Supplementation practices, perceptions and knowledge about anti-doping among Jamaican high school athletes

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ABSTRACT

The increased availability of nutritional supplements has been accompanied with concerns about safety and failed doping tests in athletes through contamination and presence of unknown ingredients. We sought to obtain baseline information on young athletes' knowledge and practices regarding supplements which can guide development of educational programmes. Questionnaires were administered to Jamaican athletes aged 12-19 years attending after-school training for competitive events including the annual athletics competition-Girls and Boys Championship or "Champs". The questionnaires comprised 27 questions divided into four sections: i) demographics, ii) supplement-taking habits iii) supplement perception and iv) knowledge. Of 127 athletes, the 57.4 % (N=73) that had taken supplements at least occasionally in the last year, had completed significantly more years of training,3.5 ± 1.5 versus 2.8 ± 1.2 years (± standard deviation), than non-users ($P<0.05$) and those training for Champs were more likely to take supplements ($P<0.005$). Males and Champs athletes were more likely to obtain supplements from coaches, and more likely to not know the source of the supplements compared with other athletes ($P<0.05$ in all instances). 37.1 % athletes stated they thought that supplements could increase sports performance. Knowledge was poor with average scores of 38 % for the knowledge section with Champs athletes obtaining significantly lower scores than athletes partaking in other sports. Athletes with self-reported familiarity of the World Anti-doping Code obtained higher scores ($P<0.0005$). The poor knowledge of supplement usage and of the World Anti-doping Code warrants training of students regarding the potential risks of taking supplements.

Keywords: Sport, Performance, Nutrition, World Anti-Doping Code, Competition

1. INTRODUCTION

With sporting activities becoming increasingly popular among youths and stricter guidelines being enforced on athletes by regulatory authorities, especially in relation to banned substances, dietary supplement usage has become an important topic of investigation. Many supplements are less effective than claimed by manufacturers while other supplements may be harmful to health or contain substances prohibited in sport, sometimes resulting in failed doping tests (Maughan, Shirreffs, & Vernec, 2018). The presence of unknown ingredients, accompanied with deliberate or inadvertent mislabelling, has been reported. For example, up to 21 % supplements were reported to be "contaminated" with anabolic steroids (Geyer et al., 2004; Geyer et al., 2008; Geyer, Schanzer, & Thevis 2014). In a study led by the United States Anti-Doping Agency (USADA) in which 171 products, representing 10% of mainstream supplements, were tested, 66 % contained at least one prohibited substance, mostly steroids and stimulants (Eichner, 2015). Some supplements, particularly those derived from plant material, contain natural compounds at higher concentrations than are typical of their purported natural origin (Venhuis, Keizers, van Riel, & de Kaste, 2014). Several adverse health effects have been reported. For example, consumption of vitamin/mineral supplements, energy drinks, weight-altering supplements and anabolic steroids among students in Trinidad and Tobago resulted in side-effects such as palpitations, headaches and sleep disturbances in about a fifth of users (Babwah, Maharaj, & Nunes, 2014). Studies have also reported a paucity of basic nutritional knowledge among students and coaches (Couture et al., 2015; Ozdogan & Ozcelik, 2011).

Young athletes face challenges such as greater energy requirements, preferential fat oxidation and lower sweating rates (Meyer, O'Connor, & Shirreffs, 2007). There is a requirement therefore for proper nutrition to maintain body mass, adequate hydration levels, oxygen delivery, recovery post-workout and performance. This may result in young athletes using supplements to meet the energy demands. In Singapore a 77% usage rate of one or more supplement was observed in 160 athletes (Slater, Tan, & Teh, 2003). Studies in the United Kingdom(Petroczi et al, 2008), United States (Eichner, 2015) and Egypt (Tawfik, El Koofy, & Moawad, 2016) have reported usage rates ranging from 46% to 59%. In Trinidad and Tobago, usage rates of 52.4 %, 44.0% and 8.9 % were found for vitamin and mineral supplements, energy drinks and weight altering supplements respectively (Babwah et al., 2014). The highest usage (98 %) was noted in a study involving 567 Canadian athletes aged 11-17 (Wiens, Erdman, Stadnyk, & Parnell, 2014). Varying usage rates ranging from 55 % to

91.1% have been reported for elite adolescent German athletes (Dietz et al., 2014; Braun et al, 2009; Diehl et al, 2012).

Common supplements consumed by young athletes include energy drinks, vitamin C, multivitamins, creatine, Echinacea, caffeine, iron, sport beverages, carbohydrate preparations protein/amino acid products, ergogenic aids, magnesium and calcium (Slater et al., 2003; Calfee & Fadale, 2006; Petroczi et al., 2008; Braun et al, 2009; Babwah, et al., 2014; Parnell, Wiens, & Erdman, 2015). Seasonal use of supplements ranged from 44% to 91%, with use occurring during the competitive seasons (Tawfik et al, 2016; Diehl et al, 2012). The main reason reported for supplement use in the literature was performance enhancement (Tawfik et al, 2016; Wiens et al., 2014; Parnell et al., 2015; Babwah et al., 2014; Diehl et al, 2012; Slater et al., 2003). Other reasons included improved physical appearance (Tawfik et al, 2016) and health improvement (Parnell et al. 2015; Slater et al., 2003).

Various patterns have been noted in the literature regarding supplementation. Some studies reported a greater incidence of dietary supplementation among male athletes compared to their female counterparts (Parnell et al., 2015; Diehl et al., 2012) whilst others showed no correlation between gender and supplement use (Slater et al., 2003). Age has also been found to be a determinant with one study showing 11 to 13-year olds least likely (73%) and 19 to 25-year olds most likely (94 %) to use dietary supplements (Parnell et al., 2015). Major sources of influence regarding choice of supplements included family (Dietz et al., 2014), coaches, physicians, physical therapists, pharmacists, other athletes and self-recommendation (Slater et al., 2003; Petroczi et al., 2008; Braun et al., 2009; Diehl et al., 2012; Babwah et al., 2014; Wiens et al., 2014; Parnell et al., 2015).

Young athletes may be considered to be a vulnerable group due to exposure to environments that put pressure on them to win at all costs. They constantly battle with fear of losing funding or a place on sporting programmes, self -image, intense coach-athlete relationships and exposure to adult-focussed environments. This is exacerbated if an athlete is in a team or on a pathway to elite status as many factors are not within their control (Grey-Thompson, 2017). In Jamaica, the “Sprint Capital of the World”, the pressure to perform in track and field begins as early as age eleven as high school children seek to excel in the annual Boys’ and Girls’ Athletics Championships (“Champs”). An event in which over 100 schools participate and organized by an institution that has existed since 1910 (Inter-Secondary Schools Sports Association, 2016). This training ground

helped to shape the careers of 100-m world record holder Usain Bolt, Jamaica's first Olympic gold medallist Arthur Wint (1948) and Merlene Ottey, who holds a record number of medals for any female athlete in the history of both the Olympic Games and World Championships, along with seven other Olympic gold medallists (Charlton & Green, 2010).

These successes in athletics have been marred with failed antidoping tests where stanozolol, oxilofrine and methylhexaneamine were detected in the urine of Jamaican athletes. In many of the cases, detection was attributed to supplement use and resulted in suspension (Court of Arbitration for Sport, 2015) or loss of medals (Court of Arbitration for Sport, 2018). The International Olympic Committee suggests age, performance goals, level of evidence, and testing by an established quality assurance program be taken into consideration prior to recommending supplements (Maughan, 2018) and therefore studies on supplementation should be undertaken in many populations to see if there is a reason and demand for such recommendations.

To date there have been no studies performed on supplement usage among young Jamaican athletes. Though drug testing is not prevalent in the under eighteen age group it is believed that development of a culture of, and healthy attitude towards, clean and fair competition must start from an early age. A part of this is awareness of benefits and risks of supplement use. The aim of this study was to investigate supplement usage, attitudes towards supplements and knowledge about the World Anti-Doping Code among young Jamaican athletes and to see whether there was a difference in those competing in athletics compared to other sports. This baseline information on young athletes' knowledge about the prevalence and attitudes towards supplement use may result in a more focused approach towards addressing potential risks in young athletes, who can still be galvanized to learn about good practice in sport and nutritional health.

2. MATERIALS AND METHODS

2.1 Ethical approval

Ethical approval was sought from the University of the West Indies Ethics Committee (ECP 188, 14/15) and the Ministry of Education in Jamaica.

2.2 Study Population

Thirty schools across Jamaica were contacted via email and telephone to participate in this study based on sporting history and participation in prestigious events. Six schools agreed to take part and appointments were made with principals and coaches to present further details, meet with students and distribute parental consent and assent forms. Questionnaires were administered to all athletes aged 12-19 years attending after-school training for "Champs" and other national competitions. In total, 127 questionnaires were returned with collection being completed in December 2017.

2.3 Data Collection

Following collection of assent and parental consent forms, paper-based surveys were completed in a classroom at school at a convenient time for all parties. The researchers were present during completion to provide clarification if required and collect the survey instrument immediately after completion. It was emphasized to the students that the questionnaire was not a test and to answer to the best of their ability. Although the response rate of schools was low (six out of 30, or 20 % of contacted schools), all distributed questionnaires were returned and used in the study (a response rate of 100 %), but for the knowledge-based questions, there was an 89 % response rate as only 113 of the 127 athletes attempted this section and therefore responses of the remaining 14 athletes were not included in the discussion for this section.

2.4 The instrument

The instrument consisted of 27 questions that were divided into four sections: i) demographics, ii) supplement-taking habits, iii) supplement perception and iv) knowledge. The segregation into the four sections was performed to facilitate the explanation of the questionnaire and data-processing and to provide added clarity to the participants as to what was being investigated. Information on age, gender, years in sport, and sport events was collected. Questions on habits referred to the frequency of intake and length of time of supplementation, specific types of supplements taken, consumption of multiple supplements, introduction to the supplements, and their source. Questions were asked about seven specific types of supplements based on anecdotal discussions with coaches and supplement providers to athletes in Kingston, but athletes were asked to provide as much information as possible on other supplements they took. The perception component involved statements about effectiveness of supplements and doping being ranked using a five-point Likert scale (1-strongly agree; 2-agree; 3-neutral; 4-disagree; 5-strongly disagree). Self-reported familiarity with the

WADA prohibited list was also recorded. To assess knowledge, participants were asked whether they agreed with statements which were either correct or incorrect (Yes/No/Don't know) and to identify banned drugs. Finally, questions on the frequency of updating the WADA list, reasons for drugs being banned and consequences of finding banned drugs were also asked. Scores for knowledge, with a maximum score of 31, were calculated as percentage values. These questions therefore tested actual knowledge rather than self-reported knowledge and therefore enabled an unbiased assessment of familiarity with elements of the World Anti-Doping Code. The instrument was developed by the researchers using information from the 2015 World Anti-Doping Code, published research looking at supplement use in athletes and experience conducting a similar study in the Bahamas looking at use of protein supplements among track and field athletes (Carter R., Unpublished MSc. Thesis, 2015). Some of the questions from that study were integrated into this instrument while the researchers' experience guided the format, wording and length of the instrument used for this study. The instrument was also pilot tested and modified based on input from five first-year Physical Therapy students on clarity, format and ease of completion.

2.5 Statistical analysis

The influence of gender, age, and participation in athletics versus other sports (i.e. "Champs", versus "other") on supplement use was considered to enable some comparison with published research. Supplement use and gender were investigated as variables governing supplement perception and knowledge. The effect of participation in the "Champs" competitions (track and field events) was included as an additional variable due to the competitive nature and pressure to do well in this national event. Descriptive statistics were used for analysis, using averages (± standard deviation) and frequencies (%). The Fisher's Exact test was used to determine statistical significance for dichotomous variables while the students t-test (unpaired) was used when the group sizes were similar. Spearman correlation was used to determine association between ordinal data (frequency of use) and continuous data (age, years in sport, score). IBM®SPSS® Version 24 was used for generating statistical data. A p value of $p < 0.05$ was considered statistically significant. These statistical tests have been recommended in similar studies (Nieper, 2005; Tscholl, Junge & Dvorak, 2008).

3. RESULTS

3.1 Demographics

The demographics of participants are listed in Table 1. Among the 127 respondents, there were similar numbers of students training for Champs (N=66) and those taking parts in other sports (N=61) which included football (N=14), basketball (N=8), boxing (N=1) swimming (N=3), netball (N=13), water polo (N=1), hockey (N=4), tennis (N=1) and dance (N=4). There were more males (N=82) than females (N=45), a bias which likely reflected the schools willingness to take part – two boys' (N=6 and N=46), one girls' (N=25) and three co-educational (N=9, N=14 and N= 27) schools. Eight athletes reported being professional players (i.e. being paid to compete in their respective sport).

3.2 Supplement habits

Table 2 displays the supplementation practices of the athletes studied. Frequency of use in the last year (never, occasionally, once per week, 2-3 times per week or more than 2-3 times per week) was weakly but significantly correlated with years in sport (0.266, $P<0.01$) but not age. Athletes involved in Champs were more likely to take supplements compared with athletes taking part in other sports ($P<0.01$), but differences related to gender were not statistically significant. There was also a significant difference in the number of years in sport among users compared with non-users (3.5±1.5 versus 2.8±1.2, $P<0.05$), although there was not a significant difference in the age of users compared to non-users based on the unpaired t-test conducted.

Of 85 athletes reporting prior use, 62 specified they had used supplements for an average of 3.9 years (range: one month – 16 years) and continuously for 2.2 years (range: 15 days-14 years). When asked about seven specific supplements, the most common supplements ever to have been used were whey (N=18), creatine (N=14), amino fuel (N=10) and AnimalPak (N=8), with lower use of lysine (N=2), cysteine (N=1), and tribulus fuel (N=0).

Of the 73 athletes reporting past year use, the most common usage was before an event (N=30) and after an event/training (N=24) with fewer athletes using the supplements solely as a daily dietary regime (N=12). Of eight athletes who reported being professional (i.e. paid) players, two females (a netball player and swimmer) and one male (Champs competitor) had never taken supplements. A further two males competing in Champs had used supplements occasionally whereas three male footballers took supplements at least 2-3 times/week in the last year. The most commonly-consumed supplements in the past year are shown in Figure 1. The "other" 17 supplements included "Nutrilite Twist Tubes" (a supplement for immunity, antioxidant protection

and joint health), “ForsLean” (derived from *Coleus forskohlii* to promote lean body mass), “Multi Men” (vitamins and minerals in a supplement that also supports energy and stamina), “Metcon”(described as performance driven supplements helping athletes push their limits which are designed by athletes and tested by athletes) and “Surgex” (a protein drink that maintains lean muscle). “All Plant Protein Powder”, “protein shakes” and “Muscadine”, a grape which reportedly promotes cardiovascular strength, joint health and increased energy, were also reported. Other supplements cited were “Amino Fuel”, “magnesium”, “zinc”, “Sorbifer Durules”(which contains slow-release ferrous sulfate), “casein”, “ginseng”, the herb “Echinacea” and “glucose” (N=1 in each case). Information on brand names was not reported in many of these instances. In addition, one athlete reported medicinal use of diclofenac (and stated this was for medical purposes rather than to supplement the diet). Interestingly, 14 athletes taking supplements to improve sports performance specifically cited caffeinated beverages, “Rhodiola”, “Vitamin B”, “Pharmaton”, “Centrum”, “AnimalPak”, “Creatine” (N=3) and “Echinicea” as supplements taken for this use, with 18 athletes taking supplements not associated with vitamins or minerals. One athlete, a user of whey and caffeinated beverages reported taking more than the recommended dose. Polyconsumption was reported where 17, six and three athletes reported use of 2-3 supplements, four or more supplements and use alongside home remedies, respectively. There were five cases of polyconsumption not involving solely the use of different vitamins or minerals. Four of these athletes were males aged 15-18 who took part in the Champs competition, three of which took the supplement combination 2-3 times/week or more.

Overall, the reasons cited for taking supplements among the 73 users were for general health (N=33), improve energy levels (N=23) and for recovery-post workout (N=17). Interestingly 19% (N=14) of users cited enhancing sport performance as a reason to take supplements. Fewer athletes took supplements for concentration (N=8) and weight loss (N=1). Females were more likely than males to take supplements for general health ($P<0.0001$) whereas males were more likely than females to take supplements for recovery post-workout ($P<0.05$). Athletes with self-declared knowledge were more likely to cite performance enhancement as a reason for taking supplements ($P<0.001$).

Most athletes obtained their supplements from their parents/guardians (N=35) followed by a coach (25). Most athletes had been told about supplements by their coaches (N=31) followed by parents (N= 23). Fewer athletes had heard about supplements from other family members, friends/teammates or store

merchant/shop keepers. The most common sources of the supplements were listed as “pharmacy”, “abroad” or “don’t know” as opposed to “another local shop” or “over the internet”. No other sources of information or supplements were offered by the interviewed athletes. Males were more likely than females to have heard about supplements from their coach ($P<0.05$), obtain supplements from their coach ($P<0.01$) and not to know the origin of supplements ($P<0.05$). Females were more likely than males to have been recommended supplements by parents or guardians ($P<0.0001$) or healthcare professionals ($P<0.05$), be provided supplements by parent/guardian ($P<0.0001$) and know the origin of supplements -most commonly from a pharmacy ($P<0.05$) or abroad ($P<0.01$). Champs athletes were less likely to have heard about supplements from parents/guardians ($P<0.01$), less likely to obtain supplements from this group of individuals ($P<0.05$) and more likely to not know the origin of supplements ($P<0.01$).

3.3 Supplement perception

Of the 73 users who had taken supplements at least occasionally in the last year, a total of 44 believed their supplements were effective, 11 did not believe they were effective and 17 declined to state an opinion. Overall, 37.1 % athletes stated they thought supplements could increase sports performance (agreed or strongly agreed) and 54.3 % thought they maintained performance. Champs athletes were more likely to declare “no effect” ($P<0.05$) and less likely to state they “maintain” sport performance ($P<0.05$). No users felt that supplements decreased performance, whereas 14.3 % of non-users felt supplements could decrease sport performance.

Athletes were asked a series of 10 questions on their opinion on doping and ‘Champs’ athletes were less likely to think doping occurred in sport with 42.2. % agreeing/strongly agreeing that doping is common, compared to 67.5 % among participants of other sports, and less likely to think than that athletes who dope are usually not caught (15.6 % versus 40 %).

3.4 Supplement knowledge

When considering all knowledge-based questions, information was gleaned from 113 questionnaires as 14 athletes did not attempt this section of the questionnaire.

Based on self-report, 41.6 % (N=47) athletes would know where to look to find whether a drug was banned in sport, 46.7 % (28/60) ‘Champs’ athletes and 35.8 % (19/53) “other” athletes. Similarly, 30.1 % (34/113)

athletes claimed they were familiar with the WADA code, 38.3 % (23/60) 'Champs' athletes, and 20.8 % (11/53) "other" athletes. Furthermore 55.2 % (37/67) users and 21.7 % (10/46) non-users would know where to look, whereas 38.8 % (26/67) users and 17.4 % (8/46) non-users claimed they were familiar with the WADA code.

The percentage scores for knowledge are shown in Figure 2 while Figure 3 displays responses to statements. Figure 4 displays correct identification of banned substances among participants (a) and correct identification of drugs that are not banned (b). Spearman's correlation was performed between score, and age, years in sport and frequency of use, and a statistically significant correlation was found between score and frequency of use (0.255, $P<0.01$).

4. DISCUSSION

4.1 Supplement habits

The usage rate of supplements of 67 % use, and 57.4 % use in the last year is like that reported in other studies. Prevalence of supplementation has ranged from 48.1 % (n=403) in a UK-based study (Petroczi et al., 2008) to 98% among Canadian athletes (Wiens et al. , 2014). In the present study, a slightly greater proportion of the males (59.8 %) compared with females (53.3 %) had used supplements in the last year. In other studies, greater levels of dietary supplement usage were noted among males in comparison to females (Parnell et al.,2015; Diehl et al., 2012) although a recent meta-analysis reported similar usage among men and women (Knapik et al., 2016). Supplementation has previously been shown to be dependent on age where 11–13 year olds were least likely (73%) whilst 19–25 year olds were the most likely (94%) to use dietary supplements (Parnell et al., 2015) but in our age group of 12-19 years, years in sport was shown to be a more relevant factor. It is also interesting that in our study, 19 % of recent users cited sport performance enhancement as a reason for taking supplements.

Polyconsumption of two or more supplements, involving 36% (26 athletes) of users, was lower than that, 89%, reported previously (Slater et al., 2003). Of the 73 athletes that had used supplements in the past year, the most common usage was before an event (N=30). The use of supplements coinciding with sports events has been reported previously (Tawfik et al, 2016) where it was indicated that 44 % of respondents used

supplements during the competitive season whilst fewer, 20%, used supplements regularly. Another study reported that 91% of supplement users reported doing so during the competitive season (Diehl et al., 2012).

In the current study, recommendation of supplements by coaches was prevalent among the users with 31/73 (42 %) having heard about supplements in this way. This contrasts with a study of high school coaches in Canada (N=47) that demonstrated that recommendation of supplement use was “extremely rare” (Couture et al., 2015). Most users got their supplements from a parent or guardian, but a substantial proportion (34 %) got their supplements from their coach. Interestingly, in a study performed on stakeholders in Spanish football (N=237), 32% had recommended/used supplements (Morente-Sanchez & Zabala, 2015). The corroboration with the present study indicates that parents, coaches and teammates must be factored in when doing any form of campaign geared towards improving the supplementation practices and knowledge base of the athletes.

The fact that athletes (regardless of age) rather than parents or coaches are responsible for antidoping violations and suffer the consequences of penalties should be emphasized during training and development of young athletes. The WADA code is explicit in explaining that the demonstration of intent, fault, negligence or knowing use are unnecessary for granting an anti-doping rule violation even though some of the penalties, such as period of ineligibility or disqualification from other events may be less severe subject to the degree of fault (World Anti-Doping Agency, 2015). It is pertinent to note that “No Fault or Negligence” claims do not apply to supplement usage because athletes are responsible for what they ingest. This means that a period of ineligibility from sport is upheld rather than eliminated. However, an athlete could claim “No Significant Fault or Negligence” if the antidoping rule violation was due to a contaminated product, which can still result in a period of ineligibility of up to two years (World Anti-Doping Agency, 2015).

In Jamaica, coaches do not undergo formalised or structured nutritional training and this should be a consideration in developing programmes. Perhaps in the future, WADA might introduce more deterrents for coaches and parents who recommend supplements that have unknown effects or develop strategies for supplement testing and approval in developing countries. In the meantime, a more structured program should be developed to enable young athletes to take responsibility for their own wellbeing and to enable them to verify and seek clarification from an independent expert with whom they are able to confide.

A total of 16 athletes stipulated that their supplements were obtained from abroad. It is possible that this is a result of a greater variety of products available, lower cost, and external influences such as attendance at international camps or competitions. This issue will need to be explored further to determine if coaches are advising the students to purchase supplements from abroad, if the coaches themselves are obtaining the supplements from overseas, and whether these pose greater risks to athletes.

4.2 Supplement perception

'Champs' athletes were less likely than those taking part in other sports to think that supplements maintained performance but were more likely to think supplements had no effect on performance. These results contradict previous work that showed a positive correlation between supplement consumption and the desire to enhance performance (Dietz et al, 2014). Consequently, the possibility that 'Champs' athletes are taking supplements because of external pressure should be investigated. Another possibility is that supplements are more widely regarded as a means of maintaining a baseline health which would not be otherwise reached through an average Jamaican diet. It should be emphasized that participation in sports in some communities is regarded as a way out of poverty and the acquisition of supplements from coaches is met with gratitude by some families who may otherwise be unable to afford the expenses of maintaining a healthy lifestyle for their offspring. 'Champs' athletes were also less likely to think doping was common in sports, and less likely to think that athletes who dope are usually not caught. This attitude may be indicative of less caution in this subgroup and may suggest that these athletes feel removed from the issue. This is interesting given that more (71.2%) of this group took supplements in the last year, compared with other athletes (42.6%). Perceptions of athletes have been reported before in 72 Australian athletes, where most believed supplementation was related to performance-enhancing effects (65.3 %) and positive doping results (62.5%) (Dascombe, Karunaratna, Cartoon, Fergie & Goodman, 2010). A positive association between sport supplement use and doping attitudes as well as doping likelihood has been observed recently (Hurst, Kavussanu, Boardley & Ring, 2019), but the current research differs in that athletes in a developing country were studied, a population which is likely to be exposed to different pressures than those described in previous literature. In a comments box of the questionnaire, athletes were asked whether they had taken supplements in the past and had stopped and were asked to provide explanations. Interestingly, financial constraints or expense (N=3) and finishing of supplies (N=8) were explicitly stated. Forgetfulness (N=4), stopping of training due to injury (N=1), parental

guidance (N=1), doctor's advice (N=1), starting sport (netball) (N=1), not feeling there was a need (N=1), starting a different diet (N=1) and only taking supplements at exam time (N=1) were the other reasons for having stopped taking supplements.

4.3 Supplement knowledge

There was a paucity of knowledge, as 41.6% of athletes had self-reported knowledge, athletes scored an average of 38% for the knowledge component (Figure 2) and only 2/10 banned substances (steroids and stimulants) exhibited correct responses from at least 50% of all the athletes (Figure 4). Education programs should highlight banned substances which are only allowed with therapeutic use exemptions (such as insulin and asthma pumps), alcohol and cannabis (which is decriminalised in Jamaica) as knowledge of these drugs being banned was poor. The results appear similar to those obtained from 1925 Australian athletes where responses of 50% correct or more were obtained for only 8/30 banned substances and methods, and on average, athletes scored 32.3%- where age, gender, ethnicity, professional/amateur status and competition level were factors influencing correct responses (Orr et al., 2018). In the current study, age had no effect on knowledge, but those completing more years of training exhibited better knowledge. The lack of knowledge has previously been reported to extend to stakeholders in Spanish football, such as coaches and physical trainers, where 57.6% did not know the meaning of WADA and only 15% had a knowledge of the prohibited list (Morente-Sanchez & Zabala, 2015). In another study conducted in Barbados, only 13% of physicians felt confident in their ability to treat athletes while staying within WADA's rules (Ward, Singh, Mansingh, Wade & Roopchand-Martin, 2017).

It should be noted that as a result of efforts to simplify the questionnaire and make it approachable to young athletes, some aspects of knowledge may not have been fully captured. For example, for the compounds displayed in Figure 4, athletes were asked to identify which compounds were banned in sport. Further questions were not asked about whether these were banned in or out of competition, or whether some substances were banned only in specific sports. The Prohibited list stipulates that stimulants (S6), morphine (S7) and cannabis (S8) are banned in competition only (all sports), whereas ethanol (P1) is banned in competition but only for specific sports (air sports, archery, automobile and powerboating) (World Anti-Doping Agency, 2019). Athletes were also not asked whether any complete drug families or substances were banned (such as specific illicit drugs). Knowledge about differences between countries might also be important to

document. For example, in Jamaica, cannabis was decriminalised in 2015, and possession of small quantities of this drug is permissible in Jamaica, whereas an athlete travelling abroad for training may be exposed to harsher penalties if they are found to be taking this drug of abuse. This may have led to some confusion among respondents, and therefore the questionnaire could be developed further to clarify these points.

There has been much discussion about how much flexibility should be applied when sanctioning minors. In the proposed 2021 code, as in the current code, a minor will not need to determine how a substance entered his or her body (World Anti-Doping Agency, 2018). Moreover, for an anti-doping rule violation from a non-specified substance, a reprimand rather than a 1-year sanction will now be the minimum penalty. It is interesting to note that several stakeholders believed the initial proposed amendments to the 2021 code went too far in accommodating minors (WADA, 2018). For example, if a minor receives a 4-year ban, it has been suggested that he/she will not be relieved of the burden of establishing that the anti-doping rule violation was not intentional. It is also pertinent to note that elite level 16- and 17-year olds, who are nevertheless minors, should not be considered as "vulnerable persons" under proposed definitions, and that the new code may differentiate between "vulnerable" and "minor". These proposed changes are based on concerns over giving too much sanctioning flexibility to 16 and 17-year-old elite-level athletes who are in a registered testing pool, or to those competing in open category international events. Taken together, it should be noted that the current study is of importance because non-specified substances only form one category of the Prohibited List. In addition, while public reporting of a penalty involving a minor is not mandatory, detection of a prohibited substance could, as a minimum, involve disqualification and removal of medals, points or prizes. This would have a negative impact on developing athletes. In addition, young elite athletes soon will no longer benefit from the added flexibility in the WADA Code, and thus are expected to acquire knowledge and good habits before they reach adulthood. In the current study eight professional athletes were interviewed, and as many professional athletes in Jamaica begin their careers by benefiting from high school sports programs and competing in Champs, it was therefore relevant that the habits, knowledge and perceptions involving these athletes be investigated.

In the current study, due to the limitations of sample size, it was not possible to study the influence of possible interactions among gender, sport and supplement usage. There was heterogeneity of group sizes, and bias that reflected a larger proportion of Champs athletes studied being males (86%) than the number represented

in other sports (41 %). The sample size might be improved upon in the future if there is better receptivity of schools in Jamaica to take part in similar studies.

5. CONCLUSION

In Jamaica, athletics are a crucial part of the culture. Jamaica is hailed as the "Sprint Capital of the World" and there are many young, promising and talented athletes that are honing their skills to ensure that they are the next best. Sound theoretical knowledge must be given to these athletes. The information obtained from this study shows a need for athletes, coaches and parents to be included in training programmes regarding supplement use and associated risks. The current study adds to the body of knowledge about supplement usage among competitive adolescent athletes.

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Declaration of interest

The authors have no conflicts of interest to declare

REFERENCES

Babwah, T. J., Maharaj, R. G., & Nunes, P. (2014). Energy drinks and other dietary supplement use among adolescents attending secondary schools in Trinidad and Tobago. *Public Health Nutrition, Jan 7*, 1-10.

Braun, H., Koehler, K., Geyer, H., Kleiner, J., Mester, J., & Schanzer, W. (2009). Dietary supplement use among elite young German athletes*. Int J Sport Nutr Exerc Metab, 19*(1), 97-109.

Calfee, R. & Fadale, P. (2006). Popular ergogenic drugs and supplements in young athletes. *Pediatrics 117* (3)*,* e577-89.

Carter, R. (2015). *Prevalence of Consumption of Protein Shakes by Bahamian Track and Field Athletes: Athletes perception of impact on performance, and their knowledge about adverse effects (Unpublished master's thesis). University of the West Indies, Jamaica*.

Charlton, V. & Green, F. (2010). The Role of Boys' and Girls' Championships in Jamaica's Track-and-Field Glory. In R. R. Irving and V. Charlton (Eds.), Jamaican Gold: Jamaican Sprinters (pp. 105-117). Kingston, Jamaica: University of the West Indies Press.

Court of Arbitration for Sport (2015). Arbitration CAS 2014/A/3571 Asafa Powell v. Jamaica Anti-Doping Commission (JADCO), award of 7 July 2015. https://jurisprudence.tas-cas.org/Shared%20Documents/3571.pdf. Accessed 28/05/19

Court of Arbitration for Sport (2018). Arbitration CAS 2017/A/4984 Nesta Carter v. International Olympic Committee (IOC), award of 31 May 2018. https://jurisprudence.tas-cas.org/Shared%20Documents/4984.pdf. Accessed 28/05/19.

Couture, S., Lamarche, B., Morissette, E., Provencher, V., Valois, P., Goulet, C., & Drapeau, V. (2015). Evaluation of Sports Nutrition Knowledge and Recommendations Among High School Coaches. *Int J Sport Nutr Exerc Metab, 25*(4), 326-334. doi:10.1123/ijsnem.2014-0195

Dascombe, B. J., Karunaratna, M., Cartoon, J., Fergie, B., & Goodman, C. (2010). Nutritional supplementation habits and perceptions of elite athletes within a state-based sporting institute. *J Sci Med Sport, 13*(2), 274-280. doi:10.1016/j.jsams.2009.03.005

Diehl, K., Thiel, A., Zipfel, S., Mayer, J., Schnell, A., & Schneider, S. (2012). Elite adolescent athletes' use of dietary supplements: characteristics, opinions, and sources of supply and information. *Int J Sport Nutr Exerc Metab, 22*(3), 165-174.

Dietz, P., Ulrich, R., Niess, A., Best, R., Simon, P., Striegel, H. (2014) . Prediction profiles for nutritional supplement use among young German elite athletes. *Int J Sport Nutr Exerc Metab*. *24*(6), 623-31. doi: 10.1123/ijsnem.2014-0009.

Eichner, A. (2015). *Dietary Supplements: The more things change, the more they stay the same*. Paper presented at the Partnership for Clean Competition Conference Syllabus: Innovation and implementation in Anti-Doping, Major League Baseball Conference Center, New York, NY.

Geyer, H., Parr, M. K., Koehler, K., Mareck, U., Schanzer, W., & Thevis, M. (2008). Nutritional supplements cross-contaminated and faked with doping substances. *J Mass Spectrom, 43*(7), 892-902. doi:10.1002/jms.1452

Geyer, H., Parr, M. K., Mareck, U., Reinhart, U., Schrader, Y., & Schanzer, W. (2004). Analysis of non-hormonal nutritional supplements for anabolic-androgenic steroids - results of an international study. *Int J Sports Med, 25*(2), 124-129. doi:10.1055/s-2004-819955

Geyer, H., Schanzer, W., & Thevis, M. (2014). Anabolic agents: recent strategies for their detection and protection from inadvertent doping. *Br J Sports Med, 48*(10), 820-826. doi:10.1136/bjsports-2014-093526

Grey-Thompson (2017). Duty of Care in Sport: Independent Report to Government. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/610130/Duty_of_Care_Review_-_April_2017__2.pdf. Accessed 28/05/19

Hurst, P., Kavussanu, M., Boardley, I. & Ring, C. (2019). Sport supplement use predicts doping attitudes and likelihood via sport supplement beliefs. J Sports Sci 12, 1-7 doi: 10.1080/02640414.2019.1589920. [Epub ahead of print]

Inter-Secondary Schools Sports Association (2016). *ISSA GraceKennedy Boys and Girls Athletic Championships March 15-19. Projection 2016.* Kingston, Jamaica: Mapco Printers Limited.

Knapik, J. J., Steelman, R. A., Hoedebecke, S. S., Austin, K. G., Farina, E. K. & Lieberman, H.R. (2016). Prevalence of dietary supplement use by athletes: Systematic review and meta-analysis. *Sports Med*, *46*, 103-123. doi: 10.1007/s40279-015-0387-7

Maughan, R. J. (2018). IOC Medical and Scientific Commission reviews its position on the use of dietary supplements by elite athletes. *Br J Sports Med, 52*(7), 418-419. doi:10.1136/bjsports-2018-099199

Maughan, R. J., Shirreffs, S. M., & Vernec, A. (2018). Making Decisions About Supplement Use. *Int J Sport Nutr Exerc Metab, 28*(2), 212-219. doi:10.1123/ijsnem.2018-0009

Meyer, F., O'Connor, H., & Shirreffs, S. M. (2007). Nutrition for the young athlete. *J Sports Sci, 25* Suppl 1, S73-82. doi: 10.1080/02640410701607338

Morente-Sanchez, J., & Zabala, M. (2015). Knowledge, attitudes and beliefs of technical staff towards doping in Spanish football. *J Sports Sci, 33*(12), 1267-1275. doi:10.1080/02640414.2014.999699

Nieper, A. (2005). Nutritional supplement practices in UK junior national track and field athletes. *Br J Sports Med, 39*(9), 645-649. doi:10.1136/bjsm.2004.015842

Orr, R., Grassmayr, M., Macniven, R., Grunseit, A., Halaki, M., & Bauman, A. (2018). Australian athletes' knowledge of the WADA Prohibited Substances List and performance enhancing substances. *Int J Drug Policy, 56*, 40-45. doi:10.1016/j.drugpo.2018.02.025

Ozdogan, Y., & Ozcelik, A. O. (2011). Evaluation of the nutrition knowledge of sports department students of universities. *J Int Soc Sports Nutr, 8*, 11. doi:10.1186/1550-2783-8-11

Parnell, J. A., Wiens, K., & Erdman, K. A. (2015). Evaluation of congruence among dietary supplement use and motivation for supplementation in young, Canadian athletes. *J Int Soc Sports Nutr, 12*, 49. doi:10.1186/s12970-015-0110-y

Petroczi, A., Naughton, D. P., Pearce, G., Bailey, R., Bloodworth, A., & McNamee, M. (2008). Nutritional supplement use by elite young UK athletes: fallacies of advice regarding efficacy. *J Int Soc Sports Nutr, 5*, 22. doi:10.1186/1550-2783-5-22

Slater, G., Tan, B., & Teh, K. C. (2003). Dietary supplementation practices of Singaporean athletes. *Int J Sport Nutr Exerc Metab, 13*(3), 320-332.

Tawfik, S., El Koofy, N., & Moawad, E. M. (2016). Patterns of Nutrition and Dietary Supplements Use in Young Egyptian Athletes: A Community-Based Cross-Sectional Survey. *PLoS One, 11*(8), e0161252. doi:10.1371/journal.pone.0161252

Tscholl, P., Junge, A., & Dvorak, J. (2008). The use of medication and nutritional supplements during FIFA World Cups 2002 and 2006. *Br J Sports Med, 42*(9), 725-730. doi:10.1136/bjsm.2007.045187

Venhuis, B., Keizers, P., van Riel, A., & de Kaste, D. (2014). A cocktail of synthetic stimulants found in a dietary supplement associated with serious adverse events. Drug Test Anal, 6(6), 578-581. doi:10.1002/dta.1664

Ward, C., Singh, P., Mansingh, A., Wade, N., & Roopchand-Martin, S. (2017). Anti-doping knowledge in Barbadian polyclinic medical staff. *The West Indian Medical Journal*. Advance online publication. doi: 10.7727/wimj.2017.149

Wiens, K., Erdman, K. A., Stadnyk, M., & Parnell, J. A. (2014). Dietary supplement usage, motivation, and education in young, Canadian athletes. *Int J Sport Nutr Exerc Metab, 24*(6), 613-622. doi:10.1123/ijsnem.2013-0087

World Anti-Doping Agency (2015). World Anti-Doping Code (with 2018 amendments). https://www.usada.org/wp-content/uploads/wada-2015-world-anti-doping-code.pdf. Accessed 31/05/19

World Anti-Doping Agency (2018). 2021 Code Revision- second draft. Summary of major proposed changes found in the first draft of the 2021 code. https://www.wada-ama.org/sites/default/files/resources/files/code_major_changes.pdf

World Anti-Doping Agency (2019). The World Anti-Doping Code International Standard. Prohibited List, January 2019. https://www.wada-ama.org/sites/default/files/wada_2019_english_prohibited_list.pdf. Accessed 02/06/2019

TABLES

Table 1. Demographics of the athlete population investigated

Sport	Frequency (%)	N	Age*	Years in sport*
Champs				
M	44.9	57	16.2 (±1.5)	3.3 (±1.5)
F	7.1	9	15.0 (±1.6)	3.4 (±1.1)
Total	51.9	66	16.0 (±1.6)	3.3 (±1.5)
Other Sports				
M	19.7	25	16.1 (±1.6)	3.0 (± 1.3)
F	28.3	36	15.2 (±0.7)	3.2 (±1.2)
Total	48.0	61	15.6 (±1.2)	3.1 (±1.2)
All Sports				
M	64.6	82	16.1 (±1.6)	3.2 (±1.5)
F	35.4	45	15.2 (±0.9)	3.2 (±1.2)
All athletes	100	127	15.8 (±1.4)	3.2 (±1.4)

***** Standard deviations of the ages and years in sport of the participants are presented.

Table 2. Supplementation practices of athletes

Sport	Ever used % (N)	Frequency of use in last year* % of category (N)				
		1	2	3	4	5
Champs						
M	82 (47)	28.1 (16)	38.6 (22)	14.0 (8)	8.8 (5)	10.5 (6)
F	67 (6)	33.3 (3)	33.3 (3)	0 (0)	22.2 (2)	11.1 (1)
Total[a]	80 (53)	28.8 (19)	37.9 (25)	12.1 (8)	10.6 (7)	10.6 (7)
Other Sports						
M	52 (13)	68.0 (17)	16.0 (4)	0 (0)	8.0 (2)	8.0 (2)
F	53 (19)	50 (18)	19.4 (7)	0 (0)	8.3 (3)	22.2 (8)
Total[a]	52 (32)	57.4 (35)	18.0 (11)	0 (0)	8.2 (5)	16.4 (10)
All Sports						
M[b]	71 (58)	40.2 (33)	31.7 (26)	9.8 (8)	8.5 (7)	9.8 (8)
F[b]	56 (25)	46.7 (21)	22.2 (10)	0 (0)	11.1 (5)	20.0 (9)
All athletes	67 (85)	42.5 (54)	28.3 (36)	6.3 (8)	9.4 (12)	13.4 (17)

*Usage was reported on a 5-point Likert scale: 1= never; 2 = occasionally, 3= 1/week, 4 = 2-3/week, 5 = more than 2-3/week. Most of the athletes (67 %, N=85) had previously taken supplements in their lives, 57.4 % (N=73) had taken supplements at least occasionally in the last year, with 29.1 % (N=37) taking supplements at least once a week in the last year. NB Fishers Exact test was performed for category 1 (no last-year use) versus categories 2-5 (last-year use) and effects of sport and gender were significant ([a] $P<0.01$) and non-significant ([b] $P>0.5$) respectively.

FIGURES

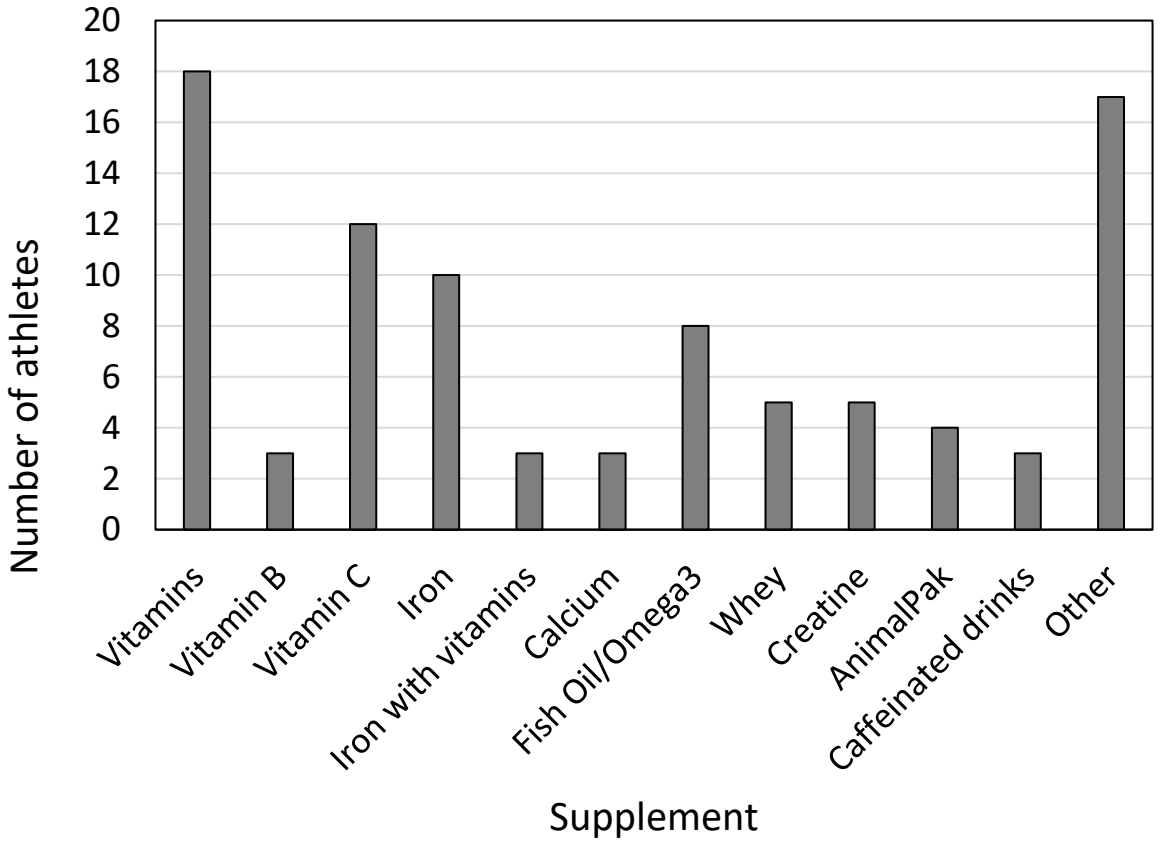

Figure 1. Most popular supplements taken by athletes in the last year. The supplements listed as "other" are described in the main text.

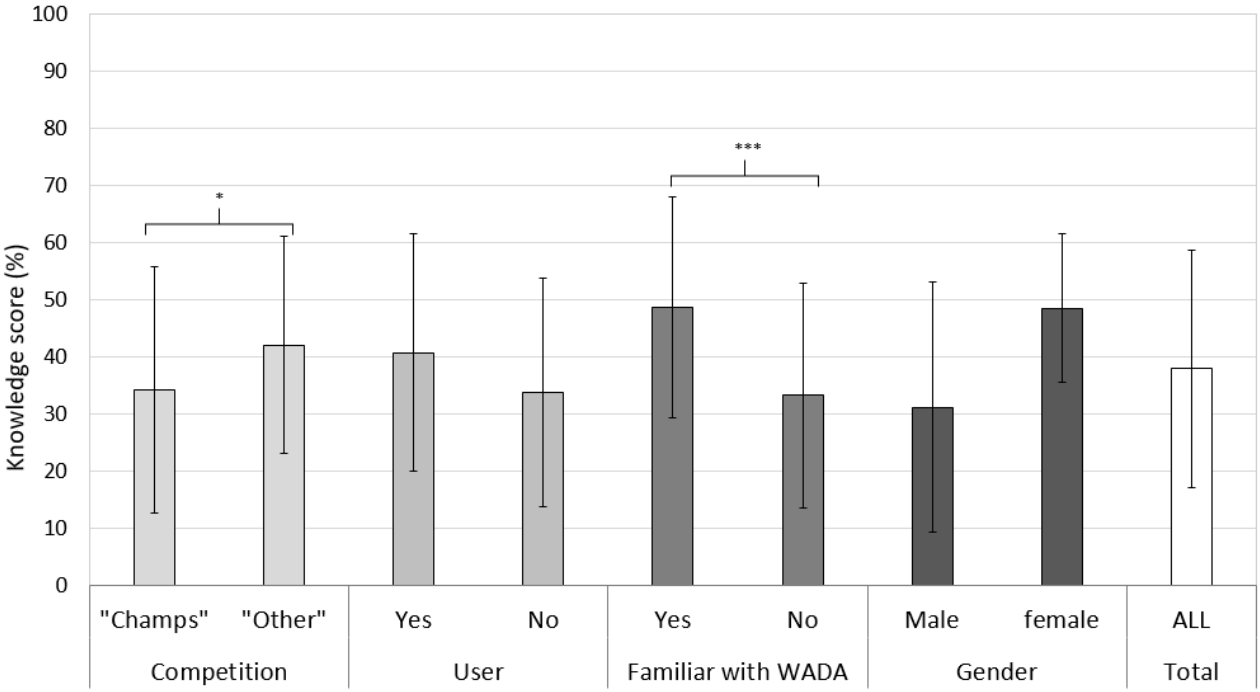

Figure 2. Percentage of correct results (± standard deviation) in the knowledge section of the questionnaire. The score from all respondents was calculated out of a total of 31 maximum possible points. Overall, athletes scored an average of 38 %. A t-test was performed for the Competition ("Champs"/"other"), supplement usage (users/non-users in last year) and self-reported familiarity (familiar/not familiar groupings), due to a homogeneity of variance in these instances (Levene's test), and significant ($P<0.05$, *), non-significant ($P>0.05$) and significant differences ($P<0.001$, ***) were obtained, respectively.

1

2

3

4

5

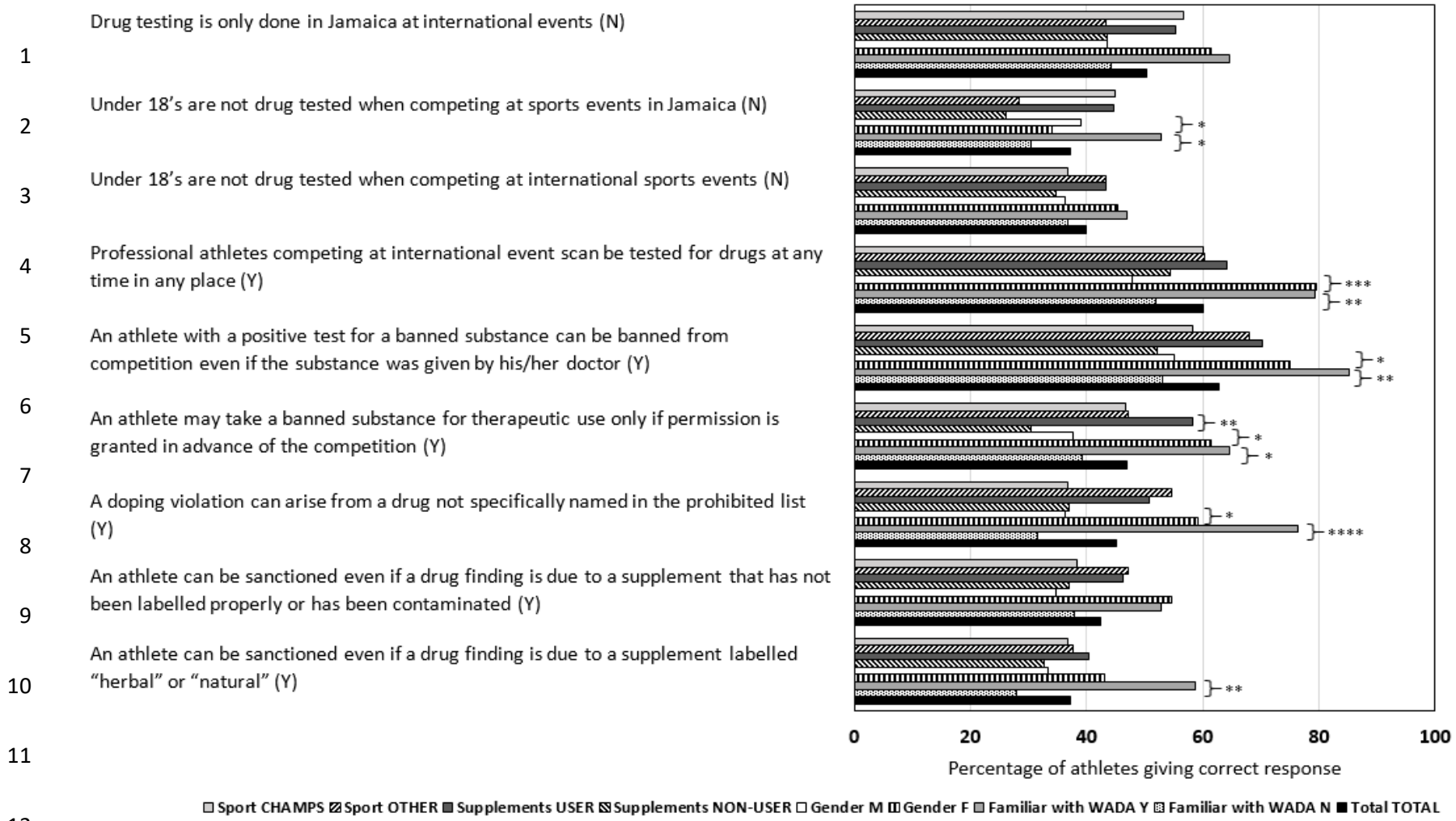

Figure 3. Percentage of athletes giving correct answers regarding specific statements. The correct answers (Y or N) are indicated, and the percentage of athletes providing the indicated answer among the grouped variables are indicated. Gender and self-reported familiarity were frequent factors governing responses to individual questions followed by sport/event, and in 4 instances females scored significantly higher in the individual questions shown, with males only scoring significantly better for one of the statements. Similarly, in 5 instances the athletes with self-reported knowledge scored better than counterparts who stated unfamiliarity with the WADA code. *;P<0.05:**;P<0.01: ***;P<0.001:****;P<0.0001 (Fisher's exact test).

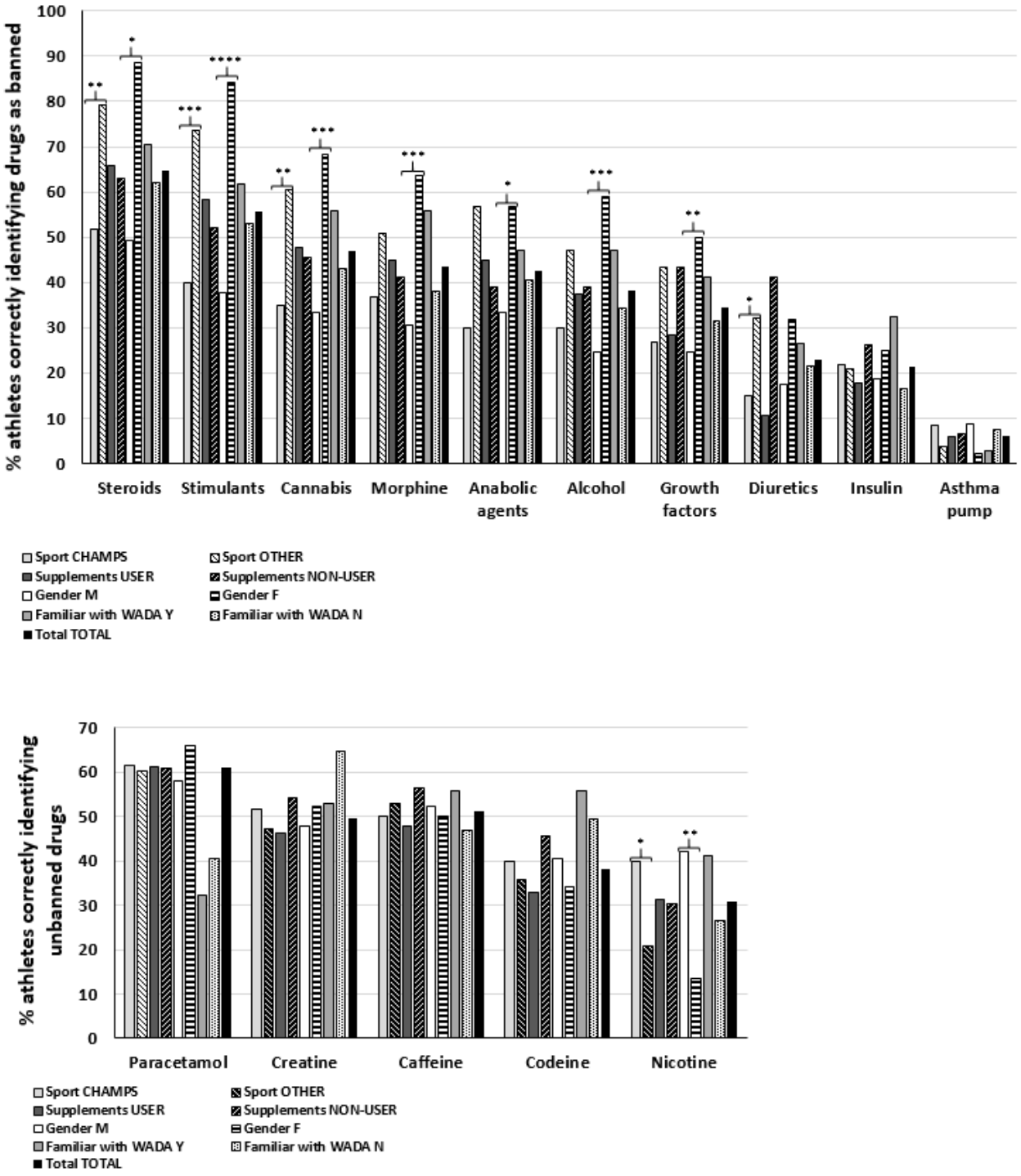

Figure 4. The percentage of athletes answering the knowledge section of the questionnaire that correctly identified classes of banned (a) and non-banned (b) substances. Athletes were asked to assume in their answer that no specific permission had been granted (i.e. "Therapeutic use exemption"). While 65 % of all athletes could identify steroids, fewer athletes could identify growth factors (35 %), diuretics (23 %), insulin (21 %) and asthma pumps (6 %) as banned substances (assuming no therapeutic use exemption), and less than half (47 %) identified cannabis as a banned substance. Paracetamol was recognised as unbanned by 61 % whereas nicotine was correctly identified as unbanned by 31 %. *;P<0.05:**;P<0.01: ***;P<0.001:****;P<0.0001 (Fisher's exact test).