Intake of dietary supplements is widespread among athletes in developed countries. This study evaluated the use of dietary supplements in athletes from a developing country. Dietary supplementation practices of 113 national-level athletes age 15–35 yr in Sri Lanka were assessed. All athletes from track-and-field, badminton, football, swimming, cycling, and karate squads who consented to participate in the study were administered an anonymous questionnaire by an interviewer. Information on number of supplements taken, frequency of use, nature of product, rationale, sources of advice, and reasons for taking supplements was obtained. Most athletes (94%) consumed dietary supplements. On average, 3.7 products/day were consumed. Footballers had significantly lower intake of supplements than other athletes (footballers 71%, others 98%; \( p < .05 \)). They also consumed fewer products per day (footballers 0.7, others 3.5; \( p < .05 \)). Popular supplements included multivitamins, vitamin E, calcium, energy foods and drinks, and creatine. Multiple supplement use was common, with 29% athletes taking 4 products/day. The athletes sought advice on supplement use from sports doctors (45%), team coaches (40%), or friends (15%). Most took supplements to improve performance (79%), and 19% claimed to take supplements to improve their overall health status. Dietary supplement use is widespread among national-level Sri Lankan athletes. The ad hoc use of supplements indicates that educational intervention in the sporting community is essential.

**Keywords:** multivitamins, creatine, nutritional education

Adequate nutrition and appropriate training are essential factors in successful athletic performance. As an adjunct to nutrition received from the regular diet, some athletes use dietary supplements to enhance their performance (Froiland, Koszewski, Hingst, & Kopecky, 2004; Nieper, 2005). Scientific reports document the increasing use of supplements, as well as intake of multiple supplements, among athletes from developed countries. Studies indicate that a high percentage of athletes at college, as well as secondary schools, regularly consume one or more nutritional supplements including herbal products (Crowley & Wall, 2004; Herbold, Visconti, Frates, & Bandini, 2004). A study of elite Singaporean athletes found that they consumed 59 different varieties of supplements (Slater & Tan, 2003). However, data on intake of dietary supplements among athletes from developing countries, which are culturally and economically different from developed countries, are limited.

Dietary supplements can include vitamin and mineral supplements, as well as specific herbal or botanical products, enzymes, or extracts from organs and glands (U.S. Food and Drug Administration, 2009). In recent years, health professionals have raised concerns regarding poor regulation of dietary supplements (Calfee & Fadale, 2006; Morrow et al., 2005). Regulations and availability of information regarding safety and possible long-term side effects are significantly less than for conventional foods and medicinal products (Calfee & Fadale; Morrow et al.). Many dietary supplements contain pharmacologically active ingredients capable of causing serious adverse events, especially if taken in combination with other supplements or in incorrect doses (Morrow et al.). Supplements could also contain or be contaminated by substances that may be banned by the World Anti Doping Agency (WADA) or cause significant morbidity and mortality (Haller & Benowitz, 2000; Pipe & Ayotte, 2002).

Causing special concern are reports of large numbers of children and adolescent athletes consuming dietary supplements for improved athletic performance (Calfee & Fadale, 2006; Nieper, 2005). The use of creatine, marketed as a safe ergogenic aid for adults, was found to be widespread among adolescents and school athletes in the United States even though current recommendations advise against it in individuals under 18 years of age (McGuine, Sullivan, & Bernhardt, 2001; Metzl, Small, Levine, & Gershel, 2001). A study on intake of dietary supplements in Korean teenagers revealed that their mean vitamin and mineral intakes often exceeded tolerable upper intake levels (Kim, Han, Zhu, & Keen, 2003). Such practices could lead to health-damaging effects in young athletes.
As in other countries, regulations regarding the import and sale of dietary supplements are not as stringent as for conventional drugs in Sri Lanka, and a wide range of herbal, hormonal, and synthetic supplements is available, with new substances constantly being introduced into the market (Galappatthy, Nanayakkara, Wijeyabandara, & Fernandopulle, 2005). Currently, there is no information on the effect of easy access or availability of such products on dietary supplement intake among athletes in Sri Lanka. Our aim was to assess dietary supplement intake and gather data on the varieties of supplements used, rationale for taking such supplements, sources of information, and perceived benefits or disadvantages of dietary supplements among national-level Sri Lankan athletes.

Methods

The study population consisted of national-level athletes \( (N = 113) \) from across a spectrum of different sports chosen for participation at the 2006 South Asian Federation games. These athletes were in supervised training squads selected to represent Sri Lanka at international sports events and had been training in their chosen sport for >2 years. All athletes from the badminton, football, swimming, cycling, and karate squads consented to participate and were administered the questionnaire. Although 14 track-and-field athletes refused consent because of lack of time to answer the questionnaire, 100% representation was obtained from athletes in all the other training squads. The anonymous, interviewer-administered questionnaire was prepared using the currently available categorization of dietary supplements (Australian Institute of Sports Nutrition, 2007) and availability and accessibility to dietary supplements in the local market (unpublished observations). It was pretested on 12 university athletes before being administered to the study participants. The questionnaire obtained information on socioeconomic and education data, dietary advice received by athletes, number and type of dietary supplements consumed, sources of information regarding supplements, reasons for use, and knowledge regarding dietary supplements during the past 12 months before the interview. Socioeconomic-status cutoffs were those used by the Department of Census and Statistics, Sri Lanka. Adequacy of knowledge was assessed by questioning participants regarding the nature of products consumed, dosage, benefits or side effects, satisfaction regarding their current knowledge on dietary supplements, and awareness of whether the products and ingredients they currently consumed were allowed by the WADA. The definition of a dietary supplement in the Health and Education Act, U.S. Public Law 1994, 103-417 (U.S. Food and Drug Administration, 2009), was used throughout this study.

Ethics

Ethical clearance was obtained from the ethics review committee of the Faculty of Medicine, University of Colombo, Sri Lanka. Verbal informed consent was obtained from all athletes after they were informed of the following: purpose of the questionnaire, use of obtained data to create education programs on awareness regarding beneficial and adverse effects of dietary supplements, assurances of confidentiality and anonymity of the questionnaire, and storage of data.

Statistical Methods

The Statistical Package for Social Sciences 15.0 for Windows was used for data entry and analysis (SPSS Inc., Chicago). Descriptive data are reported as \( M \pm SD \) or frequencies and percentages. Chi-squared tests and ANOVA were used to compare differences in variables between participants. The level of significance was fixed at \( p < .05 \).

Results

Participants

One hundred thirteen athletes 15–35 years of age completed the questionnaire. The overall response rate was 88%. The within-sport response rate was 100% for all selected teams except the track-and-field team, in which the response rate was 67%. The only nonresponders were 14 track-and-field athletes. Selected sociodemographic data on the athletes are presented in Table 1.

Supplement Intake

Most athletes (93.8%) reported using dietary supplements. Supplement intake was similar between males and females. Data on supplement intake are presented in Table 2. Average use was \( 3.7 \) products · day\(^{-1} \) · athlete\(^{-1} \) (range 0–7 products/day). Athletes consumed multiple supplements, with 29% consuming four products/day and 10% consuming six products/day (Figure 1). The types of dietary supplements consumed by athletes are indicated in Figure 2. Popular supplements included multivitamin preparations, vitamin E, calcium, energy foods and drinks, and creatine.

Sources of Supplements

Forty athletes (42.4%) received multivitamins, calcium, or creatine free of charge from the Sports Medicine Institute of the Ministry of Sports, and 48.1% purchased their supplements. Almost two thirds of unemployed athletes (63%) purchased dietary supplements. Athletes who used herbal supplements obtained them from Sri Lankan traditional physicians.
Table 1  Selected Sociodemographic Data of the Athletes

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>15–35 years</th>
<th>3–5 hr/day (6 days/week)</th>
<th>n = 27</th>
<th>n = 76</th>
<th>n = 10</th>
<th>n = 27</th>
<th>n = 54</th>
<th>n = 32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age range</td>
<td>15–35 years</td>
<td>3–5 hr/day (6 days/week)</td>
<td>n = 27</td>
<td>n = 76</td>
<td>n = 10</td>
<td>n = 27</td>
<td>n = 54</td>
<td>n = 32</td>
</tr>
<tr>
<td>Supervised training hours</td>
<td>3–5 hr/day (6 days/week)</td>
<td>n = 27</td>
<td>n = 76</td>
<td>n = 10</td>
<td>n = 27</td>
<td>n = 54</td>
<td>n = 32</td>
<td></td>
</tr>
<tr>
<td>Education (n)</td>
<td>completed primary school</td>
<td>n = 27</td>
<td>n = 76</td>
<td>n = 10</td>
<td>n = 27</td>
<td>n = 54</td>
<td>n = 32</td>
<td></td>
</tr>
<tr>
<td></td>
<td>completed secondary school</td>
<td>n = 27</td>
<td>n = 76</td>
<td>n = 10</td>
<td>n = 27</td>
<td>n = 54</td>
<td>n = 32</td>
<td></td>
</tr>
<tr>
<td>Economic status (income)</td>
<td>&gt;U.S.$300/month</td>
<td>n = 27</td>
<td>n = 76</td>
<td>n = 10</td>
<td>n = 27</td>
<td>n = 54</td>
<td>n = 32</td>
<td></td>
</tr>
<tr>
<td></td>
<td>U.S.$100–300/month</td>
<td>n = 27</td>
<td>n = 76</td>
<td>n = 10</td>
<td>n = 27</td>
<td>n = 54</td>
<td>n = 32</td>
<td></td>
</tr>
<tr>
<td></td>
<td>U.S.$50/month</td>
<td>n = 27</td>
<td>n = 76</td>
<td>n = 10</td>
<td>n = 27</td>
<td>n = 54</td>
<td>n = 32</td>
<td></td>
</tr>
</tbody>
</table>

Table 2  General and Supplementation Data of the Athletes

<table>
<thead>
<tr>
<th>Type of Sport</th>
<th>Track and field</th>
<th>Badminton</th>
<th>Football</th>
<th>Swimming</th>
<th>Cycling</th>
<th>Karate</th>
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</thead>
<tbody>
<tr>
<td>Number</td>
<td>113</td>
<td>29</td>
<td>23</td>
<td>18</td>
<td>23</td>
<td>11</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>73</td>
<td>12</td>
<td>13</td>
<td>18</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>female</td>
<td>40</td>
<td>17</td>
<td>10</td>
<td>0</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Athletes age &lt;18 years, n</td>
<td>27</td>
<td>0</td>
<td>7</td>
<td>2</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Athletes consuming supplement, n</td>
<td>106 (93.8%)</td>
<td>28 (96.6%)</td>
<td>23 (100%)</td>
<td>12 (70.6%)</td>
<td>23 (100%)</td>
<td>11 (100%)</td>
</tr>
<tr>
<td>Products consumed per athlete per day, M ± SD</td>
<td>3.7 ± 1</td>
<td>4.3 ± 1</td>
<td>2.4 ± 1</td>
<td>0.7 ± 0.7</td>
<td>3.4 ± 1</td>
<td>3.6 ± 1</td>
</tr>
<tr>
<td>Athletes consuming creatine, n</td>
<td>31</td>
<td>19 (61.2%)</td>
<td>2 (6.4%)</td>
<td>2 (6.4%)</td>
<td>3 (9.6%)</td>
<td>3 (9.6%)</td>
</tr>
</tbody>
</table>

*Significantly lower percentage of footballers than in other sports (p < .05). *Significantly lower intake of dietary supplement products per day than in other sports (p < .05). *Significantly higher intake of creatine than in other athletes (p < .05).

**Figure 1** — Consumption of supplements by athletes.
Differences in Supplement Use

No statistically significant associations in age or gender were seen between athletes taking supplements and those who did not. Footballers had lower rates of supplement intake than athletes in other sports (Table 2). Footballers were also of lower socioeconomic and educational status than the other athletes ($p < .05$). Paucity of information on dietary supplements because of lack of access to the central sports unit and poor financial resources were reasons given for not taking supplements. Older athletes (age 25–35 years) consumed significantly more supplements than athletes under 18 years of age (4.1 vs. 2.7 products/day, $p < .05$). Only 2 athletes younger than 18 years used creatine, whereas 29 athletes over 18 years used it regularly. Creatine use was significantly higher ($p < .05$) among track-and-field athletes (68%) than in other sports (8%). No other significant associations were seen in type of supplement use and age, sport type, or gender.

Information on Diet and Dietary Supplements

Only 5 athletes obtained specialized dietary advice from registered nutritionists. Others received general advice regarding a healthy diet from sports doctors (45%) or team coaches (48%). There was no difference in supplement use between those who had consulted a nutritionist and those who had not. The 7 athletes who did not use supplements had not received any dietary advice. Advice on dietary supplements was received from sports doctors (45%), team coaches (40%), or friends and family (15%). No athlete listed sources of information regarding dietary supplements as print media, television, or the Internet. The number of supplements consumed per day, satisfaction with adequacy of information regarding supplements, or awareness regarding prohibited substances did not differ between athletes irrespective of their source of information on supplement intake. The 9 athletes consuming iron supplements were unaware of their iron status. Only 16% of all athletes were aware of the existence of a list of products prohibited by the WADA. Only 2 athletes were aware that consuming dietary supplements could cause health risks. Just under a third (27.3%) of athletes were satisfied with the adequacy of information received.

Reasons for Consuming Dietary Supplements

Most athletes (79.2%) took supplements to enhance performance, and 19.8% consumed supplements to improve their general health status. There were no significant differences in social indicators, education, sport, nature of product, or number of supplements ingested between athletes taking supplements to enhance performance and those who took them to improve health.
Dietary Supplements in Athletes

Discussion

Intake of dietary supplements was widespread among athletes from selected national sports teams in Sri Lanka. The high percentage of athletes ingesting supplements (94%) is comparable to data from developed countries (Froiland et al., 2004; Nieper, 2005; Slater & Tan, 2003). However, although most athletes were taking multiple supplement products, supplement intake per day was less than reported in other studies (Froiland et al.; Nieper; Slater & Tan). Track-and-field athletes had the highest supplement intakes, and the lowest intake was reported by footballers. This discrepancy could be ascribed to footballers being of lower socioeconomic status and having less access to central resources and knowledge than track-and-field athletes.

Many athletes appeared to be taking supplements on an ad hoc basis. With a number of athletes consuming multiple products, there is a possibility of exposure to harmful levels of supplements or interactions causing adverse health outcomes (Calfaee & Fadale, 2006; Pipe & Ayotte, 2002). Interactions between dietary supplements and other nutrients may unduly restrict absorption of some nutrients, for example, calcium and iron (Gleerup, Rossander-Hulthen, Gramatkovski, & Hallberg, 1995). Because the long-term effects of taking multiple dietary supplements on a daily basis are not well known, supplements should be used with caution and only after careful evaluation of each product for safety. The indiscriminate use of supplements by these athletes is cause for concern.

Most athletes were taking dietary supplements to enhance athletic performance. However, most dietary supplements consumed by these athletes, such as multivitamin preparations, amino acids in energy foods and drinks, or herbal products, have not been shown to have ergogenic effects on athletic performance (Terjung, et al., 2000; Wiles, Coleman, Tegerdine, & Swain, 2006). Furthermore, almost 90% of athletes were consuming mineral and multivitamin supplements to boost athletic performance despite having no information regarding their micronutrient status. Vitamin and mineral supplementation is known to benefit athletes only if they are deficient in particular nutrients (Fry et al., 2006; Singh, Moses, & Deuster, 1992). Although 9 athletes took iron supplements (including 3 female athletes), none were aware of their iron status. These facts indicate that use of certain dietary supplements was lacking any rationale. Many athletes also claimed to consume energy foods or drinks. The past few years have seen an increased availability of energy foods and drinks with ergogenic claims in Sri Lanka (unpublished observations). Indiscriminate use and the high level of consumption of such products are cause for concern.

Nearly 60% of athletes indicated that they used nutritional supplements on advice given by their team coach or family members, who are likely to be an inadequate source of knowledge. Athletes who obtained advice from sports doctors were not different from others in terms of number or type of supplements consumed, reasons for intake, and satisfaction regarding knowledge on supplements. Poor knowledge, even among athletes given advice from the central sports medicine unit, could be attributed to the fact that many athletes admitted taking additional products on advice of the team coach or friends after obtaining some dietary supplements from the unit. These facts emphasize the importance of education regarding dietary supplements for athletes, as well as other sports personnel.

Only a few athletes had obtained specialist nutritional advice regarding their diet. The main concern of athletes in this study was to supplement their diet with vitamins, minerals, and other supplements rather than concentrate on improving their regular diet. Thus, the possibility exists of key dietary issues and factors that definitely improve performance and health, such as regular consumption of nutrient-dense foods and proper pre- and postevent nutrition, being neglected. Furthermore, unemployed athletes may purchase dietary supplements at the expense of regular nutritious foods. This underscores the importance of athletes being advised by a qualified nutrition professional before embarking on a dietary supplementation regimen. When this option is unavailable, it is imperative for sports doctors and team coaches to be aware of the importance of a healthy diet for athletes and the appropriate use of dietary supplements. There were a number of limitations to the study. We did not analyze the diets of the athletes and therefore were not able to assess whether intake of some supplements was warranted. Furthermore, we did not assess sports doctors’ and coaches’ knowledge of dietary supplements and their use by athletes. Including a questionnaire for sports personnel would have given greater insight into the supplementation behavior of athletes.

Several of our findings were particularly encouraging in contrast to data reported from developed countries. Athletes in Sri Lanka were only using nine varieties of supplements, of which four were vitamins and minerals, in marked contrast to athletes in the United States (12–15 varieties), the United Kingdom (17 varieties), Singapore (59 varieties) as reported by Herbold et al. (2004), Nieper (2005), and Slater and Tan (2003). The limited range of supplements available in Sri Lanka, poor financial status of many athletes, and lack of exposure to other sources of information such as print media or the Internet are possible contributory factors to the lower number of products used. Furthermore, the number of athletes reporting intake of herbal supplements was surprisingly lower than those reported from other studies (Herbold et al.; Slater & Tan). This is a key positive finding, because herbal supplements are unregulated in most countries and more likely to be contaminated, leading to side effects or positive doping tests (Catlin et al., 2000). Herbal remedies are usually used as treatment for illnesses rather than as dietary supplements in Sri Lanka, which is probably the cause of low levels of intake by athletes. Moreover, only 2 of 27 adolescent athletes <18 years of age used creatine, in marked contrast to other studies in which a high percentage of adolescents reported...
taking creatine (Pipe & Ayotte, 2002; Metzl et al., 2001). Sri Lanka appears to be in the early stages of use and market promotion of dietary supplements. Now would be an ideal time to regularize use of dietary supplements by educational interventions in the sporting community.

The results of this study offer some insight into trends in supplement use among sportsmen and -women in a developing country. Compared with data from other countries, athletes in Sri Lanka were taking fewer varieties of supplements, with younger athletes taking fewer products. Most supplements taken by these athletes were multivitamin and mineral products. The knowledge on dietary supplements was inadequate, and the fact that most athletes were dissatisfied with their knowledge on dietary supplements indicates an opportunity to educate the extended sporting community including athletes themselves. Creating increased awareness and knowledge of the need to be informed of potential benefits and adverse effects of dietary supplements would lead to better health and nutrition practices among athletes. According to information from other studies, athletic trainers, family, and media are most likely to influence young athletes regarding use of dietary supplements (Herbold et al., 2004; Nieper, 2005; Slater & Tan, 2003). In Sri Lanka, trainers and family members appeared to have a great influence on athletes’ supplement intake. Data from this research could form the basis for developing and implementing targeted education programs for sports personnel.

References