

### Introduction

The use of dietary supplements is increasingly reported globally, particularly amongst athletes [1-3]. Many studies have shown that 40-100% of athletes typically use supplements, depending on the type of sport and the level of competition [4]. The most popular supplements consumed by athletes are vitamins and minerals, sports drinks, energy bars, and protein supplements [5-7]. However, the supplementation practices of Asian athletes remain relatively unknown. Kim and Keen [8] reported that 35.8% of Korean adolescents attending athletic high schools consumed vitamin and mineral supplements during the past 12 months. Moreover, Slater et al. [9] reported that 77% of Singaporean athletes consumed one or more dietary supplements during the previous 12 months.

The most common reasons for supplement use are to enhance performance, improve general health and immune function, and achieve better recovery from training [1,6,8]. However, some athletes are not aware of the active ingredient(s) or the amount of those ingredients in the supplements they use. Consuming multiple supplements may increase the risk of exceeding the recommended levels of specific substances or result in interactions between the ingredients, which may cause adverse health outcomes [4]. Furthermore, dietary supplements contaminated by doping agents are common. Geyer et al. [10] reported that 14.8% of 634 supplements they tested contained anabolic androgenic steroids not declared on the label, which may result in positive doping results. In addition, previous studies have identified family and friends, coaches, fellow athletes, doctors, dietitians, the Internet, and magazines as the most common sources of information used for choosing supplements [9,11]. The validity of some of these sources of information is questionable.

### Objective

The objectives of this study were to 1) determine the prevalence and type of supplement use; 2) determine the reasons for supplement use; 3) evaluate knowledge about supplements and determine the sources of supplement information; and 4) determine whether factors such as age, sex, and the number of years of training affect supplement use and the choice of supplement.

### Methodology

#### Participants

All full-time and part-time athletes training at the Hong Kong Sports Institute were potential participants in this study. Before answering the survey questions, the athletes were informed of the protocol and purpose of the study, and written consent was obtained for their participation in the study.

#### Overall study design

A questionnaire was developed based on questionnaires used in previous studies assessing athletes' dietary supplement use [7-10,12-14]. After modifying the questionnaire in accordance with the recommendations of research staff without a background in nutrition, a final draft was critiqued by dietitians. The questionnaire included the following five parts: 1) if and how often dietary supplements are used, 2) the reasons for using dietary supplements, 3) the source of information, 4) knowledge about dietary supplements, and 5) demographics. This questionnaire was circulated to athletes via SurveyMonkey (www.surveymonkey.com).

#### Statistical analysis

Descriptive data were calculated as frequencies. Associations between supplement use and age, sex, and the number of years of sport-specific training were assessed using a chi-square test. Comparisons between supplement knowledge and age, sex, and the number of years of sport-specific training were performed using a Student's t-test and an analysis of variance (ANOVA). All statistical analyses were performed using SPSS software (IBM, Armonk, NY, USA). Significance was accepted at  $p < 0.05$ .

### Results

#### Prevalence of supplement use among athletes

A total of 209 questionnaires were collected from 15 October to 24 December 2021. Among of these 209 questionnaires, 15 chose not to participate; 24 reported not using any dietary supplements during the previous 6 months; and 39 skipped to answer supplement questionnaire and therefore 131 completed questionnaires were used in the study. About 15% of respondents were rugby ( $n = 19$ ), followed by athletics ( $n = 16$ , 12%), rowing ( $n = 14$ , 11%), and badminton ( $n = 13$ , 10%; Table 1).

Sport	No. of athletes	(%)	Sport	No. of athletes	(%)
Athletics	16	12%	Sailing	2	2%
Badminton	13	10%	Squash	4	3%
Billiard Sports	4	3%	Swimming	7	5%
Cycling	3	2%	Table Tennis	2	2%
Equestrian	3	2%	Tennis	1	1%
Fencing	8	6%	Ten-pin Bowling	1	1%
Gymnastics	1	1%	Triathlon	3	2%
Karatedo	8	6%	Windsurfing	7	5%
Rowing	14	11%	Wushu	12	9%
Rugby	19	15%	Others	3	2%

n = 131

Table 1. Number of respondents from each sport

The mean age of the participants was 24 years, with a range of 18-58 years, and 54% were female. The mean number of years of sport-specific training was 9 years, with a range of 1-35 years. Half of the respondents had undergone training for more than 7 years (Table 2).

	Number of athletes (%)
<b>Age (years)</b>	
18-22	64 (49%)
23-27	37 (28%)
≥28	30 (23%)
<b>Sex</b>	
Male	60 (46%)
Female	71 (54%)
<b>Years of sport-specific training</b>	
≤7	65 (50%)
>7	66 (50%)

Table 2. Characteristics of the respondents

The most popular supplements used by the athletes were sports drinks (75%), energy bars (58%), and protein powder (52%). The least commonly used supplements were herbal supplements (1%), omega-3 fatty acids (2%), and tart cherry juice (4%). More than 75% of the athletes used supplements more than once per week (Table 3). Supplement usage was not significantly different between participants of different age groups. However, female athletes used probiotics more frequently than did male athletes ( $p = 0.031$ ).

Supplement	
<b>Most commonly used</b>	
Sports drinks	98 (75%)
Energy bars	76 (58%)
Protein powder	68 (52%)
<b>Least commonly used</b>	
Cherry juice	5 (4%)
Omega-3 fatty acids	2 (2%)
Herbal supplements	1 (1%)
<b>Frequency of dietary supplement use</b>	
More than 4 times per week	44 (34%)
3-4 times per week	32 (24%)
1-2 times per week	30 (23%)
Less than 1 time per week	25 (19%)

Table 3. Prevalence of dietary supplement use

#### Reasons for supplement use and sources of information regarding supplements

The five main reasons the athletes gave for using dietary supplements were to provide more energy (69%), to improve recovery (64%), to improve performance (56%), to gain weight or muscle mass (37%), and to increase strength or power (33%). Additionally, the athletes reported that they obtained information regarding dietary supplements from their nutritionist or dietitian (87%), fellow athletes or friends (58%), coaches (53%), the Internet (36%), and product labels (21%, Table 4).

Reasons for using dietary supplements (Top 5)	
Provide more energy	90 (69%)
Improve recovery	84 (64%)
Improve performance	73 (56%)
Gain weight or muscle mass	49 (37%)
Increase strength or power	43 (33%)
<b>Sources of dietary supplement information (Top 5)</b>	
Nutritionist or dietitian	114 (87%)
Fellow athletes or friends	76 (58%)
Coaches	69 (53%)
Internet	47 (36%)
Product labels	27 (21%)

Table 4. Reasons for supplement use and sources of dietary supplement information

### Results (Cont'd)

Knowledge about the correct and intended use of the supplements

The participants received an average score of 36% on the questionnaire, which corresponds to an inadequate knowledge of supplement use. The highest score was 87.5%, and the lowest score was 6.25%. Athletes had a sound understanding of the correct use of recovery drinks (87%), sports drinks (80.2%), creatine (63.4%), protein sources (58.8%), and caffeine (45%), but they lacked knowledge about the correct use of beta-alanine (5.3%), the safety of the supplements (10.7%), protein supplements (12.2%), tart cherry juice (13.7%), and glucosamine (19.8%, Table 5). In addition, only 37.4% of the athletes realised that the ingredients listed on the supplement label may not reflect the exact content of the supplement. The supplement knowledge score was not significantly different between participants of different age or sex groups. Moreover, the number of years of sport-specific training did not affect the knowledge scores.

Topic	Correct	%
6 [Multivitamins] Athletes should take multivitamin/mineral supplements everyday even if they consume a balanced diet.	36	27.5%
7 [Iron] All endurance athletes should take iron supplements to prevent anaemia.	43	32.8%
8 [Probiotics] Probiotics are dietary fibre are naturally found in fruits and vegetables and are good for gastrointestinal health.	30	22.9%
9 [Sports drinks] Sports drinks should be consumed when exercising longer than 60 minutes in a hot environment.	105	80.2%
10 [Creatine] Creatine supplements are used to increase strength and power.	83	63.4%
11 [Caffeine] Caffeine improves endurance performance by increasing the fat-burning effect.	59	45.0%
12 [Vitamin D] All athletes participating in indoor sports should take vitamin D supplements.	43	32.8%
13 [Recovery drinks] If athletes are unable to have meals or snacks within 1 hour of completing a difficult training session, they should take recovery drinks.	114	87.0%
14 [Protein supplements] Taking extra protein supplements helps athletes increase muscle mass.	16	12.2%
15 [Beetroot juice] Beetroot juice should be consumed 15 minutes before you exercise.	31	23.7%
16 [Protein sources] Protein supplements are superior to protein from foods, such as meat and milk.	77	58.8%
17 [Beta-alanine] Beta-alanine decreases acid production in muscles during high-intensity exercise, which helps to reduce muscle fatigue.	7	5.3%
18 [Glucosamine] Glucosamine helps muscles work harder, even without more oxygen.	26	19.8%
19 [Tart cherry juice] If athletes want to dilate their blood vessels in exercising muscles and improve energy production, they can take tart cherry juice.	18	13.7%
20 [Banned substances] All supplements may be contaminated with banned substances, which may not be listed on the product label.	49	37.4%
21 [Safety of supplements] Before being marketed, dietary supplements must be tested for efficacy and safety.	14	10.7%
<b>Average</b>		<b>36%</b>

Table 5. Percentage of respondents who answered each question correctly

### Discussion

The prevalence of supplement use by elite athletes in the current study was 88%, which is similar to the prevalence of 40-100% reported in previous studies<sup>[4,18]</sup>. The supplements most commonly used by athletes in this study were sports drinks, energy bars, and protein powder. This finding was consistent with the findings of other related studies<sup>[5-7]</sup>. Female athletes were found to use probiotics more frequently than male athletes. This may be because female athletes are more likely to take general health category supplements for their health, while males are generally more inclined to take ergogenic aids to boost athletic performance<sup>[13]</sup>.

The most common reasons for supplement use by athletes are to enhance performance, improve general health and immune system function, and achieve better recovery from training<sup>[1,6,8]</sup>. These findings are in agreement with the findings in this study that dietary supplements were typically used to provide more energy and to improve recovery and performance. In addition, family or friends, coaches, fellow athletes, doctors, dietitians, the Internet, and magazines have previously been shown to be the most common sources of information used to choose supplements<sup>[9,11]</sup>. Similar results were observed in this study.

In the current study, the respondents' knowledge about nutrition was found to be inadequate (average knowledge score, 36%). In a previous study, males were found to be more likely to have a good nutrition knowledge score than females<sup>[15]</sup>. However, there was no difference in nutrition knowledge score by sex. Older athletes were likely to have more nutrition training and education than younger athletes. However, no differences were found in nutrition knowledge between athletes of different age groups, which is consistent with the results of a previous study<sup>[16]</sup>.

The number of years of engagement in sport-specific training was not significantly associated with nutrition knowledge in the current study. This is in contrast to the results reported by Bakhtiar et al.<sup>[15]</sup>, who showed that participants with a long duration of training have higher nutrition knowledge scores than the comparison group. A possible explanation may be that the athletes in the study of Bakhtiar et al. had more opportunities due to the spectrum of services that dietitians provide.

Athletes' acknowledgement of the possible risks of doping is important for correct supplement use, as athletes are expected to comply with the World Anti-Doping Agency regulations. Only 37.4% of the athletes in this study realised that the ingredients listed on the supplement product label may not reflect the exact content of the supplement, which was less than the percentage of athletes (55.5%) familiar with the possible risks of doping reported by Jovanov et al.<sup>[18]</sup>. The inaccurate labelling of supplements exposes athletes to the risk of consuming banned substances or their precursors. Previous studies have shown that 10-15% of marketed dietary supplements may be contaminated with prohibited substances or harmful ingredients<sup>[10,17]</sup>.

### Conclusion

The results of this study showed that the use of dietary supplements is widespread amongst athletes (88%). Neither age, sex, nor the number of years of sport-specific training were significantly associated with nutrition knowledge. Sex was the only variable significantly associated with the use of dietary supplements, such as probiotics. However, the knowledge scores observed for most of the respondents were unsatisfactory. This may predispose athletes to making poor dietary supplement choices or put them at a risk of doping, which may have a negative effect on their health and sporting career. Therefore, additional measures to improve athletes' dietary supplement knowledge are critical. An educational programme focusing on nutrition and the use of supplements should be provided for athletes.

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