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EXERCISE PHYSIOLOGISTS SHOULD NOT RECOMMEND THE USE OF EPHEDRINE AND RELATED COMPOUNDS AS ERGOGENIC AIDS OR STIMULANTS FOR INCREASED WEIGHT LOSS

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ABSTRACT

EXERCISE PHYSIOLOGISTS SHOULD NOT RECOMMEND THE USE OF EPHEDRINE AND RELATED COMPOUNDS AS ERGOGENIC AIDS OR STIMULANTS FOR INCREASED WEIGHT LOSS. **Robert A. Robergs, Tommy Boone, Donna Lockner. JEP**online**.** 2003;6(4):42-52. Ephedra, or ma huang, refers to the above ground portion of the plants that comprise the genus ephedra. Although the species of ephedra differ in their chemical composition, the content of biologically active compounds in these plants is mainly due to ephedrine (other compounds being pseudoephedrine, norpseudoephedrine [cathine], and norephedrine [phenylpropanolamine]). Ephedrine is similar in chemical structure and biological function to amphetamine, although having a 25-fold lower biological potency. Nonetheless, ephedrine is a potent central and peripheral nervous system stimulant, causing the stimulation of both ? and ? adrenergic receptors, and the release of dopamine within the brain and norepinephrine (noradrenaline) from sympathetic nerves within and external to the CNS. These mechanisms of action cause bronchial smooth muscle relaxation, increases in heart rate and blood pressure, variable peripheral vasculature constriction and dilation, general feelings of emotional and/or psychological arousal and increased alertness, and an accelerated metabolic rate. The biological responses to ephedrine have lead to its use as a stimulant in efforts to improve exercise performance, and assist in weight loss. It has been estimated that at least 3 billion doses of over-the-counter ephedrine or extracts from ephedra were ingested in the U.S. in 2000 for the purpose of stimulating increased weight loss. In addition, compounds high in ephedrine, such as over-the-counter medications to treat sinus congestion or symptoms of the common cold, can be and are used to synthesize the illegal drug metamphetamine. Intake of ephedrine exposes the user to unacceptable negative side effects, including mood disturbances, abnormal heart function, hypertension, gastrointestinal dysfunction and headache, while providing small amounts of added weight loss and/or central nervous system stimulation. Furthermore, individuals with underlying cardiovascular disease or other illnesses may be at more serious health risk when taking ephedrine. Individuals who need to lose weight (body fat) should rely on modifications to diet and increased daily physical activity and exercise. The need for body fat loss rather than gross weight loss should also be recommended and understood. Where additional assistance is needed in body fat reduction, individuals should consult a registered dietitian or their physician.

Key Words: Ephedra, Ergogenic Aid, Herbs, Supplements, Exercise, Body Composition, Health, Disease,

BACKGROUND

The research of ephedra and/or ephedrine is quite extensive, and has recently been well-reviewed by the US Department of Health and Human Services Agency for Healthcare and Research Quality (1), and within the scientific research journal publication of the same data by Shekelle et al. (2). An additional review/commentary on this topic has been published by the US Food and Drug Administration (3). Despite this recent compilation of critical research review and scientific commentary, we feel that a contribution to this topic by exercise physiologists is essential for the following reasons:

1) Exercise physiologists are the most highly educated and trained professionals on topics pertaining to the health benefits of physical activity and exercise, and how to improve exercise performance.

2) Use of ephedrine for weight loss is predominantly accompanied by recommendations from product manufacturers to also increase exercise or physical activity.

3) Exercise physiologists and dietitians represent the professionals who are integral to the research and professional practice of weight management.

4) The authors of the two main reviews on the safety and efficacy of ephedrine did not comprise an exercise physiologist or dietitian. Nevertheless, an exercise physiologist was included in the Technical Expert Panel that reviewed the US Department of Health and Human Services AHRQ report (1).

5) Recommendations to the public by professionals, such as exercise physiologists, need to balance scientific findings with the highest standards of ethics and professionalism. The public needs a clear explanation of both the scientific and ethical issues associated with any health behavior.

The Indirect Cause of the Problem

There are several mutually exclusive events that have contributed to the present controversy over the efficacy and safety of ephedrine intake for purposes of stimulating increased weight loss. It is best to look at these events in a time series, even though some components have no clear time onset.

By the mid-1990s data from epidemiology research clearly revealed that the U.S. was experiencing an epidemic like no other experienced in the history of the country. The epidemic was different in that it was not disease-based, but rather an epidemic of obesity caused by inadequate diet and daily physical activity (4). Americans were eating too much, consuming the wrong types of food, and were too sedentary (5). Reflections on past recommendations for daily exercise or physical activity revealed failures in promoting a more active lifestyle, and epidemiology research of the mid-1990s that revealed the potential for meaningful reductions in premature death from minimal gains in daily physical activity were accepted by the medical community (6,7). Such findings of the need to only accumulate 30 min/day of activity that was as easy as walking the dog, gardening, or playing with children were interpreted to provide a more appealing rationale for Americans to increase their physical activity (7). Public health and physical activity statistics over the last decade have revealed the premature and inappropriate acceptance of the minimal physical activity approach to combating premature death from the diseases of a sedentary lifestyle (eg. heart disease, diabetes, and certain cancers, etc.). In the last 10 years, Americans have been getting more fat, more inactive, and revealing symptoms of sedentary diseases in adults and even children of younger and younger ages (8,9). Clearly, there has been a reluctance from Americans to use exercise, physical activity and more controlled food intake to curtail increased body fat content and the subsequent disease processes influenced by inactivity and being over-fat.

The final event that contributed to today's controversy over ephedrine was the U.S. Congress approval of the Dietary Supplement Health and Education Act (DSHEA). Initial approval occurred in 1994, and final wording and publication of the DSHEA was complete in 1997 (10). Prior to DSHEA, dietary supplements were subject to the same stringent regulatory requirements as were other foods; the need to prove safety and correct marketing claims to the Food and Drug Administration (FDA) prior to marketing and sales. The DSHEA allowed substances that could be labeled as "dietary supplements" to not require FDA pre-market review for safety and marketing assessments. In addition, product manufacturers did not have to register themselves or their products with the FDA prior to production or sales. In essence, the DSHEA left issues such as product safety, the purity of ingredients, and the labeled composition of the supplement to be the responsibility of the manufacturer.

A dietary supplement was defined as a product that could be taken by mouth that contains a dietary ingredient intended to supplement the diet. A dietary ingredient was defined as component of dietary supplements that was one or more of the following (3,11);

- ?? a vitamin
- ?? a mineral
- ?? an herb or other botanical
- ?? an amino acid
- ?? a dietary substance for use by man to supplement the diet by increasing the total dietary intake, or a concentrate, metabolite, constituent or extract.

What makes a compound a dietary supplement and not a drug? The above list provides some answers to this question, but answer is still not clear. For example, many herbs or botanicals that can be labeled as a dietary ingredient can also be a drug, and ephedrine is a classic example of this. Furthermore, many plant extracts contain compounds that are not only drugs, but are narcotics in that they posses addictive qualities and as such are tightly regulated by the FDA. A few notable examples are nicotine, opium, morphine and heroine.

These developments in the recent history of the U.S. helped to nurture a social scene where Americans knew they were becoming over-fat, were too inactive, and eating too much of the wrong foods. Dietary and physical activity recommendations were continuing to fail, and dietary supplement companies could now market products to the public without prior validation, safety assessment, and external control over marketing claims. It is no surprise that supplements were developed aimed at improving weight loss, and consequently, it should be no surprise that Americans desired to try such supplements as an easier method of weight control than modifications in diet and exercise/physical activity.

It has been estimated that in 1999 approximately 12 million individuals used ephedra and related compunds (12). Dietary supplements of all kinds are used by millions of people on a daily basis, amounting to billions of dollars in annual sales revenue (13). There is enormous financial incentive for companies to market dietary supplements to such a willing market, and obviously, enormous potential for this situation to be exploited by unethical businessmen and women. With limited regulation of the marketplace and an increasing desire by Americans to reduce body weight without changing dietary or exercise habits, it is apparent that individuals need help in recognizing potential risks associated with weight loss supplements. We will later introduce and discuss the actions that need to be taken by the U.S. Congress and the FDA to ensure to the American public that all dietary supplements are safe and thereby indirectly increase the legitimacy of the dietary supplements industry.

What Is Ephedra?

Ephedra, or ma huang, refers to the above ground portion of the plants that comprise the genus ephedra (Figure 1). The species of ephedra differ in their chemical composition and, therefore, the content of the alkaloid compounds ephedrine, pseudoephedrine, norpseudoephedrine (cathine), and norephedrine (phenylpropanolamine). For example, North American and Central American species of ephedra do not contain sufficient quantities of alkaloids to be pharmacologically and biologically meaningful (14,15). To avoid confusion between ephedra and ephedrine in this manuscript, we will use the word ephedrine and when doing so imply that this also relates to the ingestion of extracts of ephedra, which contain ephedrine.

a)

b)

Figure 1. Photographs of a) one species of the ephedra plant (Ephedra sinica), and b) a close view of the plant branches were most of the alkaloid content is found.

Chemical Structures

Ephedrine is classified within a class of potent drugs referred to as alkaloids, which stimulate cardiovascular and neurological function resulting in decreased sensations of fatigue during physical stress. As such, ephedrine is similar in chemical structure and biological function to amphetamines (Figure 2). Alkaloids have been defined in many ways, but a generally accepted definition is as follows: a plant-derived compound that is toxic or physiologically active, contains a nitrogen in a heterocyclic ring, is basic (in solution, pH > 7), has a complex structure, and is of limited distribution in the plant kingdom. The fact that alkaloids produce an alkaline solution (due to their amine group(s)) when dissolved in water is the true origin of their name. Yet, not all solutions of alkaloids are alkaline (15). Most alkaloids are derived from amino acids such as tyrosine. However, a few (like caffeine or nicotine) are derived from purine or pyrimidine functional groups. A medically important alkaloid is quinine, which has been used to treat malaria (chewing of Cinchona bark) since 1633. Other notable alkaloids are atropine, scopolamine, capsaicine, codeine, and the addictive drugs nicotine, cocaine, opium, morphine, and heroine (15).

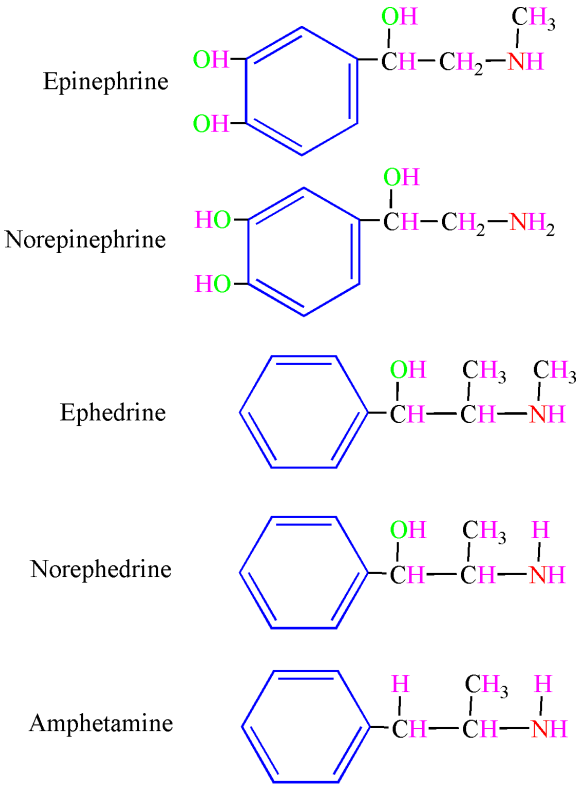

Figure 2. The similar chemical structures of the catecholamines (epinephrine and norepinephrine), ephedrine, norephedrine, and amphetamine.

Pharmacology

Ephedrine has a biological potency approximately 25-fold lower than the amphetamines (14). Ephedrine is a potent central and peripheral nervous system stimulant, causing the stimulation of both ? and ? adrenergic

receptors, as well as the release of norepinephrine (noradrenaline) from sympathetic nerves within and external to the central nervous system (CNS). These mechanisms of action cause ephedrine to induce localized, as well as systemic actions, consisting of bronchial smooth muscle relaxation, increases in heart rate and blood pressure, variable peripheral vasculature constriction and dilation, general feelings of emotional/psychological arousal and increased alertness, and an accelerated metabolic rate. The CNS actions of ephedrine also cause the neurological symptoms of anxiety and psychoses (16,17,18).

Over-the-counter products that contain ephedrine and are promoted as weight loss aids often contain additional stimulants such as caffeine. As will be discussed below, caffeine ingestion with ephedrine adds to the weight loss effect, as well as to the central nervous system stimulation and potential detrimental side-effects.

DOES INTAKE OF EPHEDRA INCREASE WEIGHT LOSS?

The clear answer to this question is yes. On average, additional weight loss when compared to placebo amounts to 0.590 kg/month (Figure 3). These findings have been attained from studies ranging in duration from 2 to 6 months (1,2). No studies have yet assessed the role of ephedrine in long-term (> 6 months) weight loss. Addition of caffeine to ephedrine intake results in an additional 0.363 kg/month of weight loss (Figure 3). These results pertain to an intake of ephedrine recommended by product manufacturers, amounting to 30-150 mg/day, with caffeine intake ranging between 150 to 600 mg/dose. Although there are no data on maintenance of weight loss, it is expected that without significant changes related to dietary intake and physical activity, weight will be regained when supplementation stops.

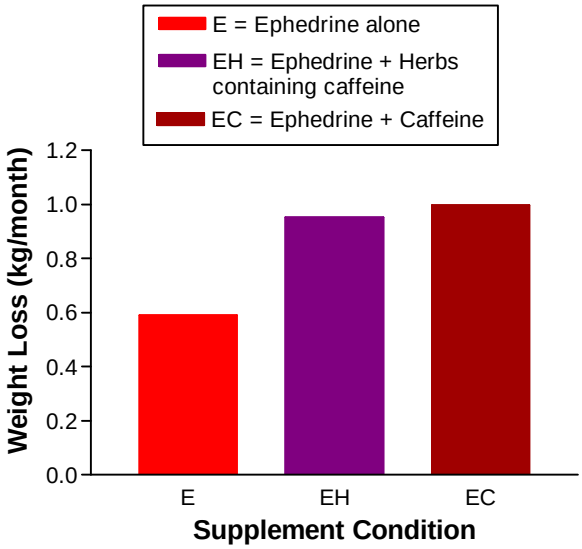

Figure 3. The average weight loss reported by Shekelle et al. (2) associated with varied intake of ephedrine and caffeine.

We are concerned that the AHRQ report and reviews from additional scientists have not qualified the weight loss associated with ephedrine and caffeine intake. Our concerns can be grouped into two aspects;

1) We have to question the practice by clinicians and epidemiologists in focusing on total body weight and the crude variable of body mass index (mass [kg]/(height[m]^2)) to assess overweight and obesity, and the weight loss resulting from ephedrine and caffeine ingestion. Overweight is not the true health concern of the US; being over-fat is the problem. Body weight and body mass index measures do not accurately track changes in body fat or function as clear definitions of obesity (19,20). Certainly, quantifying body fat mass and its change in response to an intervention is more difficult than simply measuring body weight. However, it is the loss in fat mass that results from a controlled and well-regulated diet and exercise regimen that improves health and well-being. Ideally, the fat-free body mass needs to be preserved or even increased during a weight loss regimen. Thus, optimal weight loss should comprise body fat loss alone, and some individuals who do not lose weight may be gaining fat-free mass (muscle, bone mineral, water) and losing considerable fat mass. This latter scenario is good, and would be masked by body weight measures alone.

2) Even if you use the largest reported mean weight loss from ephedrine and caffeine intake of 0.998 kg/month, and assume it is all fat loss, this is not a meaningful loss of body fat. For example, assuming 1 kg of fat approximates a caloric content of 7,715 Kcal, the fat loss that could result from ephedrine and caffeine ingestion amounts to 7,700 Kcal/month. When distributed over a month of 31 days, this amounts to 248

Kcal/day. To develop this caloric deficit, a person needs to only walk a mile and eat less food equivalent to a serving of yoghurt each day. Using an ephedrine product is not the magic pill Americans are in search of to assist in losing body fat.

Weight Loss From Diet and Exercise

A reduction of body fat can be accomplished safely by reducing food intake, as well as fluid that contains calories such as soft drinks, and increasing energy expenditure though physical activity. A modest reduction of 500-1000 Kcal/day can result in a weight loss of 0.5-0.9 kg per week (21). Replacing soft drinks or other fluids that contribute Calories with no-Calorie beverages is one strategy to achieve such a reduction with minimal adjustments of daily menus. Reducing Kcal intake below a total of 800 Kcal/day may result in faster weight loss. But this strategy cannot be recommended because of the limited nutrient content and the fact that these very low Kcal diets have not been shown to result in sustained weight loss for longer than higher Kcal plans (22). The distribution of Kcal from the energy nutrients in a reduced Kcal diet seems less important in achieving weight loss than sustaining an energy deficit. A reduced-fat ad libitum diet (<40 g/day) has been shown to produce greater initial and sustained weight loss compared to a higher fat intake (23). However, with similar protein content (29-32% of Kcal), obese adults have been shown to lose similar amount of weight when fed 1,000 Kcal/day for 6 weeks whether the diet composition was lower fat (26% of total Kcal) (-7.5 kg) or higher fat (53% of total Kcal) (-8.9 kg) (24). Interestingly, individuals who report maintaining a weight loss of at least 13.6 kg for a year describe their eating pattern as low in fat and high in carbohydrate (25). Although diets that vary in relative amounts of macronutrients may affect satiety, and therefore compliance, comparisons in controlled trials are limited (26).

The effect of exercise on weight loss may be less important than its effect on weight maintenance. A recent meta-analysis of the effect of exercise on weight loss showed only a modest (2.9 kg) loss due to exercise during programs lasting an average of 12 weeks, but weight loss progressed to 6.1 kg at one year follow-up in those who continued to exercise (27). Although many studies report only changes in weight and not changes in fat mass, some of those where body composition is reported show that exercise training during Calorie restriction helps to preserve the fat-free mass (28,292,30).

Maintaining the fat free mass (mostly muscle mass) is important for maintaining what is for many people the largest component of daily energy expenditure - resting metabolic rate. Although a reduction in resting metabolic rate (RMR) is usually seen during caloric restriction resulting in weight loss (31,32), any strategy that can help to negate this drop in RMR should be encouraged. A meta-analysis of studies examining the change in RMR with diet compared to diet with exercise has shown less of a reduction in RMR when exercise is included (33,34,35). Most of the studies included in the meta-analysis used low-fat diets of less than 1,200 Kcal/day and 31-60 minutes of aerobic activity 4-5 days/week. Despite several studies that failed to show a benefit of strength training to reverse the drop in RMR seen with caloric restriction (34), strength training has for some been of benefit in maintaining RMR (29) or increasing RMR when not restricting energy intake (36).

DOES INTAKE OF EPHEDRA IMPROVE EXERCISE PERFORMANCE?

Only been a small number of studies have been published that assessed the ergogenic potential of ephedrine. Shekelle et al. (1,2) based their analysis of ephedrine and exercise performance on 8 studies, which are all documented and discussed by Shekelle. Of this research, there is evidence to show that ephedrine plus caffeine can improve intense exercise such as weight lifting and cycle exercise to fatigue for durations between 0.5 and 3 min. However, all such research has yet to be able to separate the influence of ephedrine from caffeine (37). Longer duration, less intense exercise has shown no benefit from ephedrine intake. Consequently, each of the AHRQ report (1), Shekelle et al. (2) and Bucci (10) clearly state that research on the ergogenic potential of ephedrine plus caffeine is insufficient in number and research design. For example, no study has adequately assessed exercise performance. Time to fatigue during running or cycling is not performance, but a laboratory

measure of endurance. In addition, the collection of exercise studies only assessed short-term ephedrine intake and the immediate responses of exercise to this supplementation.

IS EPHEDRINE SAFE?

There is an enormous amount of scientific interpretations, commentaries, and public opinion on the safety or dangers of ephedrine intake. Numerous medical and/or research trained professionals have expressed their support or opposition to the use of ephedrine. Such debate and conjecture is a good trait of any validation and scientific process, but the diversity of professional opinion on ephedrine is guaranteed to confuse the public about whether ephedrine is safe.

Evidence From Scientific Research

Prior to presenting research data on the safety of ephedrine, the public needs to understand that in most research studies, research subjects are pre-screened for any functional condition that is likely to increase the risk of participation in the study. Based on federal guidelines, researchers need to exclude these subjects from the study. As such, no research conducted on any practice that is likely to cause harm will use subjects that possess traits likely to combine with the treatment to cause harm. Consequently, no experimental research study uses subjects who are collectively representative of the entire U.S. population. This is a major limitation since it invalidates that application of the research to the broader population. Such a limitation is important when any issue arises concerning the application of research results to all citizens.

Based on this limitation of experimental research, there needs to be caution when interpreting research findings, as well as comments from scientists who claim that ephedrine is safe based on published research. Despite these limitations, of the 52 controlled trials that researched the safety of ephedra products, ephedrine, or ephedrine plus caffeine, as reported by Shekelle et al. (1,2), there are very compelling findings that demonstrate the dangers of ephedrine supplementation. Figure 4 presents data from Shekelle et al. that compares the incidence of detrimental side-effects from ephedrine, or ephedrine plus caffeine to placebo groups. Clearly, even in the controlled studies, where subject recruitment and health status is screened and confined to healthy individuals, ephedrine intake is associated with, on average, 2 to 4 times the risk for developing potentially serious side-effects. Risk was greatest for psychiatric disorders. The large 95% confidence interval data for these detrimental conditions reveals even a more negative view, especially for hypertension.

Evidence From the Pharmacology of Ephedrine

Ephedrine functions as a mild amphetamine. In so doing, it has side effects that are unhealthy if taken on a regular basis, such as an increase in blood pressure, heart rate, and disturbances to the normal electrical excitation of the heart (1,2). In addition, ephedrine can induce stimulatory events in the brain that may cause detrimental symptoms that range from mild mood disturbances to serious neural malfunction (1,2). Interestingly, such symptomology is revealed in the data reported by Shekelle et al. (1,2), and as revealed in Figure 4. Repeated intake at high doses (>100 mg/day) may also induce an addictive-like dependence. Pharmacology evidence alone should dissuade use of ephedrine.

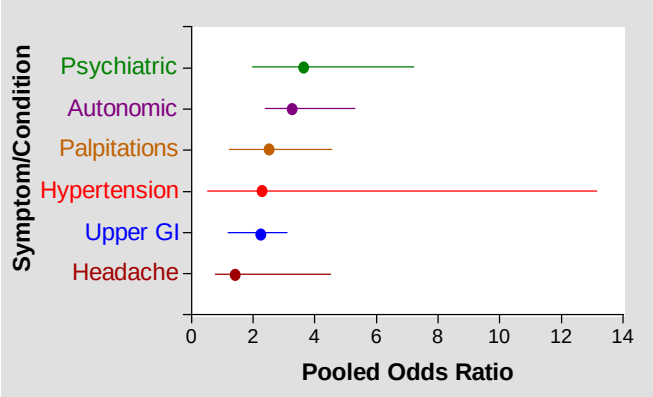

Figure 4. Pooled odds ratios, with 95% confidence intervals (lines) for the main categories of adverse events reported in controlled trials of ephedrine supplementation. Adapted from Shekelle et al. (2).

Evidence From Case Reports of Medical Complications/Symptoms

Due to the inability of scientific research to use subjects that represent the diversity of the U.S. population, case reports of adverse events are very important. Of course, public criticisms of adverse events exist based on the

limited ability to accept a cause-effect response between the intake of ephedrine to the event at question. Nevertheless, given the prior explanation of the limitations to experimental research and subject recruitment, adverse events cannot be overlooked.

It is not our intention to revise or re-tell many of the adverse events stories. Such stories are presented in detail elsewhere (1,2). The fact remains that of the more than 18,000 case reports evaluated by the U.S. Department of Health and Human Services Agency for Healthcare and Research Quality (1), 284 underwent detailed review, indicating a serious likelihood for a connection between ephedrine intake and the event. For these 284 cases, clinical evidence was assessed and if a series of conditions applied, the adverse event was termed a "sentinel event", implying that there is a greater likelihood that cause-and-effect may have existed. These conditions were: 1) ephedra/ephedrine consumption within 24 hours of the event, 2) toxicology evidence of ephedrine or related products in the blood or urine of the patient, and 3) exclusion of other possible causes of the event (RAND). For ephedra and ephedrine intake, a total of 33 sentinel events were identified, and an additional 50 events were coded to be "possible sentinel events". These findings are summarized in Table 1.

Table 1. Summary data, for ephedra and ephedrine intake combined, for sentinel and possible sentinel events.

Event	*Sentinel*	*% Male*	*% 13-30 yrs*	*Possible*	*% Male*	*% 13-30 yrs*
Death	5	60	80	12	67	42
Myocardial Infarction and other cardiac	5	60	60	10	50	20
Cerebrovascular accident and other Neurologic	11	36	45	13	38	23
Seizure	4	0	50	7	50	43
Psychiatric symptoms	8	63	63	8	50	63

Data from the US Department of Health and Human Services Agency for Healthcare and Research Quality (1).

Table 2. Data on the adverse reactions and relative sales of herbal products in the U.S.A. for the year 2001.

Herb	*Adverse Reactions (n)*	*% Sales*
Ephedra	**1178**	**0.82**
Ginko Biloba	28	14.05
St. John's Wort	31	7.98
Echinacea	69	16.62
Ginseng	46	10.45
Valerian	44	4.78
Kava	59	4.30
Yohimbe	10	0.75
All herbal products excluding ephedra	***654***	***99.18***

Data from Bent et al. (38)

A comparison of the adverse events form ephedrine to other herbal supplements provides another realistic and fair comparison for the risks inherent in ephedrine use. Bent et al. (38) reported that the medical complaints and adverse events linked to ephedrine intake far exceed those of other herbal products. For example, data reveal that 64% of all medical adverse events linked to herbal supplements occur from ephedrine products, despite such products accounting for < 1 % of total herbal product sales. The data presented by Bent et al. are provided in Table 2. Clearly, no rational argument can be made for asserting that ephedrine intake is safe when compared to other substances, within or external to the dietary supplement herbal market.

Recommendations For Revisions to the Dietary Supplement Health and Education Act (DSHEA)
Medical commentary exists that questions the current Dietary Supplement Health and Education Act (DSHEA) (13). We feel that such commentary is justified. Currently, the DSHEA allows compounds to be sold as a dietary supplement, with minimal regulation by the FDA, so long as it adheres to a herbal extract criterion. However, and as explained in the sections on the chemical and pharmacological properties of alkaloids, many potentially dangerous compounds are derived from herbal extracts, and some of these are controlled substances. Consequently, there is a tremendous inconsistency in what is an allowable and what is not an allowable herbal extract. Fontanarosa et al. (13, p. 1569) have recognized this issue, and have stated;

> "*Dietary supplements that have biological activity should be evaluated and regulated with at least the same degree of oversight as is used for over-the-counter medications, and for some, with regulation similar to prescription drugs.*"

We believe that such regulatory action is essential to prevent future public health risks from the same or other herbal extracts that possess biological activity. As such, "*biological activity*" requires further definition. In our minds, biological activity would imply that it influences cellular function or systemic physiological that could induce cellular or physiological dysfunction. An eventual ban of ephedrine products might be a future event, as has been urged by the American Heart Association, and has in fact occurred in Illinois (May, 2003). Bans on the use of ephedrine and related products has also occurred in specific institutions or sporting groups such as the US military (Airforce, Army and Marine Core), minor league baseball, the National Football League, the International Olympic Committee, and the National Collegiate Athletics Association. However, such bans do nothing to prevent the potential for additional harm to be done by other herbal dietary supplements. The most important preventative action that can be taken is to remove the regulatory loop-holes of the DSHEA.

SUMMARY

As exercise physiologists and dieticians, our interpretation of all research on ephedrine leads us to conclude that the use of ephedrine containing products exposes the user to unacceptable health risks relative to the minimal weight loss and ergogenic potential of the supplement.

We strongly believe that all exercise physiologists and dieticians SHOULD NOT RECOMMEND the use of ephedrine as a stimulant for increased weight loss, or as an ergogenic aid for intense exercise performance.

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