Perspective

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Adulterated dietary supplements threaten the health and sporting career of up-and-coming young athletes

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The anti-doping world is all too familiar with 'sports' or 'performance enhancing' dietary supplements (i.e., products marketed for body building, weight-loss, pre-workout/energy) that are adulterated with stimulants, anabolic agents, and pharmaceuticals, either by accidental contamination or by deliberate spiking. But the larger community surrounding developing young athletes is often not aware of the lurking health and anti-doping risks such products pose. Since most young athletes are not drug tested they, along with the sports administrators, coaches, and parents, are often not motivated to read or are not presented with educational materials alerting them to the possibility of the adulteration of dietary supplements. They also assume that dietary supplements are safe. However, this simply isn't the case when it comes to sports supplements. Several reviews on the contents of such supplements have estimated a contamination rate with stimulants and/or anabolic-androgenic steroids of 14–18% and higher.[1,2] This problem is only going to get worse as the global sports supplement portion of the industry grows and is estimated to reach $12 billion annually by 2020.[3]

Most governments, including the US government, do not have effective regulations in place to protect consumers. A good example to illustrate this problem is the case of methylhexaneamine, an amphetamine-like stimulant first detected in 31 anti-doping samples in 2009[4] and subsequently linked to severe adverse events among athletes, military, and the general public.[5–8] Despite multiple Food and Drug Administration (FDA) enforcement actions in 2013[9] and every year since, methylhexaneamine is still present in dietary supplements and causing serious harm.[10] In another study, researchers examined 27 brands of supplements on sale after FDA recalls and found that 2 out of 3 were still adulterated with banned drugs.[11] Despite attempts to introduce new legislation or tighten existing ones,[12–14] the number of adulterated dietary supplements is ever present. The US government currently does not have effective tools to remove dangerous products from the market and therefore it is critical that coaches, parents, and others involved in administering youth sport organizations receive education about managing the risks posed by adulterated dietary supplements.

The true health consequences caused by adulterated supplements is unknown because adverse events are notoriously underreported.[15–17] Many healthcare providers do not know how or where to file an adverse event report, and parents, coaches, and other youth sport administrators may not even notice the side-effects in their athletes, let alone recognize that they should report them. Furthermore, some side-effects are not acute events, but instead appear as delayed, chronic health problems. As an example, the long-term use of body building supplements has recently been linked to testicular cancer.[18] Coaches and parents and the broader sport organization community cannot just rely on the sudden appearance of strange symptoms in their athletes to identify dangerous supplements.

Sport or performance-enhancing supplements pose risks that are unique to the growing athlete. The developing endocrine and nervous systems are sensitive to the presence of hormones, anabolic-androgenic steroids, and stimulants. For example, the endogenous production of testosterone can be suppressed for months following even a low dose of anabolic-androgenic steroids, and cardiovascular risks and mood disturbance are common side-effects for adolescents.[19] Anabolic agents can also cause premature epiphyseal closure (which is permanent),[20] brain remodelling, and an increased risk of maladaptive behaviors and neurological disorders.[21] For stimulants, increases in blood pressure, loss of appetite, emotional instability, nervousness, jitteriness, and social withdrawal are common side-effects in youth, and prolonged exposure to stimulants can also negatively affect growth.[22] To make matters worse, the stimulants currently popular in dietary supplements are untested in humans[23,24] so their effects on the growing body and mind are completely undocumented. Pharmaceuticals, which are found surprisingly often in dietary supplements, can also have different toxicological effects on children than they do in adults, sometimes making their effects more severe, or at the very least unpredictable.[25] Even very young children are at risk. A retrospective study of in children under 6 reported a 274% increase in the number of poisonings due to pharmaceuticals present in dietary supplements from 2000 to 2010.[26] The substances commonly found in adulterated sports supplements pose serious risks to the health of young athletes, but may not immediately induce obvious side-effects.

Even caffeine has serious and well-documented side-effects at high doses such as inducing transient ischemia[27] and causing sudden death in otherwise healthy individuals.[28,29] While many

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adolescents can handle moderate caffeine without serious consequences, it is often hard to identify the quantity of caffeine and other stimulants in dietary supplements or energy drinks. The American Academy of Pediatrics does not recommend caffeine for adolescents.[30] Caffeine is a very popular ingredient in sports supplements and it can be listed in obscure ways on the label, if it is listed at all.[31] Caffeine should not be ignored in any conversation about dietary supplement safety for young athletes.

Exposure to adulterated sports supplements by adolescents and young adults may be high because the dietary supplements in question are often very popular. Among high school students, the level of supplement use can be as high as 74% and is correlated with the level of sport participation.[32] Many young athletes report using the types of products that are at a higher risk of being adulterated, namely supplements to build muscle, lose weight, and to improve athletic performance.[32,33] Adolescents report obtaining information about dietary supplements from coaches, friends, family members, teammates, the Internet, and other media. Fitness magazines often have high teen readership and contain many advertisements for dietary supplements that are false or misleading but are appealing to teens.[34] The US Anti-Doping Agency (USADA) report – *What Sport Means in America* – also confirms that coaches are key in the life of a young athlete. It is essential that coaches and all of the other individuals surrounding the developing young athlete are well-informed on the dangers of sport supplements so that they can intervene if they learn about the use of such products by their athletes.

The stakes are high for all of us to protect the health of young athletes and to protect clean sport. Between the USADA Supplement 411 High Risk List[35] and the FDA Health Fraud page,[36] plus a multitude of reports in the scientific literature,[11,23,24,37–43] there are more than a thousand products identified to contain stimulants, anabolic-androgenic steroids, or pharmaceuticals. While USADA will continue to support changes in legislation that would stop the sale of illegal and dangerous products under the guise of dietary supplements, we must act now to protect our stakeholders.

It is essential that coaches, parents, and all of the other support personnel involved in the administration of youth sports receive high quality education about reducing the risks from the use of dietary supplements, especially for products marketed for bodybuilding, weight-loss, or energy/pre-workout. Educational efforts should include references to resources that list known adulterated or otherwise risky products such as the Supplement 411 High Risk List and the FDA Health Fraud page, and references to the importance of third-party certification. Youth sport administrators, including those administering sport programmes in junior high and high schools, should have firm policies in place to limit access to such products, and should ensure that coaches and team trainers are aware of these policies.

This is a global problem and it is not going away anytime soon. Until governments around the world improve the effectiveness of enforcement tools to stem the tide of adulterated supplements, it is the responsibility of anti-doping agencies, and all sport organizations to protect clean athletes and clean sport by ensuring athletes do not use adulterated dietary supplements.

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