Supplement use and behaviours of athletes affiliated with an Australian state-based sports institute

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Running title

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Abstract

We aimed to update knowledge of the use surrounding supplements amongst Australian athletes at a state-based sports institute. We conducted a cross-sectional survey using an online questionnaire to assess the influence of age, sports category, and scholarship category on supplement use. Of 94 completed questionnaires, 82 (87%) indicated supplements in the previous 12 months (mean=4.9±3.3). No significant difference in supplement usage rate was identified when considering age, scholarship category, or sport category. The most frequently used supplements were sports drinks (70%), caffeine (48%), protein powder (42%), and sports bars (42%). Recovery (63%), health maintenance (59%) and improved energy (50%) were the most frequently reported rationale to use supplements. Allied health professionals and credible on-line resources were the predominant sources of influence regarding use. However, athletes from lower scholarship categories were more likely to have social media, parents and siblings influence usage, and age was inversely related to increased influence from parents, social media, physicians not associated with the institute, the internet and siblings. Older athletes and those on higher scholarships were more likely to source supplements from training facilities and sports nutrition staff outside of the institute or direct from a supplier, whereas those on lower scholarships tended to rely more on family

and friends for their supplements. Findings from this study show a high prevalence of supplement use, and are the first to show an influence of social media, particularly in younger athletes. Opportunities exist to optimise how athletes are informed regarding supplement use, and organisational and supplement policy.

Key words: ergogenic aid, sports nutrition, questionnaire.

Introduction

Supplements are often used to optimise nutrition, or to enhance health and performance, with usage rates of 37-93% among elite athletes (Giannopoulou, Noutsos, Apostolidis, Bayios, & Nassis, 2013; Knapik et al., 2016; Sato et al., 2015). The large variance in supplement usage rates may be due to the varying definitions of supplements and time periods in which athletes' usage were assessed (Knapik et al., 2016). Only two studies have assessed supplement usage rates in Australian athletes, with 88 – 97% of athletes reporting supplement use (Dascombe, Karunaratna, Cartoon, Fergie, & Goodman, 2010; Shaw, Slater, & Burke, 2016). However, a reassessment of this population is vital as there has not been a survey since 2009 and during that time there have been several high profile intentional and unintentional doping cases, both domestically and internationally (CAS, 2015, 2016; USADA, 2012; "World Anti-doping Agency v. Thomas Bellchambers, et al., Australian Football League, Australian Sports Anti-doping Authority," 2015). Anecdotal evidence from institute staff suggests that these incidents have affected the attitudes of both athletes and coaching staff towards supplements, even including the use of basic sports foods.

Enhancing performance, recovery and health are the most commonly cited reasons that athletes use supplements (Kim et al.,

2011; Sato et al., 2015). Athletes often report that family and friends (Braun et al., 2009; Erdman, Fung, & Reimer, 2006), coaches/trainers (Deihl et al., 2012; Sato et al., 2015), physicians and allied health professionals (Aljaloud & Ibrahim, 2013; Dascombe et al., 2010) are their key influences when considering whether or not to use supplements. However, media (Deihl et al., 2012) and online sources (Aljaloud & Ibrahim, 2013) have emerged as important sources of information and influence, and the influence of these factors has not yet been assessed in Australian athletes. This is vital as the increasingly pervasive nature of these influences (*Like, post, share: young Australians' experience of social media*, 2013), and reliance on people without specific nutritional training, potentially compromises the safety and efficacy of supplement programs. Therefore, gaining an understanding of the level of knowledge that athletes possess regarding supplements and the policies that guide their use is important in guiding education programs to combat or reinforce current supplement behaviours.

Recent reports have suggested that 15-30% of supplements exclude the listed amounts of active ingredients or contain unlisted substances (Hall & Judkins, 2012; Maughan, 2013). This omission increases the risk of unintentional doping and is an issue requiring ongoing vigilance by athletes and support personnel (Maughan, 2013; Outram & Stewart, 2015). Therefore, ongoing assessment of

factors affecting supplement usage is required to minimise the risks associated with poorly informed behaviours.

Researchers have previously investigated the factors that affect supplement usage. Braun et al. (2009) and Erdman et al. (2006) identified older athletes as more frequent supplement users, whereas Giannopoulou et al. (2013) and Kim et al. (2011) found no correlation between age and supplement use. Higher competitive level has been identified within a number of studies as correlating with increased supplement use, however age has frequently been identified as a dependant factor (Braun et al., 2009; Erdman et al., 2006; Giannopoulou et al., 2013). It has also been reported that athletes from endurance, power, and individual sports are greater users of supplements when compared to technical and team sports, however reasons for this are yet to be clearly identified (Deihl et al., 2012; Giannopoulou et al., 2013). Importantly, although there is a wealth of research investigating the various elements affecting supplement use, there are relatively few that have assessed a broad range of these factors in a single population to allow for a thorough examination.

Therefore, the aims of this study were to evaluate the use and behaviours surrounding supplements amongst Australian athletes affiliated with a state-based sporting institute, and assess the influence of age, sports category and scholarship category. A

secondary aim was to identify temporal changes in this population via comparison to a previously published study conducted within the same sports institute (Dascombe et al., 2010).

Methods

Participants

All athletes 242 athletes who were currently on scholarship to train at a state-based sports institute were emailed to invite them to participate in this cross-sectional survey design study. A total of 112 (46%) responses were received (n=94 [39%] complete, n=18 [7%] partially complete [excluded]), leaving 94 responses (females = 59%) for the final analysis (see Table 1). Consent was obtained from all participants. Approval for the research procedures was obtained from the host institution Human Research Ethics Committee.

Questionnaire

Athletes were directed to follow a link that was emailed to them to complete a short 10 min online questionnaire on their mobile phone/tablet/computer (Qualtrics LLC, Utah, USA). After reading through the literature to determine what questionnaires had been used, and having had discussions with colleagues that had attempted to capture similar information, it was decided that creating our own would minimise some of the limitations of previous work and allow

us to assess a breadth of factors. This questionnaire was developed in consultation with a team of sports dietitians, physiologists and a physician and sports psychologist (with significant experience in questionnaire development). The questionnaire gathered information regarding demographic information and supplement use in the last 12 months. Scholarship categories were defined by the institute standards and for the purposes of analysis, athletes were characterised as belonging to the upper (podium – currently top 3 in the world; potential podium - international senior competitor in an individual event or team with a 4-8 placing at benchmark competitions and considered capable of progressing to medal performance within 2 y; international - international senior competitor in an individual event or team at benchmark competitions and considered capable of retaining or progressing this level of performance) or lower three scholarship levels (developing international - athlete with the capability to achieve at least international class athlete status within 3 y; emerging international - athlete with the capability to achieve at least international class athlete status within 4-7 y; training only agreement - athletes who are likely to enter into emerging international level in the next annual intake).

Due to a lack of standard nomenclature for sport categorisation, the sample was classified as team and individual sports by the

predominant category in which the event could be contested in an Olympic competition (IOC, 2016). Supplements were defined as per the Australian Institute of Sport (AIS) Sports Supplements Framework (AIS, 2017) as sports foods (i.e., normal food items to support training, competition and recovery), medical supplements (i.e., supplements prescribed to correct a deficiency), and performance supplements (i.e., supplements used specifically to enhance performance). Reasons for use/non-use of supplements, where athletes sourced their supplements, influences on supplement use/non-use and self-reported knowledge of supplements was assessed. Additionally, knowledge of national sporting organisation (NSO), institute and anti-doping policies (Australian Sports Anti-doping Authority – ASADA; World Anti-Doping Agency – WADA) that govern supplement use were assessed.

Statistical analysis

Statistical analysis was completed using IBM SPSS Statistics (V24.0, IBM Corporation, New York, USA). Descriptive statistics were reported as mean±SD or as frequencies and percentages. Pearson's chi-square and post hoc Fishers exact test were used to assess differences between categorical variables. Independent samples t-test were used to compare group means by sport and scholarship category with statistical significance accepted at $p \leq 0.05$.

Where the data was not normally distributed, results were analysed using the Mann-Whitney test and medians reported.

Logistic regression was used to assess the relationship between age and each categorical variable, with B, standard error (SE) and odds-ratios (OR) reported. Based on previous research (Erdman, Fung, Doyle-Baker, Verhoef, & Reimer, 2007), if age is at its mean, then H0=88% and H1=76%. Therefore, to achieve a power of 80% to capture type II error, we required a sample of n=85. Age was not normally distributed, therefore Spearman's RHO correlation was used to assess the relationship between age and number of supplements used.

Results

Prevalence of use

In total, 87% of athletes used one or more supplements in the 12 months prior to survey completion (see Table 1). Age was unrelated to supplement usage (B=0.09, SE =0.08, p=0.32, OR[95% CI]=1.09[0.92,1.28]). No significant difference was found in the number of athletes that used supplements when considering sport (p=0.76) or scholarship category (p=0.50).

****Table 1 near here****

The mean number of supplements used was 4.3±3.5 (range=0–18). A significant weak positive correlation was found between age and number of supplements used (r=0.22, p=0.03). No significant differences were identified between sport (p=0.64; team median=4.0; individual median=4.0) or scholarship categories (p=0.52; upper median=4.0; lower median=4.0).

****Figure 1 near here****

Types of supplements

The most frequently reported supplements used were sports drinks (70%), caffeine (48%), protein powder (42%), and sports bars (42%; see Figure 2). Within the AIS supplement classifications, athletes most frequently reported using sports foods (90%), medical supplements (55%), and performance supplements (55%).

Age was positively associated with usage of sports bars (B=0.11, SE=0.05, p=0.04, OR=1.11[1.01,1.23]), sports gels (B=0.18, SE=0.06, p=0.004, OR=1.19[1.06,1.34]), protein powder (B=0.18, SE=0.06, p=0.002, OR=1.20[1.07,1.34]), beta-alanine (B=0.21, SE=0.08, p=0.01, OR=1.23[1.05,1.45]) and creatine (B=0.26, SE=0.08, p=0.001, OR=1.29[1.11,1.50]).

Athletes from the upper three scholarship categories most frequently reported using sports drinks (75%), protein powder (60%) and sports bars (55%). Those from the lower three scholarship categories most frequently reported using sports drinks (68%), caffeine (48%) and sports bars (37%). However, there were no significant differences in the supplements used between scholarship categories (p=0.07-1.00).

Team sport and individual athletes most frequently reported using sports drinks (67% and 52%) and caffeine (42% and 41%). Individual sport athletes used significantly more sports gels than team sport athletes (26% vs. 10%; p=0.047).

****Figure 2 near here****

Sources of supplements

The majority of supplements were sourced from the supermarket (54%), pharmacy (39%), and directly from institute staff (26%). Age was positively associated with sourcing supplements at training facilities not associated with the institute (B=0.19, SE=0.08, p=0.01, OR=1.21[1.04,1.41]), nutritionists or dietitians not associated with the institute (B=0.18, SE=0.07, p=0.01, OR, 1.20[1.05,1.38]), or direct from a supplier (B=0.17, SE=0.06, p=0.01, OR=1.19[1.05,1.35]).

Athletes from the upper scholarship categories were more likely to source their supplements from nutritionists or dietitians not associated with the institute (26% vs. 5%, p=0.02) or direct from a supplier (41% vs. 6%, p=0.01). Athletes in the lower scholarship categories and team-sport athletes were more likely to be supplied by family and/or friends (32% vs. 4%, p=0.02; 44% vs. 5%, p=0.001, respectively) than athletes from the upper scholarship categories and individual athletes.

Reasons for supplement use/non-use

Reasons for using and not using supplements are detailed in Table 2. Athletes most commonly reported using supplements to enhance recovery (63%), maintain health (59%), and improve energy (50%). Age was positively associated with reasons to improve training (B=0.18, SE=0.06, p=0.003, OR=1.19[1.06,1.33]), and competition (B=0.14, SE=0.06, p=0.01, OR=1.15[1.04,1.28]) performance, and enhance recovery (B=0.14, SE=0.06, p=0.02, OR=1.15[1.02,1.28]). No significant differences were found between scholarship (p=0.07–0.83), or sport categories (p=0.07–0.98).

****Table 2 near here****

Factors influencing usage

Supplement usage was most influenced by information on the ASADA "check your substances" website (4.03±1.10), sports nutrition staff (3.68±1.10) and medical staff (3.40±1.31; see Figure 3).

Age was inversely associated with influence of parents (moderately B=-0.20, SE=0.08, p=0.04, OR=0.84[0.70,0.97]; very B=-0.30, SE=0.11, p=0.012, OR=0.74[0.60,0.93]; extremely B=-0.75, SE=0.31, p=0.02, OR=0.47[0.26,0.87]), social media (slightly B=-0.31, SE=0.10, p=0.003, OR=0.74[0.60,0.90]; moderately B=-0.21, SE=0.09, p=0.03, OR=0.81[0.68,0.98]), physicians not associated with the institute (moderately B=-0.21, SE=0.09, p=0.03, OR=0.81[0.67,0.97]), the internet (slightly B=-0.17, SE=0.08, p=0.03, OR=0.84[0.73,0.98]) and siblings (slightly B=-0.17, SE=0.08, p=0.04, OR=0.84[0.72,0.99]). Age was positively associated with influence of seeing other athletes sanctioned for unintentional doping (slightly B=0.32, SE=0.11, p=0.003, OR=1.37[1.11,1.70]; moderately B=0.24, SE=0.10, p=0.02, OR=1.27[1.05,1.54]).

Athletes from the lower three scholarship categories were more likely to be influenced by their parents (2.39±1.22 vs. 1.54±0.88; p=0.002) and siblings (1.84±1.09 vs. 1.29±0.62; p=0.02) when compared to those athletes in the upper three categories. No other

297 significant differences were identified between any of the
298 groupings.

299

300 ****Figure 3 near here****

301

302 **Self-reported knowledge**

303 When assessing the self-reported supplement knowledge of users,
304 71% knew the main ingredient, 65% knew what it does to their body,
305 51% knew the timing and dose required for the supplement to work
306 effectively, and 33% said they knew what the scientific literature
307 said about the supplement and its proposed effect. Only 2% reported
308 having no knowledge. Age was positively associated with
309 knowledge of the correct dose and timing of supplements for them
310 to work effectively (B=0.11, SE=0.05, p=0.04,
311 OR=1.11[1.01,1.23]). There were no significant differences
312 between the self-reported knowledge of supplements in scholarship
313 (p=0.33-0.81) or sport category (p=0.11-0.50).

314 Self-reported knowledge of relevant anti-doping, institute and NSO
315 guidelines controlling supplement use are detailed in Figure 4. Age
316 was unrelated to the level of self-reported knowledge of guidelines.
317 There were no significant differences between the self-reported

knowledge of relevant guidelines in scholarship (p=0.29-0.92) or sport category (p=0.07-0.48).

****Figure 4 near here****

Discussion

The aim of this study was to evaluate supplement use and behaviours of Australian athletes affiliated with a state-based sporting institute. Supplement use was high (87%) but in-line with usage rates of similar international populations (Aljaloud & Ibrahim, 2013; Kim et al., 2011; Sato et al., 2015), however making comparisons to previous studies is hampered by differences in the survey, recall period, and definition or categorisation of supplements. Importantly, this study is the first to survey of a sample of Australian athletes since 2009 (Dascombe et al., 2010; Shaw et al., 2016), and we identified that supplement usage was almost identical (87% vs. 88%) to athletes at this institute in 2009, and lower than that of a sample of elite Australian swimmers (97%). Several studies have assessed temporal changes in supplement use and reported increased (+5%; Huang, Johnson, and Pipe, 2006), steady (-3%; Shaw, Slater, and Burke, 2016) and reduced (-8%; Heikkinen et al., 2011) usage. Shaw et al. (2016) investigated

supplement use amongst elite Australian swimmers from 1998-2009 and reported unchanged usage (-3%), and our data suggests that usage rates within Australia may have remained relatively stable from 2009-2016 despite our predictions that usage may have declined over time given the perceived negative impact of recent doping violations. This may be a result of clear, contemporary supplement policies developed by the AIS and NSO's.

Sports foods and caffeine are commonly reported as the most frequently used by elite athletes (Aljaloud & Ibrahim, 2013; Erdman et al., 2006), which matches our results and fits with common dietary patterns and sports nutrition guidelines (AIS, 2017; Goldstein et al., 2010; Jäger et al., 2017). Potentially usage rates of these supplements link with the predominant reasons for using supplements that we identified (i.e., to enhance recovery, maintain health and improve energy), which was particularly evident in our population as age increased. However, it is important to remember the minority of athletes who continue to use inappropriate supplements (e.g., several athletes reported using mixed ingredient supplements despite warnings about high contamination rates).

Athletes reported sourcing their supplements from easily available sources such as the supermarket, pharmacy and directly from institute staff. However, older athletes and those on higher scholarships were more likely to source supplements from training

facilities and sports nutrition staff outside of the institute (likely at national program centres) or direct from a supplier, whereas those on lower scholarships, who are also commonly younger, tend to rely more on family and friends for their supplements. It has been reported that age and supplement use are positively related (Braun et al., 2009; Erdman et al., 2007). Although increasing age did not predict greater usage rates, they were more likely to use a greater number of supplements, some sports foods (protein, bars and gels), beta-alanine and creatine. This finding meets expectations that older athletes in our sample may have exhausted dietary interventions and be pursuing marginal gains.

We also identified a positive association between age and knowledge of the correct dose and timing of supplements for them to work effectively. This suggests that older athletes may be more confident with using supplements appropriately, possibly as a result of increased exposure to education and supplement policies, as well as interactions with expert support staff. Although our data suggested no difference in self-reported knowledge of supplement between groups, a concerted approach by this institute to enhance its supplement education since the previous survey appears to have led to an improvement (~6%) in knowledge about supplements (Dascombe et al., 2010), which may support the differences observed. Supporting this, Wardenaar et al. (2017) recently

identified that dietary counselling results in increased supplement use and better informed choices.

Not only did those on lower scholarships tend to rely more on family and friends for sourcing their supplements, but they were also more influenced by their parents and siblings. Further, lower age predicted increased influence from their parents, social media, physicians not associate with the institute, the internet and siblings to guide their supplement usage. Importantly, this study is the first time that social media has been directly identified as an influential factor for athletes, particularly younger athletes, which is consistent with similar findings in the general young Australian population (*Like, post, share: young Australians' experience of social media*, 2013). The growing influence of online and social media (Aljaloud & Ibrahim, 2013; Deihl et al., 2012) represents an important area of influence for athletes, and pathway to improve athlete engagement, particularly in younger athletes.

The breadth of influences on athletes suggests the importance of spreading supplement education to the athlete support network, particularly with younger athletes. Prior studies with elite athletes have identified family/friends (Braun et al., 2009; Erdman et al., 2006), coaches/trainers (Deihl et al., 2012; Sato et al., 2015) and themselves (Dascombe et al., 2010) as the predominant sources of influence. As a cohort, and with older athletes particularly there

appears to have been a positive shift towards a higher reliance on reputable sports science, nutrition and medical staff. Increasing age seems to increase the probability of athletes being influenced by seeing athletes sanctioned for unintentional doping. Additionally, there seems to be positive influence from appropriate online information sources (e.g., ASADA "check your substances" web page), which may all be a result of targeted supplement education at this institute since 2009.

We believe that we may be the first to report athletes' self-rated knowledge of anti-doping and governing body guidelines around supplement usage. The majority of our athletes (>75%) reported good to extensive self-reported knowledge of these guidelines, and generally good self-reports of knowledge about supplements, yet there was still many athletes (8–25%) that had limited or no knowledge of anti-doping and governing body guidelines. Given that the responsibility for abiding by these regulations is the responsibility of the individual athlete, this represents an important group of athletes who need to be engaged, potentially guided by our findings of the most influential sources, to ensure that all athletes are fully aware of their obligations.

The current data suggested little difference between team and individual sport athletes, other than individual sport athletes using more sports gels and team-sport athletes being supplied their

supplements more from family and friends. Previous studies have identified that similar types of supplements are used in these categories, however individual athletes tend to have higher usage rates (Giannopoulou et al., 2013; Huang et al., 2006; Lazic et al., 2011). The reasons for this difference are unclear and future research should look to identify any root causes of the difference.

The current study had several limitations. First, although the response rate was reasonable (~39%) and in-line with studies that have utilised similar study designs (Slater, Tan, & Teh, 2003; Striegel, Simon, Wurster, Niess, & Ulrich, 2006; Wardenaar et al., 2017), there may be athletes who use supplements contrary to guidelines and therefore didn't complete the survey. Second, we were limited in assessing how behaviours and influences differ when considering individual or categories of supplements, as opposed to supplements generally. For example, we would expect our athletes to be large users of sports foods and their usage rates and attitudes towards them should be different to performance enhancing or medical supplements targeted at specific purposes (e.g., beta-alanine, iron). Such information would allow for targeted education programs to reduce the risks associated with poorly informed supplement behaviours. Future research should also look to identify whether specific supplements are being used

appropriately (e.g., is caffeine used as part of a regular diet or for enhancing competition or training performance?).

Findings from this study show a high prevalence of supplement use within this population, and identified some unique influences on supplement use (e.g., social media). Our results show that opportunities exist to develop the best means by which to inform athletes regarding supplement use, organisational guidelines and anti-doping policy, particularly among younger athletes.

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Authorship Declaration

Study and survey designed by all authors. Data collection facilitated by MB, EE, CW and TS. Data analysis and interpretation by MW, KD, DG and DK. Manuscript preparation by MW, KD and DK. All authors approved the final version of paper.

Conflicts of Interest

The authors declare that there were no conflicts of interest.

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599 **Table 1.** Demographic characteristics and prevalence of use of nutritional and sports supplements

600 by age, scholarship category and sports category.

		Overall	Supplement users	Supplement non-users
Total participants, n	-	94	82 (87)	12 (13)
Age (y), mean ± SD	-	20.4 ± 4.5 (range=12-38)	-	-
Scholarship category, n (%)	Podium	4 (4)	3 (75)	1 (25)
	Potential podium	5 (5)	3 (60)	2 (40)
	International	15 (16)	14 (93)	1 (7)
	Developing international	22 (23)	20 (90)	2 (10)
	Emerging international	36 (38)	31 (86)	5 (14)
	Training only agreement	12 (13)	11 (92)	1 (8)
Scholarship category groupings, n (%)	Upper 3	24 (26)	20 (83)	4 (17)
	Lower 3	70 (75)	62 (89)	8 (11)
Sport, n (%)	Water polo	16 (17)	14 (88)	2 (12)
	Cycling	11 (12)	10 (91)	1 (9)
	Sailing	9 (10)	8 (89)	1 (11)
	Swimming	8 (9)	7 (88)	1 (12)
	Hockey	8 (9)	7 (88)	1 (12)
	Rowing	7 (7)	7 (100)	0 (0)
	Netball	7 (7)	5 (71)	2 (29)
	Gymnastics	6 (6)	4 (67)	2 (33)
	Canoeing	6 (6)	5 (83)	1 (17)
	Athletics	4 (4)	4 (100)	0 (0)
	Synchronised swimming	2 (2)	2 (100)	0 (0)
	Diving	2 (2)	1 (50)	1 (50)
	Basketball - wheelchair	2 (2)	2 (100)	0 (0)
	Winter sports	1 (1)	1 (100)	0 (0)
	Weightlifting	1 (1)	1 (100)	0 (0)
	Triathlon	1 (1)	1 (100)	0 (0)
	Trampoline	1 (1)	1 (100)	0 (0)
	Cycling - BMX	1 (1)	1 (100)	0 (0)
	Boxing	1 (1)	1 (100)	0 (0)
Sport category, n (%)	Team	52 (55)	46 (89)	6 (11)
	Individual	42 (45)	36 (86)	6 (14)

601

602 **Table 2**. Reported frequency of reasons for athletes for using and not using nutritional and sports
603 supplements.

	Total n (%)
Reasons for using supplements	
Enhances recovery	52 (63)
Maintain health	48 (59)
Improves energy	41 (50)
Boost immunity	35 (43)
Improved training performance	28 (34)
Improves competition performance	27 (33)
To increase muscle	23 (28)
Improves strength	18 (22)
Dietary routine	18 (22)
To change my body composition to achieve sports goals	14 (17)
Recommendations from others	14 (17)
Reasons for not using supplements	
A healthy diet makes them unnecessary	8 (75)
I don't think that I need them to improve my training recovery or competition performance	5 (42)
Concerns about the risk of doping violations from ASADA or WADA	4 (33)

604

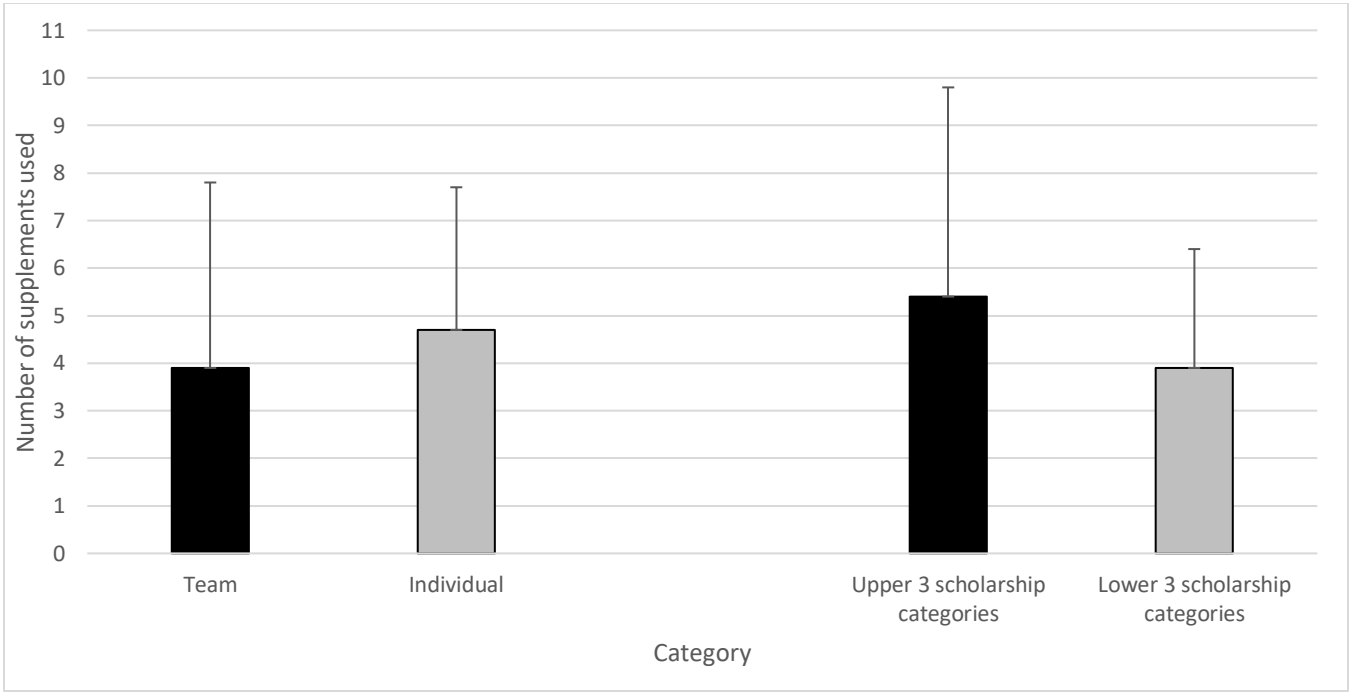
Figure Legends

Figure 1. Mean number of supplements used by scholarship and sport category**.**

Figure 2. Percentage of cohort that reported using nutritional and sports supplements amongst elite athletes characterised by AIS Supplement classification (AIS, 2017).

Figure 3. Sources of influence to use or not use sports and nutritional supplements. ASADA – Australian Sports Anti-Doping Authority; AIS – Australian Institute of Sport; S&C – strength and conditioning.

Figure 4. Knowledge of anti-doping organisation (World Anti-Doping Agency – WADA; Australian Sports Anti-Doping Authority – ASADA), institute and national sporting body guidelines controlling nutritional and sports supplement use.



616

617 **Figure 1.** Mean number of supplements used by scholarship and sport category.

618

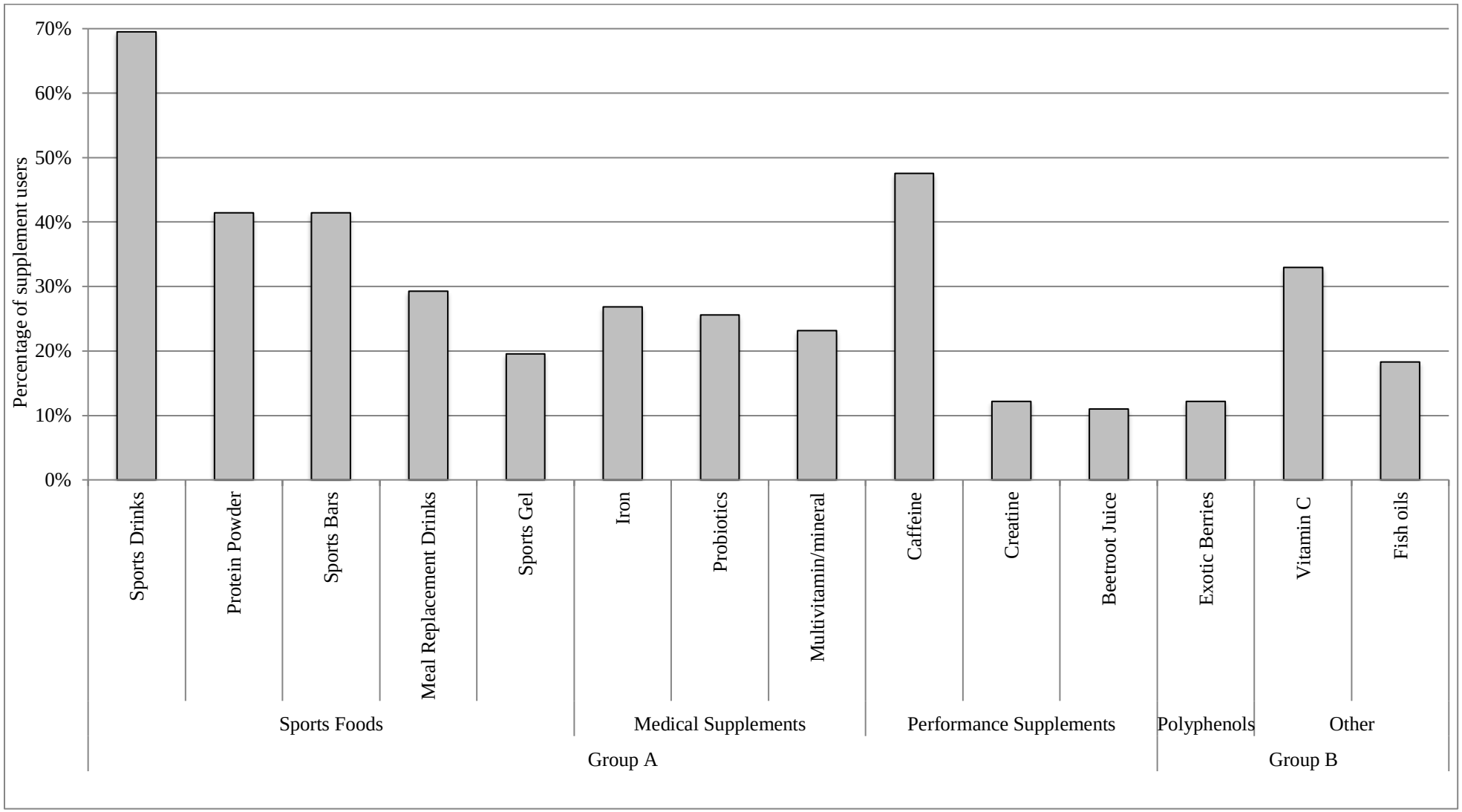
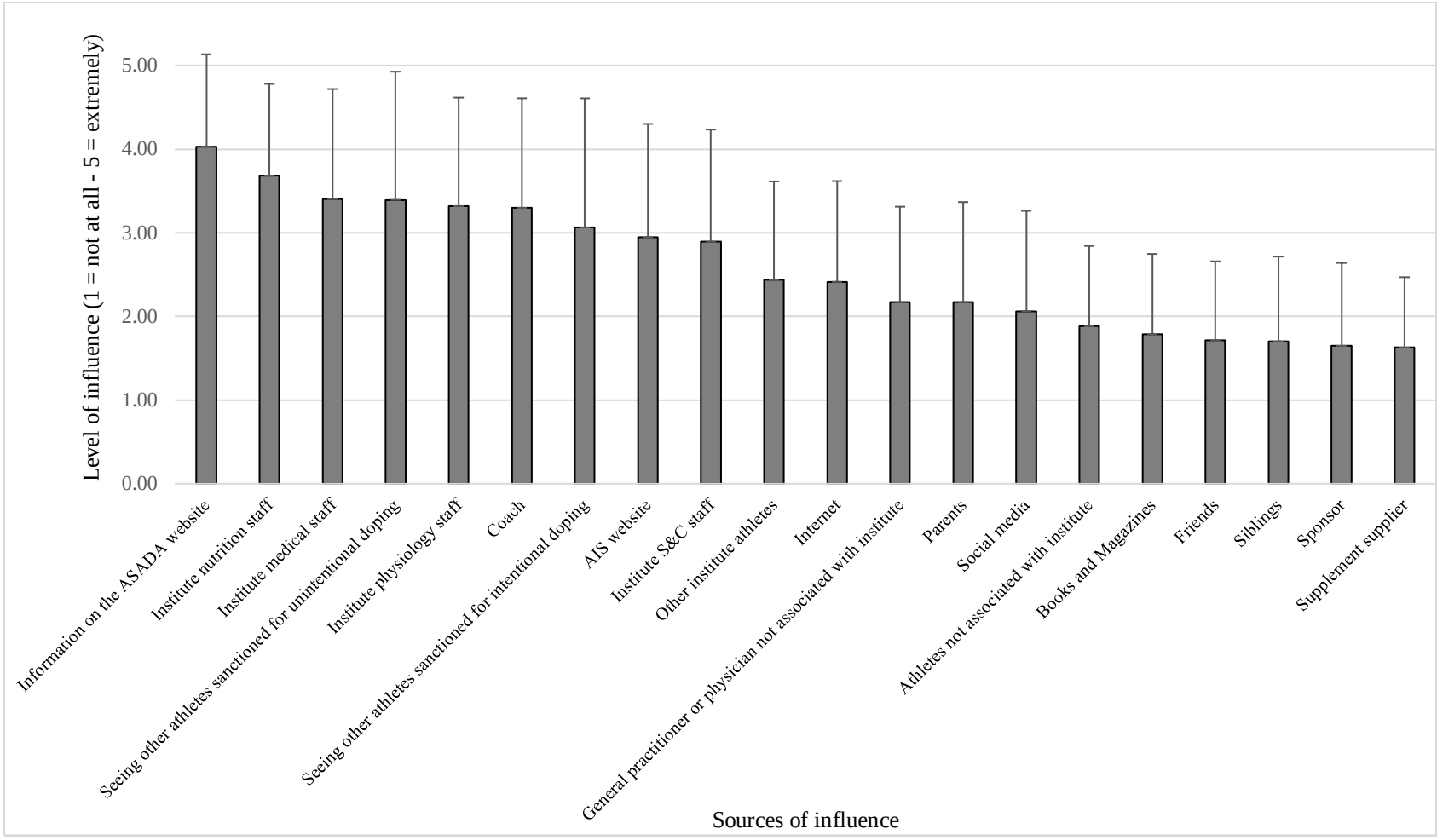


Figure 2. Percentage of supplement users that reported using nutritional and sports supplements amongst elite athletes characterised by AIS Supplement classification (AIS, 2017).

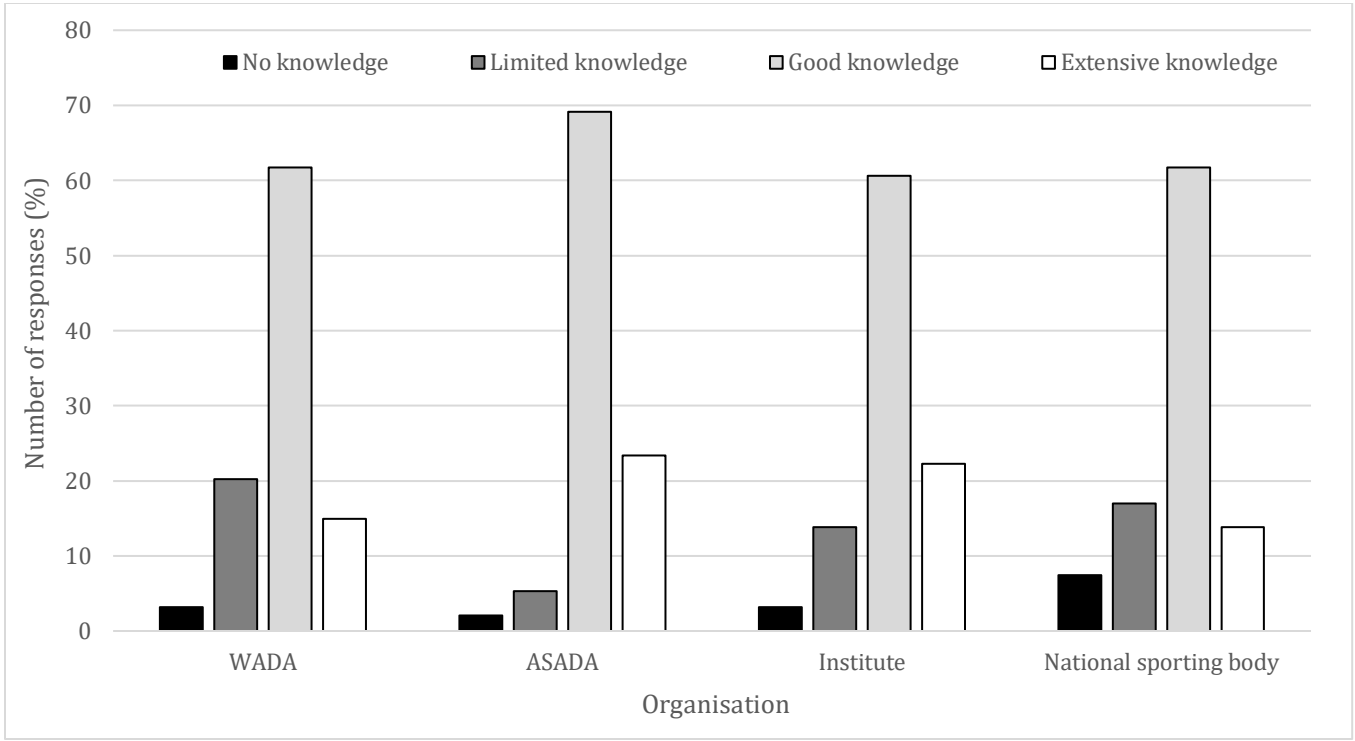
622



623

624 **Figure 3.** Sources of influence to use or not use sports and nutritional supplements. ASADA – Australian Sports Anti-Doping Authority;

625 AIS – Australian Institute of Sport; S&C – strength and conditioning.



626

627 **Figure 4.** Knowledge of anti-doping organisation (World Anti-Doping Agency – WADA; Australian Sports Anti-Doping Authority –

628 ASADA), institute and national sporting body guidelines controlling nutritional and sports supplement use.