly and camphor which had been repeatedly linked with allergic reactions and kelp which had been linked to contamination. Ernst (1998) also reported the incidence of adverse effects according to four investigations previously conducted. In one report 2,695 patients admitted to a Taiwan Department of Medicine during a 10-month period, four percent of patients were admitted because of drug related problems: herbal remedies ranked third among the categories of medicines responsible for causing adverse effects. A second report conducted between 1983 and 1989, at a London-based National Poisons Unit, the unit received 1,070 enquiries related to herbal and other traditional drugs. Twenty-five percentage of patients were symptomatic at the time of contact in the study. Most adverse effects were associated with herbal sedatives.

Shaw et al. (1997) also investigated adverse effects related to natural health products. Between 1991 and 1995, a total of 1297 symptomatic cases that were

thought to be related to the use of natural health products were reviewed. All cases were reported to the National Poisons Information Service in London or were directly enrolled into the study. Questionnaires were issued to each of the suspected cases so further information could conclude/confirm toxicity due to natural health products. In 738 cases, adverse effects were thought to be due to natural health products, in particular with vitamins, mineral and amino acids. The negative symptoms related to these supplements were most often gastrointestinal. Toxicity was often due to mixing of supplements which led to dangerously high levels of vitamins and minerals. There were 390 cases of adverse effects, of which 51 were systematically related to natural products with known health effects. Natural products with unknown health effects were related to 660 symptomatic cases. Symptoms included headache, nausea, drowsiness, abnormal liver functions depending on the type of supplement under question. Adverse effects were also often related to existing allergies.

Regulation of Natural Health Products

It has been estimated that 25% of today's prescription drugs contain ingredients from plants (Trevelyan, 1995; Murray, 1996). Although these drugs have been tested and approved by the United States Food and Drug Administration, herbal medicine, which are a type of natural health product, have not. As the use of natural health products is so common (Ernst, 1998) many investigators, practitioners and policy makers questioned the need for an organized regulatory body for herbs, and the need for a system of mandatory reporting of toxic effects due to herbal supplements (Atherton, 1994; De Smet, 1995; Eisenberg et al., 1998; Walton et al., 1993). It has been suggested

that the actual number of cases of toxicity due to herbal supplements have remained unidentified since there has been no systematic means of reporting the incidences (Huxtable, 1992). In Canada, The Standing Committee on Health has made recommendations regarding the legislative and regulatory regime governing traditional medicines, homeopathic preparations and vitamin and mineral supplements. The committee recommended a regulatory structure which would involve an Authority that would report to the assistant deputy minister of the Health Protection Branch. This authority would be responsible for assessing safety, quality control and licensing and would be involved with the labelling and the reassessment of the Food and Drugs Act. This Committee also recommended that health claims based on evidence may be made regarding natural health products. Informed choice and cost recovery among several other factors would be overseen by the authority.

Gaps in the Literature

The gaps in the literature associated with the use of supplements revolve around four areas. The first is the absence of research dealing with the use of herbal supplements, carbohydrates, meal replacements, protein supplements and miscellaneous dietary supplements in athletic groups. It is important to determine the degree of supplement use as broadly as possible as well as to determine the most frequently used supplements and the reasons and beliefs behind their use. This would serve as a baseline understanding for future research. This gap was addressed in this study through the assessment of a wide range of dietary supplements. The second gap is the lack of studies investigating patterns of supplement use. Patterns of supplement use refers to the

dose, number of dietary supplements, frequency, duration and seasonal variations. The third gap is the low sample size used in published studies. It appears that the percentage of supplement use becomes lower as the sample size increases, although the reasons for this have not been investigated (Sobal & Marquart, 1994). The final weakness in published studies is the lack of control groups used as a basis for comparison.

Objectives of this Study

This study investigated the use of dietary supplements among elite national athletes and varsity athletes. As previously stated, a control group consisting of a random sample of undergraduate university students was used as a comparison. The objectives of this study were to determine:

1. The degree of, pattern of and reasons for dietary supplement use among elite national athletes, varsity athletes and university students.
2. The perceived benefits and risks of dietary supplement use among elite national athletes and varsity athletes.
3. Whether the use of dietary supplements is related to the perceived importance of diet to one's health among elite national athletes and varsity athletes.
4. Whether the use of dietary supplements is related to the perceived adequacy of current diet among elite national athletes and varsity athletes.

5. The sources of information used about dietary supplements.

CHAPTER III

METHODS

This chapter outlines the methods used to conduct this study, including study design, study sample, study variables, development of the questionnaire, methods of data collection and data management and analysis.

Study Design

This study was a cross-sectional survey of two groups of athletes and a control group of university students. A control group consisting of a random sample of undergraduates from the University of Calgary was included in the study to provide a basis of comparison to the study groups of elite national athletes and varsity athletes. The varsity athletes were included to determine if the elite national athletes differ from other high performance athletes.

The data for this study were collected using self-report questionnaires between January 1997 and January 1998.

Study Participants

The three groups included in this study were elite national athletes, varsity athletes and a control group consisting of a random sample of university students.

All of the elite national athletes were registered with the National Sport Centre at the University of Calgary where approximately 130 of the 400 carded national athletes in Canada train. An attempt to contact coaches for each of the sport teams training at the centre was made, since they acted as the liaison between the athletes and the investigator.

At the University of Calgary, during the 1996/1997 academic school year, there were approximately three hundred varsity athletes (Faculty of Kinesiology, 1996). All athletes which were in-season between January and April, 1997 were requested to complete questionnaires. As in the case with the national athletes, first contact was made through coaches of the specific teams and in most situations the questionnaires were left with the coaches who oversaw their distribution during a practice time.

The control group consisted of a random sample of undergraduate students at the main campus of the University of Calgary excluding the Faculty of Kinesiology. This Faculty was excluded since these students may be more likely to be involved with extensive exercise and/or competitive sports. A sample was randomly selected from all of the remaining students by the Registrar's Office. This service was provided after submitting a written request to the office.

Sample Size

A sample size of 75 respondents for each of the three groups was required. This calculation was based on the ability to detect an odds ratio of at least 2.5 with an 80% level of power and an alpha level of 0.05. The odds ratio of 2.5 refers to a 75% level of dietary supplement use among the elite national athletes as compared to 50% among the varsity athletes during the previous twelve months. These percentages were based on the literature which supported these levels of use (Sobal & Marquart, 1994; Brill & Keane, 1994) and input from the supervisory committee members who were involved with the elite national athletes and varsity athletes. EPIinfo was used to calculated the sample size.

A response rate of 75% was expected for both of the athletic groups and a 40% response rate was expected for the control group. As the response rates were estimates, this group was over sampled. Four hundred students received a questionnaire to allow for non-response. If fewer than 75 questionnaires were returned, reminder cards would be sent out after two weeks, followed by a second copy of the questionnaire.

Study Variables and Measures

This section describes both the independent and dependent variables along with potential confounders.

Independent Variables

The major independent variable was the athletic status of the respondents, ie., elite national athletes, varsity athletes and university students. Other independent variables included the type of sport the athletes were involved with and the length of competition events. These variables were included in part one of the questionnaire which is included in Appendix A (page 1: Demographics).

Based on the length of competition events, the sports have been classified as endurance, power, aesthetic and intermittent. These divisions are based on the physiological requirements of the athletes (Fox, Bowers & Foss, 1993). In this study, endurance was defined as any competitive event lasting twenty minutes or more, power refers to a competitive event characterized by short bursts of energy that require strength. Whereas aesthetic sports emphasize artistic expression as well as physical fitness; intermittent sports refer to competitive events which may last over an hour but individual athletes compete in short intervals.

Dependent Variables

The dependent variables of primary interest were the types as well as the number of dietary supplements used by the respondents (see question 4: Appendix A). A listing of dietary supplements was included with the questionnaire (see question 4: Appendix A). This was developed based on literature review, input from the supervisory committee and pharmacists from two drugstores who gave a listing of dietary supplements they perceived to be sold most regularly. The respondents were asked to circle the supplements they had used in the previous twelve months and space was provided for additional supplements that were not listed. By providing a list, it was anticipated that recall would be enhanced. The list included vitamins, minerals, essential fatty acids, herbs, carbohydrates, amino acids, weight gain and loss products and others.

Patterns of use, defined in this study as dose, frequency and seasonal variations, for the three most regularly used dietary supplement were assessed using a grid format (see question 5, Appendix A). Participants were asked to respond to the three most regularly used supplements to keep the questionnaires as short as possible. The respondents were also asked to report frequency, seasonal variations, and duration of use. Frequency was measured as the number of times the dietary supplement was used over a one week time period, duration as the number of weeks the dietary supplement had been used in sequence and seasonal variation was investigated through the frequency and duration of the dietary supplements used during in-season and off-season.

Baseline diet and sources of information that influenced the use of dietary supplements were also dependent variables (see questions 5, 9,10 &11: Appendix A).

Other dependent variables were the specific reasons for and the beliefs associated with the three most commonly used dietary supplements (see question 5: Appendix A). These variables are classified as dependent since athletic status of the respondents may influence them. In addition, general reasons and beliefs were measured using a scale consisting of Likert type items adapted from Thomsen et al., (1987) which had been originally used to investigate teenagers' beliefs (see questions 7 & 8: Appendix A). Rather than developing new scales, these were used which would enhance comparability with other studies, although evidence of validity and reliability was not provided by Thomsen et al. (1987).

Potential Confounders

A confounding variable is an extraneous variable that satisfies both of two conditions: 1) it is a risk factor for the study variable and 2) it is associated with the study exposure but is not a consequence of exposure (Schlesselman, 1982). The potential confounders in this study include gender and age. In previous studies, associations have been found between the use of dietary supplements and gender as well as age (Sobal & Marquart, 1994).

The Health Belief Model

The health belief model was used as a tool for developing the questionnaire. The health belief model helps predict the likelihood that an individual will perform a particular health behaviour (Sarafino, 1990). This model has been used to predict preventative behaviours such as receiving vaccinations, and is also applicable to the use of dietary supplements. The predictors of health behaviour are based on two

assessments that individuals make. One assessment pertains to the threat of a health problem and the second concerns the risks and barriers of taking this behaviour (Sarafino 1990). Several factors influence people's perceived threat, including seriousness of threat, perceived susceptibility, cues to action, demographic variables, sociopsychological variables and structural variables. Perceived susceptibility and seriousness of the threat of poor performance may be cited as reasons for dietary supplement use by the athletes. Cues to action and structural variables will also be investigated. The health belief model also discusses the weighting of pros and cons or risks and barriers associated with a certain health behaviour.

The health belief model was used to help assess whether people choose to use dietary supplements. It was important to determine if the reasons for use and the beliefs associated with dietary supplement use reflect the relationships suggested between the variables in this model.

Development of the Questionnaire

The questionnaire included portions developed for this project and as identified above, Likert type scales that have been used in a previous study. Once all of the issues under study were identified and the format for the questions was chosen, they were combined to form the questionnaire. The questionnaire then went through three stages of evaluation. The first involved the assessment of face and content validity by faculty and students in the Department of Community Health Sciences at the University of Calgary. The feedback led to modifying of four questions. Changes were also made to the organization of the listing of dietary supplements and of the two charts which

concerned the reasons for use and the perceived risks and benefits associated with the most regularly used dietary supplements. The second stage consisted of pretesting the questionnaire. Twenty questionnaires were reviewed by basketball and volleyball athletes at Mount Royal College, along with their coaches. The completed questionnaires and written feedback from the athletes were collected. The coaches were also contacted by phone regarding clarity and the length of the questionnaire. There were no negative comments to indicate that any of the items were unclear or that the length of the questionnaire was inappropriate. However, slight modifications were made to the organization of the first grid regarding the patterns of dietary supplements use. Following these minor changes, the questionnaire was reviewed for a second time by peers in the Department in Community Health at the University of Calgary.

Data Collection

As described before, the athletic groups were approached in similar ways. Once contact was made with a particular coach, arrangements were made to have the investigator distribute and discuss the questionnaire or to have the questionnaires left with the coaches for them to oversee their completion. In most cases the latter occurred with the exception of the national hockey team, the varsity hockey team and the varsity wrestling team. In some instances, after repeated attempts, coaches never responded to requests for assistance in this study. This was particularly so with respect to the national team coaches. In one case, a sport team was accessed through their sports medicine physician. A cover letter was provided which outlined the participants right to choose to participate and that completion of the questionnaire indicated informed consent to

participate in this study. Following their completion, the questionnaires were sealed in envelopes. The investigator was usually contacted to arrange for their pick-up or in some cases dates were set in advance.

A random sample of 400 students at the University of Calgary who formed the control group were sent the questionnaire, cover letter and an addressed, postage paid, return envelope. Two weeks following the initial mail out, a reminder was sent to those who had not returned the questionnaire. It was not possible to draw comparisons between those students who chose to participate in the study and those who did not, as we did not have any other information than the student's address.

Data Management

As completed questionnaires were returned, they were coded and reviewed for missing data. In several cases, the grid regarding the patterns of dietary supplement use was only partially complete and in some cases not completed at all. Follow up could not be done after the completion of the questionnaires as the questionnaires did not contain information that could identify the participant.

All responses were coded and the data were entered using EPI Info. Double entry was done for every fifteenth questionnaire, which was an arbitrary number which seemed reasonable and equalled a total of twenty questionnaires. Six errors were detected. The errors that were corrected did not show a pattern and were not associated with a particular item.

Data Analysis

The data analysis was completed using both EPIInfo and SPSS.

Descriptive analysis was performed to describe the type and number of dietary supplements among and within groups using frequencies, means and graphical displays. To avoid problems such as small sample size of subgroups, an overall percentage was determined applicable to all elite national athletes, all varsity athletes and the control group of students at the University of Calgary to avoid problems related to small sample size. Subgroup analysis was only conducted for teams with 10 or more respondents.

Dietary supplement use was also described based on length of competition events. The patterns of use, reasons for use and the perceived risks and benefits associated with supplements were also presented using descriptive methods, including the calculation of means, medians and frequencies. Descriptive analysis was also used to present information regarding the sources of information that led to the use of dietary supplements along with graphical displays regarding the respondent's baseline diet.

Contingency analysis was done to examine associations between independent and dependent variables and to compare the three groups in particular. Chi-Square tests were used to examine the association between the use of dietary supplements, including the extent of use, quantity used and duration of use among athletes and the control group. One-way ANOVA was used to test associations related to continuous data, such as the mean number of dietary supplements used within each group. A p-value of 0.05 or less indicated a statistically significant difference among groups. If statistically significant differences were found when comparing means, post hoc Scheffé tests (alpha level 0.05) were also used to determine where differences exist.

CHAPTER IV

RESULTS

This chapter presents a description of the study groups, the extent and types of dietary supplement used, the patterns of dietary supplement use, the relationship between type of sport, event classification and dietary supplement use and the reasons for use. It also presents the perceived benefits and risks associated with dietary supplements, the perceived adequacy of the participant's base line diet and whether it is associated with the use of dietary supplements, the perceived importance of diet to one's health and finally the sources which led the participants' to use dietary supplements.

Description of Study Participants

Of the 150 elite national athletes associated with the National Sport Centre-Calgary, 48% participated in this study. The elite national teams that participated include hockey, synchronized swimming, cross-country skiing, figure skating, wrestling, biathlon, long track speed skating, swimming, bobsleigh and basketball (Table 4.1). All the respondents participating on the above teams were approached through their coaches except for the biathletes, which were recruited through their sports medicine physician. Several attempts were also made to reach the coaches from the cycling, alpine skiing, athletics, badminton, curling, freestyle skiing, luge, nordic combined, snowboarding and short track speed skating teams, however these attempts were not successful. The athletes from the alpine ski and luge teams did not participate since they were not in Calgary and the coaches felt that it would be difficult to access them. The coaches from the short track speed skating, cycling, and athletics teams had agreed to participate and

received questionnaires, however there was no response and the investigator was unable to contact the coaches for follow up.

The varsity athletes were relatively easy to recruit compared to the elite national athletes. The varsity athletes were also accessed through their coaches. The varsity teams that participated in this study were track and field, basketball, hockey, volleyball, field hockey, wrestling, and swimming team (Table 4.1). The response rate was 70%. The varsity football team and varsity soccer team did not participate since these were not in-season.

Table 4.1 Athletic Groups Study Participants Sport Affiliation

Group	***Sport***	***Frequency (%)***
National Athletes n=72	Hockey	27 (38)
	Synchronized swimming	10 (14)
	Cross-country skiing	8 (11)
	Figure skating	6 (8)
	Wrestling	5 (7)
	Biathlon	4 (6)
	Long track speed skating	4 (6)
	swimming	3 (4)
	Bobsleigh	3 (4)
	Basketball	2 (2)
Total		72 (100)
Varsity Athletes n=101	Track & field	28 (27)
	Basketball	21 (20)
	Hockey	18 (18)
	Volleyball	15 (15)
	Field hockey	11 (11)
	Wrestling	7 (8)
	Swimming	1 (1)
Total		101(100)

In the control group, of the 400 undergraduate students mailed the questionnaire, 62 students responded within the first three weeks. A reminder card was then sent to the remaining 348 students and within four more weeks 69 additional questionnaires were received. The response rate was 33%.

Table 4.2 presents some key characteristics of the three study groups. Population demographics were not available; therefore, the representativeness of these samples could not be assessed.

Table 4.2 Comparison of the Three Study Groups

Variable	***National Athletes***	***Varsity Athletes***	***Students***	***p-value*** **
Response rate	48%(72/150)	70%(101/150)	33%(131/400)	<0.01
Sex (male)	58%(42/72)	54%(55/101)	41%(54/131)	0.042
Age (mean ± SD*)	23 (4.0)	22 (2.4)	24 (8.3)	0.402
Hours of exercise in-season/ week (mean ± SD*)	20 (8.1)	15.9 (5.2)	8.4 (5.8)	<0.01
Hours of exercise off-season / week (mean ± SD*)	10 (6.4)	8.9 (5.8)	N/A	0.185

* SD refers to standard deviation.
**Chi-square or ANOVA depending on type of variable

There was a significant difference between the percentages of males and females in each of the three groups. The number of hours spent exercising during the in-

season by the elite national athletes was significantly higher than by both the varsity athletes and the student study group (Scheffé test indicated a significant difference between the students and both groups of athletes). Table 4.2 also presents the number of hours spent exercising during off-season, which was highest among the elite national athletes. This variable was not applicable to the control group since no distinction was made between in-season and off-season, the number of hours reported was arbitrarily classified as in-season.

Use of Dietary Supplements among the Study Groups

The use of dietary supplements by each of the three study groups is presented in Table 4.3. The table shows that over the past twelve months more elite national athletes reported having used a dietary supplement during the previous 12 months than the varsity athletes and the control group. However, these differences were not significant. Table 4.3 also presents the mean number of dietary supplements used in the past 12 months. The elite national athletes reported using significantly more dietary supplements than the two other groups (Scheffé test indicated a significant difference between the national athletes and the varsity athletes and between the national athletes and the students).

Table 4.3 Extent of Dietary Supplement Use among the Three Study Groups Over the Past Twelve Months

Variable	*National Athletes N=72*	*Varsity Athletes N=101*	*Students N=131*	*p-value***
Percentage of dietary supplement users	78	66	62	0.065
Number of dietary supplements used per participant (mean ± SD*)	8.1 (10.3)	4.8 (3.17)	3.9 (2.6)	0.000

* SD refers to standard deviation
** Chi-square or ANOVA depending on type of variable

Percentages of dietary supplement use by specific teams are reported in Table 4.4. This table only includes those sport teams for which 10 or more athletes responded (see table 4.1). The range of the percentage of users between the two elite national teams was 56%-80% as compared to 46%-85% among the varsity athletes. The variation among the varsity athletes may be a result of the larger number of sport teams. The number of dietary supplements used by the elite national athletes was higher than by the varsity athletes.

More variation existed in the duration of use among the varsity athletes as compared to the elite national athletes. The mean duration of use for the elite national athletes was 25 weeks and among the varsity athletes the mean was 38 weeks.

Table 4.4 Extent of Dietary Supplement Use Over the Past Twelve Months in Teams for which at Least 10 Members Completed a Questionnaire

Sport	*Users (%)*	*Number of Supplements (mean ± SD*)*	*Duration (mean weeks ± SD*)*
National teams			
National Hockey n=27	56	8.9(14.7)	24(15.5)
National Synchro n=10	80	8.8(13.0)	26(20.3)
Varsity teams			
Varsity Track & Field n=28	85	5.1(2.6)	42.9(31.3)
Varsity Basketball n=21	52	4.4(3.2)	31.0(27.8)
Varsity Hockey n=18	65	5.5(4.3)	40.0(34.1)
Varsity Volleyball n=15	53	5.8(3.2)	48.6(39.3)
Varsity Field Hockey n=11	46	2.0(1.4)	18.0(22.7)

*SD refers to standard deviation.

Event Classification

Both the elite national athletes and the varsity athletes were asked to identify the length of their competition event. Forty-one of the elite national athletes and 72 of the varsity athletes provided information. The mean number of dietary supplements used by each group of athletes is presented in Table 4.5.

Table 4.5 Mean Number of Dietary Supplement Used and Length of Competition Events among National and Varsity Athletes

Group	*0-10sec*	*11secs-2.5min*	*2.6-10min*	*10-20min*	*20+min*	*P-value ANOVA*
National Athletes N=41/72	3	3	22	12	1	
Number of Supplements used (mean ± SD*)	7 (4.2)	8 (3.5)	8 (9.3)	14 (1.5)		0.025
Varsity Athletes n=72/101	5	22	42	2	1	
Number of Supplements used (mean ± SD*)	5 (2.2)	6 (2.9)	4 (3.5)	6 (2.8)		0.132

*SD refers to standard deviation.

The majority of both athletic study groups were involved with intermittent sports, which corresponded to the 2.6-10 minute classification. Endurance sports, which corresponded to the 20 minutes and over were reported least often. The 0-10 sec included track and field events; 11 secs-2.5 min included volleyball, basketball, swimming and track and field; 2.6-10 min included national synchronized swimming and some wrestling; 10-20 min included long track speed skating, cross-country ski and biathlon and the events lasting 20 minutes and longer included biathlon and cross-country skiing.

There was a significant difference in the mean number of dietary supplements used associated with event classification among the elite national athletes but not among

the varsity athletes (Scheffé test indicated a significant difference between the 10-20 minute category and the shorter competition events).

The endurance athletes reported the greatest number of dietary supplement used by the elite national athletes, but there was more variation among them than among the varsity athletes.

Types of Dietary Supplements Used

Types of dietary supplements used in the previous twelve months by study participants are presented in Table 4.6. Table 4.6 shows that although the percentages of use are different, the types of dietary supplements that are most commonly used are very similar among the three groups. Each of the groups identified vitamin C, multivitamins and sport drinks among the top four dietary supplements. Sport drinks were classified as carbohydrates and differed from recovery drinks, which were often protein shakes. Sport bars were among the four most regularly used dietary supplements for both athletic groups but not the student group. This group identified echinacea as the fourth most popular dietary supplement as compared to the elite national athletes, which reported echinacea as the seventh most often used dietary supplement and it, was the six most often used dietary supplement among the varsity athletes.

Table 4.6 Most Frequently Used Dietary Supplements in each of the Study Groups

Group	*Dietary Supplement*	*Frequency (%)*
National Athletes n=72	Vitamin C	28 (50)
	Multivitamins	26 (46)
	Sport drinks	25 (45)
	Sport bars	20 (36)
	Recovery drinks	19 (36)
	Creatine	16 (29)
	Echinacea	15 (29)
	Iron	13 (23)
Varsity Athletes n=101	Sport drinks	41 (61)
	Sport bars	30 (45)
	Multivitamins	26 (39)
	Vitamin C	26 (39)
	Recovery drinks	18 (27)
	Echinacea	18 (27)
	Creatine	15 (22)
Students n=131	Multivitamins	41 (51)
	Vitamin C	35 (43)
	Sport drinks	29 (36)
	Echinacea	23 (28)
	Iron	19 (23)
	Ginseng	17 (21)

Pattern of Dietary Supplement Use

The pattern of dietary supplement use refers to dose, frequency, duration and seasonal variation. Since responses were often incomplete and difficult to summarise, the duration of use was the only reportable variable. Duration was defined as the length of time, in number of weeks, a participant used a particular dietary supplement in succession. In the majority of cases, the most regularly used dietary supplements had

been used for at least six months (Table 4.7). The mean duration of use for multivitamins, vitamin C and sport drinks, which were among the most regularly used dietary supplements for each of the study groups, are presented below.

Table 4.7 Mean Duration of Dietary Supplement Use for each Study Group

Group	*Supplement*	*Duration (mean Weeks per year)*	*Standard Deviation*
National Athletes n=72	Multivitamin	34	25
	Vitamin C	28	25
	Sport drinks	27	14
Varsity Athletes n=101	Sport drinks	50	39
	Vitamin C	47	34
	Sport bars	44	36
	Multivitamin	40	30
Student n=131	Vitamin C	52	40
	Multivitamin	42	39
	Sport drinks	33	38

General Reasons for Dietary Supplement Use

In the following section the reasons for dietary supplement use are discussed. General reasons for dietary supplement use are presented followed by specific reasons for use associated with the most regularly used dietary supplements in the athletic groups. In Table 4.8, general reasons for dietary supplement use according to the

agreement with 13 Likert type items are presented. The control group was included in the following tables as a comparison.

Table 4.8 Percentage of Participants Who Agreed or Strongly Agreed with Reasons for Dietary Supplement Use

Reasons	***National Rank athletes (%) n=72***		***Varsity Rank athletes (%) n=101***		***Students Rank (%) n=131***		***p-value***
Improve health	95	1	88	2	94	1	0.363
Enhance recovery	93	2	83	4	37	9	0.000
Enhance performance	80	3	87	2	49	7	0.000
Increase energy	86	4	92	1	91	2	0.405
Cure colds	80	5	76	4	77	4	0.845
Dr. recommended	80	5	65	7	78	3	0.120
Prevention	76	7	56	8	63	6	0.105
Increase muscle mass	66	8	29	6	7	10	0.007
Coach recommended	72	9	52	10	22	11	0.000
Balance nutrients	52	10	55	9	65	4	0.251
Weight gain	73	11	33	12	14	13	0.007
Improve complexion	22	12	38	11	44	8	0.038
Weight loss	7	13	19	13	22	11	0.077

As shown in Table 4.8, the athletic groups supported reasons related to both general health and to increasing athletic performance, whereas the students tended to strongly agree with only those reasons related to general health. This led to a larger number of items overall that were agreed with by the athletic groups. Each of the groups perceived weight loss, and improved complexion were relatively unimportant reasons for dietary supplement use. As shown in Table 4.8, there were six statements in which the differences in responses among study groups was significantly different. Many of these

items related to athletic performance including the enhanced recovery, weight gain, increased muscle mass, coach recommended and enhanced performance (Scheffé test indicated a significant differences between the students and both groups of athletes except in the case of improved completion where the difference was only between students and elite national athletes).

Specific Reasons for Dietary Supplement Use

Different from Table 4.8, which presented general reasons for dietary supplement use, the following tables present specific reasons for use related to the dietary supplements used most regularly. Tables 4.9 and 4.10 provide summaries of a chart each participant was requested to complete, however few participants provided complete information and the differences among the groups were small. The three most commonly cited reasons for each of the dietary supplements are presented. These tables also present the benefits and risked perceived by each of the groups. This will be discussed in the following section.

Table 4.9 Perceived Reasons, Benefits and Risks Associated with the Most Regularly Used Dietary Supplements by Elite National Athletes

Group	*Supplement**	*Reason***	*n*	*Benefit*	*n*	*Risk*	*n*
National Athletes N=72	Vitamin C N=28	Balance diet	6	Prevention	5	Unknown	14
		Prevention	4	Ensure nutrients	3	None	5
		Recovery	4	Recovery	3	None	5
	Multivitamin N=26	Balance diet	1	Ensure nutrients	8	Unknown	9
		General health	0 3	Prevention	2	None	4
	Sport drinks N=25	Energy	7	Recovery	4	Unknown	7
		Prevention	5	Energy	2	None	2
		Recovery	2				
	Sport bars N=20	Recovery	3	Energy	3	Unknown	3
		Energy	2	Recovery	2		
	Recovery drinks N=19	Recovery	1 0	Recovery	9	Unknown	7
				Energy	2	None	3
	Creatine N=16	Weight gain	6	Performance	7	Unknown	7
		Prevention		Energy	3	None	2
	Echinacea N=15	Recovery	4	Prevention	4	None	5
		Prevention	2	Recovery	2	Unknown	3

* Dietary supplements used by less than 15 participants were not included.

**Reasons mentioned once were not presented.

Table 4.10 Perceived Reasons, Benefits and Risks Associated with the Most Regularly Used Dietary Supplements by Varsity Athletes

Group	*Supplement**	*Reason***	*n*	*Benefit*	*n*	*Risk*	*n*
Varsity Athletes n=101	Sport drinks N=41	Energy	7	Prevention	7	Unknown	17
		Recovery	6	Energy	4	None	4
		Balance diet	2	Recovery	3	Weight gain	2
	Sport bars N=30	Energy	7	Energy	6	Unknown	6
		Recovery	4	Recovery	2		
	Multivit. N=26	Balance diet	9	Balance diet	6	Unknown	10
		General health	4	General health	4	None	5
		Recovery	3	Energy	3	Weight gain	2
	Vitamin C N=26	Recovery	8	Prevention	6	Unknown	8
		Balance diet	6	General health	5	None	7
		Prevention	5	None	4	Toxicity	2
	Echinacea N=18	Recovery	6	General health	4	Unknown	5
				Recovery	2	None	3
	Recovery drink N=18	Recovery	8	Prevention	5	Unknown	9
		Energy	3	Energy	3	None	3
				Recovery	2		
	Creatine N=15	Weight gain	6	Performance	4	Unknown	3
		Recovery	4	Recovery	3	Weight gain	3
		Performance	2	Energy	2	Injury	2

* Dietary supplements used by less than 15 participants were not included
**Reasons mentioned once were not presented

Generally, the participants presented no more than three reasons related to a particular dietary supplement. Each reason was reported, excluding those mentioned once.

The reasons that were reported by both the elite national athletes and the varsity athletes were very similar. Further, responses from each study group differed slightly from dietary supplement to dietary supplement. Increased energy, increased recovery following exercise, prevention of illness and to ensure a balanced diet were the most frequently reported reasons by the elite national athletes. Among the varsity athletes, increased energy and improved recovery following exercise were the most common reasons cited for the most regularly used dietary supplements.

Specific Benefits and Risks Associated with Dietary Supplement Use

The benefits and risks were also investigated for both of the athletic groups. Each respondent reported the perceived benefits and risks associated with their most regularly used dietary supplements. The perceived benefits span across a wide range of effects for both study groups. The perceived risks were very similar between the study groups and the number of different risks reported was small (Tables 4.9 and 4.10).

The most frequently cited benefits for the use of dietary supplements by both athletic groups were to increase energy and enhance recovery. These benefits were followed by prevention of illness and ensuring adequate dietary intake and enhancing general health.

The risks, regardless of the dietary supplement under question, were most often cited as unknown and/or none for both athletic groups. The elite national athletes

reported unknown and none, as the only perceived risks for all ten dietary supplements except for creatine where two respondents mentioned weight gain. The varsity athletes gave the same responses, as the risks were unknown for 7 of the 10 dietary supplements and the "none" response was made for 8 of the dietary supplements. Weight gain was a perceived risk associated with sport drinks, multivitamins, creatine and carbohydrate loading. Toxicity was mentioned regarding vitamin C and injury was a risk linked to the use of creatine.

The General Benefits and Risks Associated with Dietary Supplement Use

The results from the closed-ended question regarding potential benefits and risks are presented in the following table. Table 4.11 shows the degree of agreement with 11 statements regarding beliefs expressing harm and benefits related to dietary supplement use.

There was considerable agreement among the athletes as three of the four most strongly agreed with statements were the same. However, the elite national athletes more often believed that dietary supplements increased energy and that athletes require them. Prevention of colds and natural supplements being healthier were the items most strongly endorsed by the varsity athletes. The statement agreed with least often by both study groups was that any amount of dietary supplements is safe.

There was a significant difference between the national athletes and students indicated by a Scheffe test regarding the beliefs that natural supplements are healthier and that dietary supplements may help increase energy. There was also a

significant difference between the students and varsity athletes related to the belief that dietary supplements may help to prevent colds.

Table 4.11 Percentage of Respondents Who Agree or Strongly Agree with the Beliefs About Dietary supplements

Beliefs	***National n=72***	***Rank***	***Varsity n=101***	***Rank***	***Students n=131***	***Rank***	***P-value***
Natural supplements Are healthier	71	1	61	1	42	4	0.000
Athletes require Supplements	67	2	59	3	65	2	0.693
Prevent colds	45	3	61	1	34	5	0.038
Feel better if taken	45	3	56	4	56	3	0.474
Increase energy	29	5	41	5	66	1	0.000
Improve appearance	21	6	25	6	24	6	0.958
Difficult to acquire Adequate nutrients From diet	18	7	20	7	15	8	0.363
Less risk in taking Herbs	13	8	18	8	23	7	0.289
Herbs can be taken in Any amount	7	9	6	10	8	9	0.203
Make up for lack of Nutrients from diet	5	11	9	9	5	10	0.600

The Perceived Adequacy of Nutrient Intake by each Study Group

As presented in Figure 4.1, each of the study participants were asked to rate their baseline diet apart from the use of dietary supplements. Specifically, they were asked to identify whether their nutrient intake was poor, adequate or well balanced.

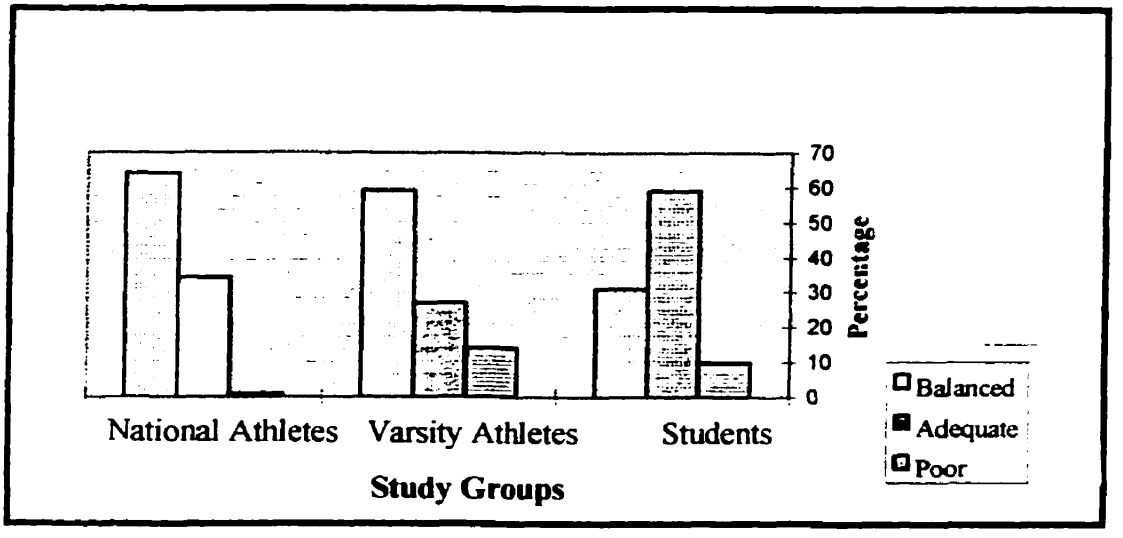

Figure 4.1 Perceived Adequacy of Dietary Intake by each Study Group

Both of the athletic groups were more likely to assess their diet as well balanced than the student study group. Only 1% of the elite national athletes and 14% of the varsity athletes reported having a poorly balanced diet. The student group was more likely to rate their diet as adequate rather than balanced.

Figure 4.2 presents the mean number of dietary supplements used by respondents who rated their diet as balanced, adequate and poor. As the figure shows, the use of dietary supplements was higher if one perceived to have a balanced diet. This was seen most clearly among the elite national athletes.

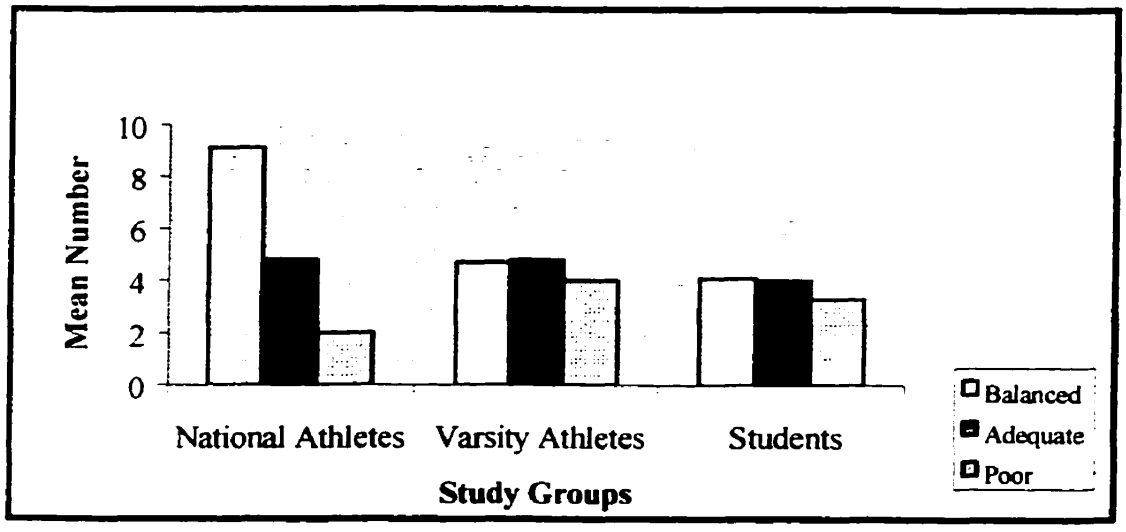

Figure 4.2 Perceived Adequacy of Dietary Intake and the Mean Number of Dietary Supplements Used by each Study Group

The Importance of Adequate Dietary Intake and Areas Lacking Nutrients

Each of the study participants were asked to express how important they perceive their diet to be to general health and wellbeing. A shown in Figure 4.3, each group was most likely to rate its importance as very to somewhat important. Only a small number in each group perceived diet as unimportant. Ten percent of the students were undecided regarding the impact of diet on ones health, which was higher than the athletic groups.

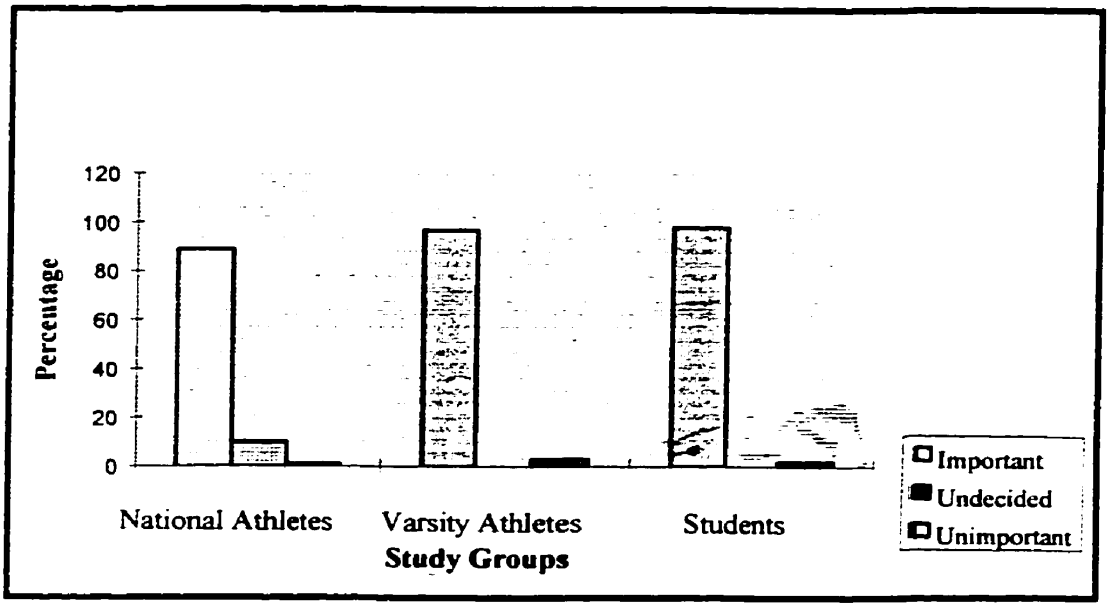

Figure 4.3 Importance of Adequate Dietary Intake Perceived by each Study Group

Figure 4.4 presents the quantity of dietary supplements used by the respondents based on how important they perceived diet to be to their general well being and health.

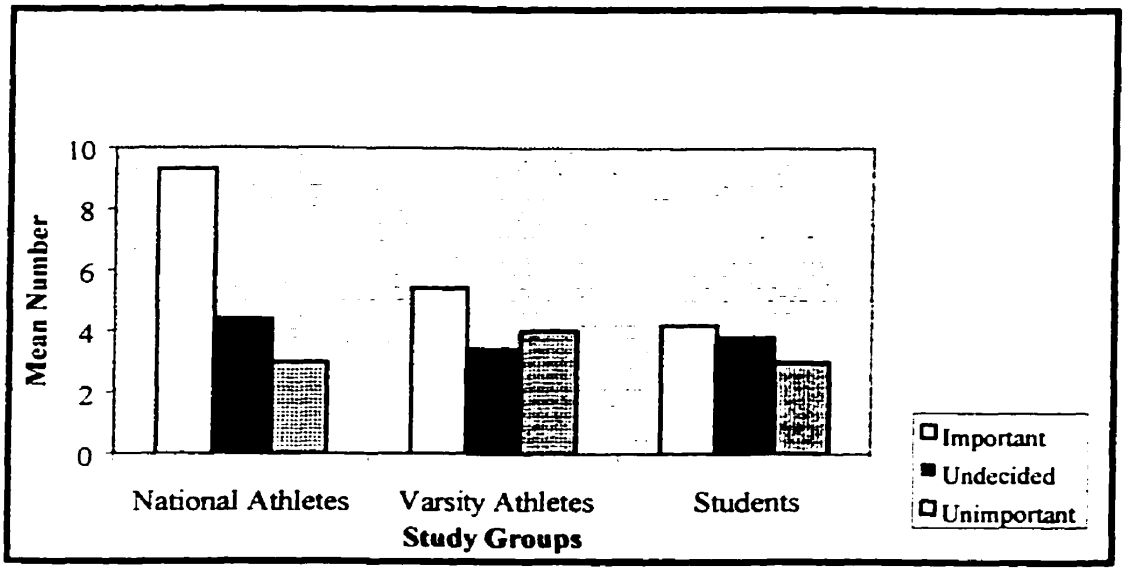

Figure 4.4 Perceived Importance of Diet and the Mean Number of Dietary Supplements Used by each Study Group

The mean number of dietary supplements used was higher among the elite national athletes if one perceived diet to be important to general health. This association is also seen among the students but to a lesser extent. Among the varsity athletes, those who perceived diet to be important also reported using the largest number of dietary supplements (a mean of 5.4 dietary supplements). However those who reported diet as being unimportant used the second largest number of supplements (a mean of 4.0 dietary supplements) as compared to a mean of 3.4 for those who were undecided.

An open-ended item on the questionnaire requested that the respondents identify areas of their diet that they perceive are lacking in adequate nutrients. The overall number of responses was very low as only 5% of the elite national athletes, 12% of the varsity athletes and 16% of the students identified areas lacking in nutrients. Each

of the groups listed vegetables as the primary area of their diets that lack nutrients. The elite national athletes also identified iron and the students identified calcium as other areas that may be lacking.

The Sources of Information That Led to the Use of Dietary Supplements within Each Study Group

Study participants were asked to recall all of the sources of information that they had previously used pertaining to dietary supplements (see Table 4.12).

Table 4.12 Information Sources that Led to Dietary Supplement Use for the three Study Groups

Source	*National n=72 athletes (%)*	*Varsity n=101 athletes (%)*	*Students n=131 (%)*
Coach	69	39	8
Friend	65	73	69
Physician	62	39	40
Dietitian	62	22	19
Magazine	58	46	60
Family	46	45	60
Book	39	25	26
Course	27	12	14
Television	25	24	38
Seminar	19	10	8
Journal	14	15	21
Other	2	6	9
Internet	0	8	11

The elite national athletes listed the largest number of information sources. This study group selected coaches, friends, physicians and dieticians as the most frequent information source. The varsity athletic and student groups identified friend, family and

magazines followed by physicians as their most frequent sources of information. For each of the study groups, friends and physicians were among the most influential sources that led to dietary supplementation.

Confounding Variables

Two potential confounding variables that may have been related to the extent of dietary supplement use were age and gender. However, no statistically significant difference was found in percentage of use among the three study groups. Further, there was no significant difference among the study groups based on age. However, there was a significant difference based on gender and it appears the difference exists within the student study group, as it was more likely that these respondents were female. The student group had the highest percentage of women and the lowest percent of dietary supplement use. There was no statistical difference in dietary supplement use based on gender. Therefore, in our study age and gender do not appear to be confounding variables.

CHAPTER V

DISCUSSION

In this chapter, the results of this study are discussed in comparison to the literature related to dietary supplement use. The strengths and limitations of this study are addressed and recommendations for further research are proposed.

Characteristics of Study Groups

There were no significant differences among study groups relative to age or number of hours spent exercising per week during off-season. However, students were slightly more likely to be female. Although the students exercised significantly less often than the athletic groups, the mean number of hours exercising they reported was very high. This high level of activity may reflect a bias in this random sample, as University of Calgary students interested in health and fitness may have been more likely to participate in this study. The higher than expected level of physical activity reported by this group may have influenced comparisons made between this and the other study groups as the students appeared to be more similar to the athletic groups than one would have thought an average population of university students.

The Use of Dietary Supplements

While, in this study, a positive association seemed to exist between level of competition and increased use of dietary supplements, there was no significant difference in percentage of users among the elite national athletes (70%), the varsity athletes (64%) and the students (62%). An association between physical activity and dietary supplement use has been reported in existing literature (Block et al.,1988). The

percentage of use among athletic groups was higher than the percentage found by Sobal & Marquart (1994) (59% use among elite national athletes and 43% use among university athletes). The higher use among the athletes in our study may be due to the difference in the definition of dietary supplements. Our study included a wider range of dietary supplements than most existing investigations. The percentage of dietary supplement use by the student study group was also higher than reported for the general population as compared to previous studies (Standing Committee on Health, 1998). As previously stated, this group reported being extremely active and slightly more likely to be female than the elite national athletes and varsity athletes. Both of these factors may have influenced the higher use of dietary supplements. Previous literature has reported a positive association between being female and extent of dietary supplement use (Subar & Block, 1990; Slesinski, 1995).

The percentage of dietary supplement use was also reported for each of the sport teams having ten or more participants complete the questionnaire. The varsity track and field team had the highest reported use (85%), followed by the national synchronized swim team (80%). The literature reports that those sports which emphasize muscle strength use dietary supplements most. This would explain the higher use among the track and field athletes as several of their competition events require large amounts of power and strength. The high level of use among the synchronized swimmers may be due to the fact that this sport mainly consists of females. (Subar & Block, 1990; Slesinski, 1995). The level of use may also reflect the endurance required by the athletes and/or the need to supplement a low caloric diet, as a poor diet is often

associated with aesthetic sports. A poor baseline diet among athletes may result in a high use of dietary supplements to ensure adequate nutrient intake. Within teams, the differences in extent of use may be due to a subculture where they may share information on dietary supplements to different degrees. The variances in levels of use should be studied further to determine other contributing factors.

Number of Dietary Supplement Used

Although there was no significant difference among study groups with regards to percentage of users, there was a significant difference in the mean number of dietary supplements used. The elite national athletes used, on average, nearly twice the number of dietary supplements as the varsity athletes and students. Further, of the two elite national teams consisting of more than 10 respondents, both reported the same quantity. The two elite national teams included in this analysis were hockey and synchronized swimming which are different sports by nature, and the athletes likely use dietary supplements for different reasons. Therefore, the large quantity of dietary supplements used, as compared to the other study groups, may be a result of a high level of competition shared by both teams rather than type of sport. The high number of dietary supplements used by these elite national athletes should be investigated further as these athletes may be at risk of toxicity due to high doses and/or negative interactions between dietary supplements.

The varsity athlete and student study group reported using, on average, approximately four dietary supplements within the previous 12 months. Based on the previous literature, one may have predicted that the two athletic groups would have used

a larger number of dietary supplements than the students because of the impact of involvement in sport. This was not the case, most likely due to the high number of hours spent exercising per week in the control group, which may have biased the results.

Types of Dietary Supplements Used

The types of dietary supplements used most often by each of the study groups have been similar to those found in previous studies. Both vitamin C and multivitamins have often been among the most frequently reported dietary supplements in both athletic and general populations. These dietary supplements were among the three most regularly reported dietary supplements in each of the three study groups. As compared to previous studies, this study showed the frequent use of echinacea and ginseng which most likely reflects the recent increase in use of natural health products (Standing Committee on Health, 1998). An inconsistency that exists between this and previous studies was the low level of use of iron, vitamins E, A and B complexes. Considering the common reasons reported for the use of dietary supplements, which include promotion of general health and prevention of illness, one would expect that these dietary supplements would be among the most often used. This was the case in previous studies. In this study iron was the fifth most often used by students and was not included among the top five in either athletic group. The reason for this variance may be the inclusion of a wider selection of dietary supplements in this study, could be the result of recall bias, or may reflect real changes in dietary supplement use.

Unexpectedly, the use of amino acids and protein powders were not among the most often used dietary supplements. Because of their popularity in sales and

the publicity, it was expected that these dietary supplements would have been reported more frequently. Perhaps a different presentation including more attention to protein in the listing of dietary supplements in the questionnaire would have generated different results. A second type of dietary supplement that was not identified as often as would have been expected were recovery aids. Again, the reorganization of the listing of dietary supplements in the questionnaire may influenced reporting.

Some of the dietary supplements that were mentioned by the athletes but were not among the most frequently used supplements include zinc, iron, vitamin E, A and B complexes, chromium, evening primrose, garlic, cayenne and boron. The wide range of dietary supplements used by the athletic groups illustrates the diversity in dietary supplementation practices. Ensuring safe and effective use of dietary supplements through education would be a necessary and difficult task since the athletes would have to be informed about both positive and adverse effects related to the many different types of dietary supplements.

Pattern of Dietary Supplement Use

Among the variables established as patterns of use, duration of use was the only variable consistently completed by the study groups and, therefore, was the only variable analysed. The data suggests that most of the dietary supplements have been used by the varsity athletes and students for a minimum of nine months and by the elite national athletes only slightly less. The slightly shorter duration among the elite national athletes may be a result of interest in a large array of dietary supplements which increases experimentation and the starting and stopping of several dietary supplements

over the previous 12 months.

The relatively long duration of use suggests that among these groups, dietary supplement use becomes routine and is not sporadic. Previous studies have reported that athletes use dietary supplements on a "regular" basis more often than on an "occasional" basis (Sobal & Marquart, 1994). This finding should be further investigated as it may be a result of several factors including observed positive benefits, the hope that there may be positive effects or a commitment to the enhancement of performance and/or general health despite the lack of noticeable benefits.

Reasons for Dietary Supplement Use

The most frequent reason for dietary supplement use according to the Likert type items which measured this variable was improved health for each of the three study groups. The second most popular reason for use among the elite national athletes was enhanced athletic performance whereas for the students and varsity athletes the second most popular reason was increased energy. According to the literature, among athletes the most important reasons for dietary supplementation use were to improve performance, prevent illness, ensure adequate nutrients and provide energy (Sobal & Marquart, 1994; Thomsen et al.., 1987 and Brill & Keane, 1994). Among the elite national athletes and varsity athletes, improved performance and energy were both among the five most strongly supported items and the others were supported to a lesser degree. The student group differed most regarding the use of dietary supplements for enhanced performance, increased muscle mass and enhancement of recovery. The elite national group highly supported these reasons as did the varsity athletes to a slightly

lesser degree. However, the student study group were more likely to report general reasons for use relating to overall well-being. The elite national athletes also reported using dietary supplements at the advice of coaches more often than the varsity athletes.

The elite national athletes supported the largest number of reasons for dietary supplement use as compared to the varsity athletes and students. The elite national athletes showed strong support for seven of the thirteen Likert type items. These Likert items involved reasons for dietary supplement use related to both enhancing performance and general health. The varsity athletes showed the strongest support for three items and all reasons for use related to enhancing athletic performance. As compared to the other groups, the students most strongly endorsed three statements related to reasons endorsing dietary supplement use for the purpose of promoting general health

There appeared to be two distinct categories of reasons for dietary supplement use. These categories are those relating to general health and those relating to enhancing athletic performance. The support of items related to both categories by the elite national athletes may reflect the high number of dietary supplements used by this group. However, the literature does not provide strong support for these two categories of reasons.

Perceived Benefits and Risks

Regarding the general beliefs associated with the use of dietary supplements, the five most supported Likert items were the same for each of the groups. A few respondents in each group supported the item that indicated herbs could be taken in any amount and that natural health product were healthier than manufactured ones. Although in some cases the latter is true, some herbs taken in high dosages can have toxic effects (Ernst, 1998; Shaw et al., 1997). Therefore, misconceptions may exist related to the potential impact of natural health products that should be investigated further.

Detailed data was presented for the perceived benefits and risks associated with the most often used dietary supplements in each of the two athletic groups. Perceptions of benefit were dependent on the dietary supplement under question. For those dietary supplements related to improving general health and/or preventing illness, the benefits associated with their use were also related to general health issues. Dietary supplements such as sport bars, sport drinks and creatine were perceived to be associated with enhanced recovery, increased energy and performance in all study groups.

The risks perceived by each of the athletic study groups were very similar. Both the varsity athletes and elite national athletes reported the terms "none" and "unknown" most often. Regardless of the dietary supplement, respondents rarely identified specific risks. The lack of detailed information provided by both groups may indicate a lack of awareness regarding the potential impact, both positive and negative,

of using the dietary supplements. Education from coaches, physicians, nutritionists and other information sources concerning dietary supplements should be maximized to enhance knowledge and to ensure safe and effective use.

Perceived Adequacy of Nutrient Intake and its Importance

The perceived adequacy and importance of adequate nutrient intake was highest among the elite national athletes. Support from specialized health care providers such as physicians, nutritionist and physiologists along with coaches may increase athletes' awareness related to the importance of diet and may provide additional education to support healthy choices. Both athletic groups reported having a balanced diet more often than the student group. Unexpectedly, the varsity athletes reported a poor diet more often than the other study groups. This is contrary to the perception that athletes may invest energy in balancing their diet to ensure adequate nutrient intake to support athletic performance. Further, access to coaches and other professionals involved with competitive sports may influence them to eat a balanced diet. The student study group was most likely to report an adequate diet and to be undecided of the importance of receiving adequate nutrients, which may be due to a lack of information, motivation or financial constraints.

The Areas of Diet Lacking Nutrients

The number of areas reported lacking in nutrients were highest among students although the varsity athletes perceived having a poor diet most often. The larger number of areas lacking in nutrients for the students may be a reflection of the high number of respondents who were undecided concerning the importance of receiving

adequate nutrients. The lack of concern may result in decreased motivation or effort required to adequately balance one's diet. Vegetables were most often perceived to be lacking in each of the study groups' diet. Further, in each study group, unhealthy eating habits including skipping meals, eating fast food too often and over eating was the second most popular response.

Sources of Information Leading to the Use of Dietary Supplements

The sources reported by the elite national athletes were more specialized than those reported by the varsity athletes and the student study group and included coaches, physicians and dieticians. The varsity athletes and students more often reported friends, magazines and families as important sources which influenced their use of dietary supplements. This question illustrated an important difference between the elite national athletes and varsity athletes. This information helps to identity avenues that can maximize individuals' accessibility to existing information and new knowledge regarding safe and effective use of dietary supplements.

Strengths and Limitations

Strengths

An important strength of this study was the use of the student control group as literature to date had rarely included one. The inclusion of the two athletic groups as well as the students allowed for increased understanding of results. For example, the number of dietary supplements used was interesting to compare among groups since the varsity athletes were more similar to the students than to the elite national athletes. Further, each of the groups seemed to have different reasons for dietary

supplement use. Although the differences between groups were apparent in the examples above, in several cases the groups seemed more similar than different. Some important examples of the similarities include the extent of dietary supplement use among groups and the level of activity within groups. The control group seemed more similar to the varsity athletes than to the elite national athletes. This was the case in relation to the number of dietary supplements used and the duration of use. More pronounced differences between the students and athletes in relation to dietary supplement use may have existed if the control group more closely resembled a general population of university students who are likely less active.

The relatively large number of respondents included in this study was a strength which addressed a weakness in previous studies. In previous research, a large portion of studies consisting of less than fifty participants. The larger number of participants in this study helped to understand the findings.

A final strength of this study was the inclusion of a wide range of dietary supplements. A gap in the existing literature was the lack of inclusion of natural health products, carbohydrates, meal replacements, protein powder and miscellaneous dietary supplements. This study addressed this gap and new information regarding the frequent use of Echinacea and Ginseng was obtained. Further information is needed regarding the patterns of use relating to these dietary supplements and the knowledge athletes have obtained pertaining to them.

Limitations

The low response rate and the differences in response rate was a primary limitation of this study. The method by which the athletes were accessed was difficult and time consuming. The several attempts made to access the athletes through their coaches were often unsuccessful. Although attempts made in person rather than through telephone calls and faxes would have increased participation, this type of recruitment may be interpreted as coercion.

The potential bias in the student control group was also a primary limitation of this study as pertaining to the high number of hours spent exercising per week by this group. The students level of involvement with exercise was more similar to the athletic groups than was expected. This similarity may have impacted the comparisons between this group and the other study groups.

The small number of participants in some of the sport teams prevented analysis based on sport team affiliation. In cases such as speed skating and swimming, very few team members responded to the questionnaire. In instances where the investigator was able to meet with the teams, the number of responses was much greater. Two examples of this were the hockey and the wrestling teams.

A final weakness of this study was the lack of detailed information concerning patterns of dietary supplement use. This was also a weakness in existing literature and requires further investigation. This information is of a very specific nature, which may have been difficult to recall and would have required further time and effort to provide. During the pre-testing phase of the development of the questionnaire some

problems in clarity were detected and corrected. However, difficulties persisted regarding the length and a lack of clarity related to the instructions. A similar chart, although shorter, regarding the reasons for dietary supplement use was completed sufficiently as compared to the chart associated with the patterns.

Recommendations for Future Research

Need for Larger Studies

Although subgroup analysis was not an objective of this study, several coaches indicated that information presented based on teams would be useful. In future studies, ensuring large sample sizes for each sport team would allow for this type of analysis. Although in some cases entire teams were represented, in some situations several more athletes could have been recruited. This is the case in regards to the national speed skating and varsity swimming teams.

Safety

Future research should address the potential interaction of supplements that athletes appeared to be using simultaneously. Information is needed to determine if present practices by the athletes are safe and effective. Attention should be given to the possibility of toxicity and contraindications. This would be particularly important in regards to natural health products since the common perception is that they are very safe and natural. The potentially potent impact these products can have on ones health may not be fully recognized. An important issue for the athletes also related to the large number of dietary supplements used is the possibility of unknowingly consuming a

banned or restricted substance. The athletes may be particularly at risk by using natural health products in which individuals may be unaware of the contents of certain supplements.

Baseline Diet and Dietary Supplement Use

The relationship between baseline diet and the use of dietary supplements should be investigated further as it seems that those who perceive to be receiving adequate nutrients are those using dietary supplements. The elite national athletes reported having a balanced diet, and perceived diet as important to ones health more often than the other groups. Further, this group used dietary supplements most frequently and used the largest number of supplements. Those individuals that may require dietary supplements as their baseline diet is perceived to be lacking appeared to use dietary supplements less often.

Questions related to baseline diet relied on respondents perceptions. Baseline diet would be better investigated if respondents agree to complete a food diary. The use of a diary, although cumbersome for the participants, would promote more accurate and detailed findings.

Accessing Valid Information

Finally, the most accessible and effective source of information regarding dietary supplements should be identified for each study group. It appears that coaches or nutritionists may be the most used sources for the athletes whereas physicians or mass media may be used more by the students. These distinctions should be studied further to ensure that as future knowledge concerning dietary supplements is acquired, the most

efficient ways to disperse the new knowledge among participants will be known.

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APPENDIX A
QUESTIONNAIRE

THE UNIVERSITY OF
CALGARY
Faculty of Medicine
Department of Community Health Sciences

The Use of Dietary Supplements Among National Athletes and Varsity Athletes

Investigators: Andrea Malekos and a supervisory committee which includes Dr. M. Verhoef, Dr. W. Meeuwisse, Dr. D. Smith and K.A. Carter-Erdman

The following questionnaire is part of a research project to determine the percentage of dietary supplement use among elite national athletes registered at the National Training Centre, varsity athletes at the University of Calgary and a control group consisting of non-athletic University of Calgary students. The purpose is also to investigate the patterns of use, reasons for use and the perceived benefits and risks associated with the use of dietary supplements and not the practices of doping or the use of illegal supplements. The research is being conducted by Andrea Malekos with the guidance of Dr. M. Verhoef and supervisory committee members including Dr. W. Meeuwisse, Dr. D. Smith and Ms. K. A. Carter Erdman.

The use of dietary supplements is important to understand as, to date, little is known for Canadian athletes and university students.

The information obtained will help health care providers and coaches become more aware of the dietary supplements being used and their patterns of use. The information will also provide guidance for future research.

We appreciate your time in completing this questionnaire, as your participation is vital to the success of this study. All of the information you provide will be completely anonymous. You can not be linked to the questionnaire you complete. Once the questionnaires are collected, they will be kept in a locked cabinet.

The results of the questionnaire will be available by contacting Andrea Malekos, Dr. Marja Verhoef, or through possible future publications. In future publications, the data will only be presented in aggregate and all sports will be classified as endurance, power, intermittent or aesthetic. Therefore the use of specific dietary supplements within a certain sport will not be reported.

If you have any questions concerning this study please feel free to contact Andrea Malekos at (403) 220-7205

Thank you for your time and cooperation!

Andrea Malekos

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Telephone: 403-220-4286, Fax: 403-270-7307

Demographics

Are you: ☐ male
☐ female

What is your height? _____cm _____ft

What is your weight? _____kg _____lb

Are you: ☐ a registered national athlete
☐ an athlete on a University of Calgary sports team
☐ neither

Are you a student at the University of Calgary?
yes ☐ no ☐

What year were you born? _____

Which sport you are primarily involved in?
_____

On average, what is the length of your competition event? _____ (sec/min/hours).
If you are involved in an intermittent sport (eg. basketball, volleyball) please explain the length of play time during a game on the back of the sheet.

Please list the months of the year you are in-season and the months you are off-season as well as the number of hours you spend training per week.

	Months	Number of hours/week
In-season	_____	_____
off-season	_____	_____

Supplement Use

1) In the previous twelve months, have you used one or more dietary supplement(s)?
For a list of supplements see insert.
yes ☐ no ☐
(If yes, please go to question #4; if no, please answer the following questions:)

If no

2) Have you ever considered taking a dietary supplement?
yes ☐ no ☐

3) If no, please explain why you have not used a dietary supplement within the past twelve months.
_____
_____
_____

If you answered no to having used a dietary supplement within the past twelve months, your participation in this study is complete. Thank you for your time and cooperation.

Patterns of use

4) Please circle all of the numbers corresponding to the dietary supplements you have used in the previous twelve months on the separate sheet provided.

The following grid asks for information about the patterns of use for the supplements you have used the most often during the past 12 months. When filling out the duration column please refer to your most recent use of each supplement.

5) For your most regularly used dietary supplements, please specify the following information:

in-season off-season

Supplement number (from insert)	How long have you used the supplement? starting month	ending month	Average Frequency of use per week	months of the year you used the supplement(s)	Source that lead to use of supplement (use titles; ie. coach, doctor, friend, ads)
32 in-season	Feb 1'97	Feb 8'97	7 Times	June, Nov, Feb	My Coach
off-season	June 1'97	June 10'97	7 times		
in-season					
off-season					
in-season					
off-season					
in-season					
off-season					
in-season					
off-season					
in-season					
off-season					
in-season					
off-season					

Information onDietary Supplements

Please specify all of the sources from which you have received information concerning dietary supplements.

magazines ☐ journals ☐ friends ☐
books ☐ courses ☐ family ☐
physicians ☐ seminars ☐ internet ☐
coaches ☐ television ☐ dietitian/nutritionist ☐
other_____

Listing of Dietary Supplements

Please circle the number corresponding to the supplement(s) you have used in the previous 12 months.

Vitamins

01 multivitamin
02 beta-carotene
03 E
04 D
05 K
06 A
07 B-1(Thiamin)
08 B-2(Riboflavin)
09 B3(Niacin & Niacinamide)
10 B-6(Pyridoxine)
11 B-12(Cobalamin)
12 B Complex
13 C(Ascorbic Acid)
14 folic acid
15 other(specify)

_____
_____

Minerals

16 multivitamin & mineral
17 multimineral (Colloidal)
18 Calcium
19 Zinc
20 Iron
21 Phosphorus
22 Magnesium
23 Chromium
24 Selenium
25 Potassium
26 other(specify)

_____
_____

Essential Fatty Acids

27 omega-3(fish oil)
28 omega-6(evening primrose)
29 MCT Oil
30 other(specify)

_____
_____

Herbs

31 garlic
32 echinasea
33 spirulina(green algae)
34 Ginseng
35 aloe
36 slippery elm
37 cayenne
38 other(specify)

_____
_____

Carbohydrates

39 sport drinks (Egs. Gatorade, Powerade, AllSport)
40 sport gel/ bars
41 carbo loading
42 carbohydrate recovery drink
43 other(specify)

_____
_____

Amino Acids

44 Glutamine
45 individual
46 mixture or other(specify)

_____

Weight Gain

48 Arginine
49 Ornithine
50 skim milk powder
51 Boron
52 protein powders
53 Smilax
54 Soy Whey
55 other(specify)

_____
_____

Weight Loss

56 weight loss powders
57 chromium compounds
58 Vanadyl Sulphate
59 other(specify)

_____

Other

60 meal replacements (drinks or bars)
61 coenzyme Q-10
62 shark cartilage
63 Creatine
64 other(specify)

_____

Reasons For Use And The Benefits And Risks Associated With Dietary Supplements

6) Please fill out the following grid for the supplements you have used most regularly during the past 12 months.

Supplement number (see pg 3)	Reasons for use	How would you rate your knowledge of these supplements poor, average or above average?	Benefits from using these supplements	Risks of using these supplments

7) When using dietary supplements, please identify how important you feel the following reasons are.

	very important	somewhat important	not important
a. They make me feel healthier.	☐	☐	☐
b. My doctor told me to take them.	☐	☐	☐
c. They give me energy.	☐	☐	☐
d. They help cure my colds.	☐	☐	☐
e. They help my complexion.	☐	☐	☐
f. I don't eat a balanced diet	☐	☐	☐
g. They enhance my performance in sports.	☐	☐	☐
i. I take them to be on the safe side.	☐	☐	☐
h. They help me lose weight	☐	☐	☐
j. My coach told me to take them.	☐	☐	☐
k. They help build my muscles.	☐	☐	☐
l. They help me gain weight.	☐	☐	☐
m. They enhance my recovery after a practice or competition.	☐	☐	☐

8) Please indicate how strongly you feel about the following statements regarding beliefs about supplement use. Please check the appropriate box.

	strongly disagree	disagree	neither	agree	strongly agree
a) Natural supplements are better than manufactured ones.	☐	☐	☐	☐	☐
b) Most athletes need supplements	☐	☐	☐	☐	☐
c) If a person feels tired and run down, a person needs vitamins or minerals.	☐	☐	☐	☐	☐
d) People who take vitamin C get fewer and less severe colds.	☐	☐	☐	☐	☐
e) Supplements can be taken in any amount	☐	☐	☐	☐	☐
f) If a person skips a meal, he/she can make it up with a supplement.	☐	☐	☐	☐	☐
g) It is difficult to get enough vitamins and minerals from ordinary food.	☐	☐	☐	☐	☐
h) Herbal supplements can be taken more often and in greater amounts than manufactured supplements.	☐	☐	☐	☐	☐
i) Supplements make people feel better physically.	☐	☐	☐	☐	☐
j) Supplements can improve your appearance.	☐	☐	☐	☐	☐
k) Risks associated with herbal supplements are minimal.	☐	☐	☐	☐	☐

Background Information

9) How important is your diet to your health?

very important ☐ important ☐ undecided ☐ not important ☐

10) How would you rate your basic diet, apart from supplement use?

poor ☐ adequate ☐ well balanced ☐

11) Please specify any areas in which you perceive your diet is lacking

_____

_____

Thank you for participating in this study!