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ORIGINAL PAPER

Dietary Supplement Use by Children and Adolescents in the United States to Enhance Sport Performance: Results of the National Health Interview Survey

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Abstract Dietary supplements may improve sport performance in adults. However, this has not been established in children. The aim of this study was to assess self-reported or parental-reported dietary supplement use to enhance sports performance among the child subset of the National Health Interview Survey (NHIS) dataset and determine national population estimates for that use. NHIS 2007 Child Alternative Medicine files containing records for children aged <18 years were used. Typical demographic variables were utilized as well as parental presence; parental education level; use of any herb, vitamin, and/or mineral use for sports performance by children; and age. Most (94.5%) who reported using supplements used multivitamin and/or mineral combinations followed by fish oil/omega-3 s, creatine, and fiber. Males were more likely users (OR = 2.1; 95% CI [1.3, 3.3]), and Whites reported greater usage. Mean user age was 10.8 ($SD = 0.2$) with 57.7% >10 years, indicating some increase in use with higher age categories ($p < .001$). Most were US born and reported living with both parents. Parents and children report child use of a wide variety of herbal and vitamin/mineral supplements to improve sports performance. Usage could be predicted by age, gender, and level of education but less likely by parent-based demographics.

Keywords Adolescent · Dietary supplements · Food supplements · Sports performance

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Introduction

According to the National Council on Youth Sports (NCYS, 2008) there are 44 million youth athletes participating in organized athletics annually in the United States. High school sports participation is also

at an all-time high. For over 20 years, the number of US high school athletes has continued to rise, but of particular note is the dramatic increase documented after the 1993–1994 academic year. From 1979–1980 to 1993–1994, high school athletic participation rose by just over a total of 335,000 athletes (5.3–5.6 million). Since that point, participation has increased by almost 2 million athletes to 7.5 million (National Federation of State High School Associations, 2009).

While athletic participation is generally seen as a positive, healthy behavior, factors such as safety, physical growth and development, and nutrition are issues vital to a young athlete's health. From a legislative standpoint, the passing of the Dietary Supplement Health Education Act (DSHEA) in 1994 has allowed manufacturers of dietary supplements to openly market products without prior Food and Drug Administration (FDA) approval for safety and efficacy. The potential for health concerns of young athletes can be seen in the position statement of the American College of Sports Medicine (ACSM), the American Dietetic Association (ADA), and the Dietitians of Canada (DOC) on Nutrition and Athletic Performance (2009).

In the United States, the Dietary Supplements and Health Education Act of 1994 allows supplement manufacturers to make health claims regarding the effect of products on body structure or function, but not therapeutic claims to "diagnose, mitigate, treat, cure, or prevent" a specific disease or medical condition. As long as a special supplement label indicates the active ingredients and the entire ingredients list is provided, claims for enhanced performance can be made, valid or not (p. 721).Without regulation, the dietary supplement industry has experienced annual growth at an average of 12% per year (Muth, Domanico, Anderson, Siegal, & Bloch, 1999). In 2010, dietary supplements for sport-specific and weight loss usage accounted for $22.7 billion in supplement company profits (Nutrition Business Journal, 2011).

An examination of youth athletes revealed that many are either currently using or considering the use of supplements including those marketed to improve sport performance (Bell, Dorsch, McCreary, & Hovey, 2004). It is estimated that 70% of youth under age 18 have consumed dietary supplements (Herbold, Vazquez, Goodman, & Emans, 2004; Wilson et al., 2006). While the reasons for use vary, many youth athletes seek supplementation for the enhancement of sport performance (Calfee & Fadale, 2006; Metzl, Small, Levine, & Gershel, 2001; Smith & Dahm, 2000). However, studies have shown that many dietary supplements fail tests of safety, purity, and quality of ingredients; consequently, this increase in use among a vulnerable population is alarming (Fox, 2010; Green, Catlin, & Starcevic, 2001; International Olympics Committee, (n.d.). Even with regulatory improvements triggered by the 2007 current Good Manufacturing Practice requirements (Food & Drug Administration, 2007), dietary supplement use among children and adolescent athletes for sport performance enhancement should be considered an area of needed health education. Reduction of potential health risks from such supplements should also be a goal within primary prevention.

Supplement Use in Children and Adolescents for Sport Performance

Regarding sport performance and dietary supplements, the American Academy of Pediatrics (AAP) considers them to be "any substance taken in non-pharmacologic doses specifically for the purposes of improving sports performance" (AAP, 2005). In addition, a substance should be considered performance enhancing if it benefits sports performance by increasing strength, power, speed, or endurance (ergogenic) or by altering body weight or body composition. Furthermore, substances that improve performance by causing changes in behavior, arousal level, and/or perception of pain should be considered performance enhancing (p. 1104).

According to AAP, performance-enhancing substances include the following:

- Pharmacologic agents (prescription or nonprescription) taken in doses that exceed the recommended therapeutic dose or taken when the therapeutic indication(s) are not present (e.g., using decongestants for stimulant effect, using bronchodilators when exercise-induced bronchospasm is not present, increasing baseline methylphenidate hydrochloride dose for athletic competition).
- Agents used for weight control, including stimulants, diet pills, diuretics, and laxatives, when the user is in a sport that has weight classifications or that rewards leanness.

- Agents used for weight gain, including over-the-counter products advertised as promoting increased muscle mass.
- Physiologic agents or other strategies used to enhance oxygen-carrying capacity, including erythropoietin and red blood cell transfusions (blood doping).
- Any substance that is used for reasons other than to treat a documented disease state or deficiency.
- Any substance that is known to mask adverse effects or detectability of another performance-enhancing substance.
- Nutritional supplements taken at supra-physiologic doses or at levels greater than required to replace deficits created by a disease state, training, and/or participation in sports (p. 1104).

The AAP categorically opposes sports performance enhancer use and in 2005 published a position statement on performance-enhancing substances. The position statement warned of shortcuts in training by taking products marketed by supplement companies and suggested a reasonable strength and conditioning program along with a well-balanced diet be presented as a sensible alternative. The AAP stated that there was a paucity of data available on the efficacy and safety of most widely used performance-enhancing substances in children and adolescents (AAP, 2005).

Purpose and Rationale

Although evidence suggests that some supplements may improve sport performance among adults, the potential long-term benefits and consequences have not been scientifically studied in a healthy child or adolescent population. Despite this lack of clinical evidence, supplement manufacturers have historically targeted teenagers in particular through the development of age-specific products and advertisement placements (BodyBuilding.com, n.d.; First Place Supplements, 2005; Shaw, Zhang, & Metallinos-Katsaras, 2009). The aim of this study was to assess self-reported use of dietary supplements to enhance athletic and sport performance among children and the adolescent subset of the NHIS dataset and to consequently determine the national population estimates of those using herbal as well as vitamin/mineral supplements for this purpose.

Methods

Study Design

The study was a secondary data analysis of the cross-sectional National Health Interview Survey (NHIS) 2007 data set (Centers for Disease Control & Prevention [CDC], 2007). The ASCII Data sets of the NHIS 2007 Person File, Adult, and Child Alternative Medicine Files were imported into the Statistical Analysis System, version 9.1.3 (SAS Institute Inc., Cary, NC), and merged into a single data set. Only observations (respondents) having records in the Child Alternative Medicine file and variables relevant to answer the research questions were retained. The CDC defines adolescents as those aged 10–24 years (CDC, 2004) so this sample included children aged <10 years and adolescents aged <18 years. The variables retained included socio-demographic variables such as age, gender, race/ethnicity, geographic location, and citizenship status of the respondents; parental presence in the family; parental level of education; parental use of sport enhancement, herbal, vitamin/mineral supplements; and use of any herb, vitamin, and/or mineral for sports performance by these children. Most of the imported variables were recategorized or recoded to suit the specific purposes of this study. The study was approved by both the research committee and the institutional review board of the institution at which the analysis was performed.

Outcome and Predictor Variables

Children participating in the NHIS 2007 or their parents were asked specifically whether the child or adolescent had "improved their sports performance" within past 30 days by taking either a vitamin or mineral supplement or herb for the purpose of "enhancing sport performance." Valid responses within the survey data that were analyzed were "yes" or "no." Other responses such as "unknown, not certain" or nonresponses were coded as missing and eliminated from the analysis. Therefore, the variable *improvement of sports performance* was created to represent the affirmative responses and constituted the main outcome variable. The main predictors were variables that queried the use of several options of herbs, vitamins, and minerals for sports performance by the child, with the responses to

each being "yes/no." A complete list of all possible herbal, vitamin, and mineral options queried in NHIS 2007 is listed in Table 1. However, for models on the effect of demographic variables on the use of supplements, the binary outcome variable *used supplements for sports* was defined to include "yes" if a respondent agreed to use of any dietary supplement and "no" otherwise.

Demographic Variables

Information on race/ethnicity was collected by a method consistent with the procedures used by the US Census Bureau (USCB) to create the Modified Race Data Summary File used for population control. With this method, race/ethnicity was assessed through two variables: a variable that questioned specifically the Hispanic origins (Puerto Rico, Mexican/Mexican–American, Cuban/Cuban American, Dominican Republic, Central/South American, other Latin American, other Spanish, Hispanic/Latino/Spanish/nonspecific type, and not Hispanic/Spanish origin) and another variable that included all other racial groups in the US (White only, Black/African American only, American Indian/American Native only, Asian only, nonreleasable race group and multiple race). These variables were grouped and recoded into five categories: Whites (non-Hispanics), Blacks, Hispanic, Asian, and Others (USCB, 2000).

Age was a continuous variable that included entry from zero years. This was recategorized excluding ages 18 years and above as follows: $\leq$10 years of age and >10 years. Education level was assessed by a variable that categorized "never attended school or less than kindergarten" as one level and "1st to 8th grade," "9th–12th grade," and ">12th grade/some college" in another category. The NHIS collected data in geographic clusters that included the Northeast, Midwest, South, and West regions of the US Parental presence in the family was originally categorized as "mother, no father"; "father, no mother"; "mother and father"; or "neither mother nor father." Parental education levels were originally recorded as separate variables and were subsequently recoded as "$\leq$8th grade"; "high school graduate/GED recipient"; "college education," including technical/vocational/degree, associate/bachelors; and "graduate education," including master's, professional, or doctoral degree. For each of the variables above, responses that could not fit into the defined categories were coded as missing.

Data Analysis

Data analyses were performed using the Statistical Analysis System (SAS) software, version 9.1.3 (SAS institute Inc., Cary, NC). National population estimates (weighted frequencies) were generated using the NHIS survey weight for all variables, including weighted percentages and standard errors. Odds ratios and 95% CI were calculated using binary/multiple logistic regression models to assess the likelihood of respondents reporting improvement of sport performance following the use of herbal, mineral, and/or vitamin dietary supplements as well as the likelihood of using those supplements in general with respect to each demographic variable. The survey (linear) regression model was also used to assess the relationship between reported usage of dietary supplements and age. The statistical significance of each assessment was evaluated based on a 5% level of significance.

Results

A total of 9,417 records (respondents) as found in the Child Alternative Medicine file of NHIS 2007 were analyzed. This resulted in a national population estimate of over 73.7 million children. About 1.2 million (1.64%) children or adolescents reported using some sort of dietary supplements (herbs, mineral, or vitamins) specifically to enhance sport performance, with about the same percentage (1.65%) noting an improvement in sports performances within the past 30 days of implementing the NHIS 2007. The various types of herbs, vitamins, and/or minerals and other substances used are reported in Table 2. Among those who reported using supplements to enhance sports, a majority (94.5%) used a multivitamin and/or mineral combination. Use of fish oil, omega-3, or DHA fatty acids was reported by 43.5%, creatine by 34.1%, and fiber or psyllium by 25.9%.

Table 3 contains a distribution of those who reported using dietary supplements to enhance sport performance across various demographic variables. Males (68.6%) were twice as likely to report using supplements for sports performance compared to

Table 1 A complete list of possible herbs, vitamins, and minerals for child and adolescent sports enhancement from the National Health Interview Survey, 2007

Herbal supplements	Vitamin and mineral supplements
1. Combination herb pill	1. Multivitamin and/or mineral combination
2. Androstenedione	2. Calcium
3. Black cohosh	3. Chromium
4. Carnitine	4. Coral calcium
5. Chasteberry	5. Folic acid/folate
6. Chondroitin	6. Iron
7. Coenzyme Q-10	7. Magnesium
8. Comfrey	8. Niacin
9. Conjugated Linolenic Acid (CAL)	9. Potassium
10. Cranberry pills or gelcaps	10. Selenium
11. Creatine	11. Vitamin A
12. DHEA	12. Vitamin B complex
13. Echinacea	13. Vitamin B6
14. Ephedra	14. Vitamin B12
15. Evening primrose	15. Vitamin C
16. Feverfew	16. Vitamin D
17. Fiber or Psyllium (pills or powder)	17. Vitamin E
18. Fish oil, Omega 3 or DHA fatty acids	18. Vitamin K
19. Flaxseed oil or pills	19. Zinc
20. Garlic pills or gelcaps	20. Vitamin packet
21. Ginger pills or gelcaps	
22. Ginkgo biloba	
23. Ginseng	
24. Glucosimine	
25. Goldenseal	
26. Guarana	
27. Grape seed extract	
28. Green tea pills (not brewed)	
29. EGCG (pills)	
30. Hawthorn	
31. Horny goat weed	
32. Kava kava	
33. Lecithin	
34. Lutein	
35. Lycopene	
36. Melatonin	
37. MSM (Mythylsulfonylmethane)	
38. Milk thistle	
39. Prebiotics or probiotics	
40. SAM-e	
41. Saw palmetto	
42. Senna	
43. Soy or soy isoflavones	
44. St John's wort	
45. Valerian	

Adapted from the National Health Interview Survey (2007)

Table 2 National population estimates (NPE) and percentages of specific types of herbal or vitamin/mineral supplements used by children and adolescents in the United States to improve sports performance

Supplement	NPE	Percent (SE)
Herbal supplement		
(Used in past 30 days)	81,365	5.5 (1.3)
Combination herb pill	5,717	8.1 (–)
Creatine	24,177	34.1 (–)
Evening primrose	10,144	14.3 (–)
Fiber or Psyllium	18,364	25.9 (–)
Fish oil or Omega 3 or DHA fatty acids	30,837	43.5 (–)
Soy supplements or isoflavones	2,982	4.2 (–)
Vitamin/mineral supplement		
(Used in past 30 days)	1,161,152	4.4 (0.5)
Multivitamin and/or mineral combination	1,088,488	94.5 (0.8)
Calcium	79,807	6.9 (1.0)
Chromium	1,603	0.1 (0.0)
Iron	1,621	0.1 (0.0)
Magnesium	1,603	0.1 (0.0)
Potassium	11,095	1.0 (0.0)
Vitamin A	1,847	0.2 (0.2)
Vitamin B complex	22,785	2.0 (0.2)
Vitamin B12	1,847	0.2 (0.2)
Vitamin C	39,232	3.4 (0.8)
Vitamin D	2,671	0.2 (0.0)
Vitamin packet	2,982	0.3 (0.0)

Adapted from the National Health Interview Survey (2007)

females and 60% of Whites reported usage compared to 20% of Blacks and 12.5% of Hispanics. This distribution was not statistically significant. The mean age of those reporting the use of supplements was 10.8 ± 0.2 years of age, with about 57.7% having an age >10 years. Usage increased with age ($p < .001$), with 47% of supplement use reported by those in grades 9–12. They were almost twice as likely to report usage compared to those between 1st and 8th grades (OR = 1.87, 95% CI [1.13, 3.08]). Twenty-three percent of usage was reported by those who never attended school or had attended kindergarten only, and a strong majority (94.5%) was US born.

Most respondents reporting usage of supplements also reported living with both parents (72.9%), with no statistically significant difference in usage with those living with either a single or no parents. Although a 63% increased odds in usage was noted for those living with father-only as compared to mother-only, this was not statistically significant (OR = 1.63, 95% CI [0.56, 4.75]). Over 54% of either parent had a college level of education and less than 3% had a level <8th grade.

Discussion

Two salient issues underlie the importance of these results: First, youth sports participation is generally regarded positively as a social and cultural activity and considered beneficial for physical, mental, and emotional health as well as growth and development. The fact that participation continues to increase should be viewed favorably in context of adolescent and child health. Second, while ample scientific evidence supports appropriate nutrition and hydration practices for healthy youth sports participation, the use of dietary supplements to enhance sport performance among young, healthy participants is not endorsed nor recommended by existing health science literature.

Within this study population of 73.7 million children, it should be noted that nationally over 44

Table 3 National population estimates (NPE), odds ratios (OR), and 95% CI of children and adolescents in the United States that use sports enhancement supplements (herbs, minerals, or vitamins) as distributed across demographic variables

Demographic variable	NPE	% (SE)	OR	95% CI
Overall	1,207,857	1.64 (0.17)		
Region				
Northeast	256,261	21.00 (1.03)	Ref	
Midwest	223,924	18.54 (0.98)	0.61	[0.32, 1.18]
South	467,856	38.73 (2.68)	0.82	[0.47, 1.44]
West	259,816	21.51 (1.61)	0.75	[0.41, 1.36]
Sex				
Male	828,312	68.58 (3.76)	2.11	[1.34, 3.33]
Female	379,545	31.42 (3.76)	Ref	
Race/Ethnicity				
White	729,194	60.37 (3.19)	Ref	
Hispanic	150,549	12.46 (2.89)	0.92	[0.54, 1.57]
Black	242,212	20.05 (2.44)	0.75	[0.42, 1.36]
Asian	38,003	3.16 (0.75)	0.71	[0.32, 1.55]
Other	47,899	3.97 (0.18)	2.50	[0.73, 8.63]
Age				
Mean age	10.84 (0.81)			
≤10	510,886	42.30 (2.90)	Ref	
>10	696,971	57.70 (2.90)	2.13	[1.40, 3.24]
Education				
Never attended or kindergarten-only	278,542	23.06 (2.68)	0.55	[0.31, 0.97]
1st-8th grade	568,795	47.09 (3.80)	Ref	Ref
High school	360,520	29.85 (3.15)	1.87	[1.13, 3.08]
College	0	0	–	–
US citizenship				
Yes	1,141,535	94.51 (1.53)	0.77	[0.39, 1.52]
No	66,322	5.49 (1.53)	Ref	
Parents present				
Mother, no father	250,076	20.70 (1.49)	0.88	[0.52, 1.47]
Father, no mother	54,246	4.49 (2.17)	1.42	[0.44, 4.62]
Mother and father	880,580	72.90 (3.89)	Ref	
Neither mother nor father	22,955	1.90 (0.81)	0.61	[0.20, 1.87]
Education of father				
≤8th grade	26,262	2.83 (0.93)	Ref	
High school/GED	306,840	33.05 (3.84)	1.93	[0.70, 5.32]
College/bachelor's	515,499	55.53 (4.59)	2.58	[0.88, 7.53]
Masters/doctorate/post-doc	79,724	8.59 (1.68)	1.59	[0.43, 5.81]
Education of mother				
≤8th grade	21,184	1.87 (0.71)	Ref	
High school/GED	366,939	32.45 (3.07)	2.87	[1.05, 7.88]
College/bachelor's	611,351	54.07 (3.45)	3.38	[1.23, 9.26]
Masters/doctorate/post-doc	131,182	11.60 (1.85)	4.21	[1.38, 12.80]

Total NPE = 73,727,832

Adapted from the National Health Interview Survey (2007)

million kids participate in organized youth sports, estimating more than I in 2 of our study population taking part in athletics. The vast majority of youth sport participants do not report taking dietary supplements for sports performance, but some certainly do as this study reports. In this sample, among those using

dietary supplements, most reported taking a vitamin or vitamin/mineral combination, which is fairly consistent with other national studies among this age cohort. From a growth and development perspective, the ADA (2009), recommends that the best nutrition-based strategy for promoting optimal health and reducing the risk of chronic disease among all groups, including children, is to wisely choose a variety of foods. The ADA lists only five instances where any type of dietary supplement is medically warranted for older adults: pregnant women, people who are food insecure (i.e., they are, "at times, uncertain of having, or unable to acquire, enough food for all household members because they had insufficient money and other resources for food"), alcohol-dependent individuals, strict vegetarians and vegans, and those with increased needs due to a health condition or chronic use of a medication. Their single recommendation for children including adolescents is to supplement the diet with vitamin D if they do not get at least 400 IU's of vitamin D per day (ADA, 2009).

In their 2009 Position Statement on Nutrition and Athletic Performance, the ACSM stated, "Vitamin and mineral supplements are not needed if adequate energy to maintain body weight is consumed from a variety of foods" (ACSM, ADA, DOC, 2009). Creatine, utilized by 34.1% of this study population reporting use, is a commonly marketed supplement to enhance building of muscle mass and sport performance and is currently the most widely used ergogenic aid among athletes wanting to build muscle and enhance recovery (ACSM, ADA, DOC, 2009). Creatine has been shown to be effective among adults in repeated short bursts of high-intensity activity in sports such as sprinting and weight lifting but not for endurance sports such as distance running (Azizi, 2010). The vast majority of research on creatine has been conducted in a laboratory setting with male athletes aged >18 years, and there is scant clinical research on a healthy athletic population <18. This is concerning given the findings in this sample that the mean age of those reporting any supplement use for sport performance is just under 11 years. This seems relatively young to be reporting anything to enhance sport performance but could be a sign of marketing efforts and more children entering sports at earlier ages. One has to ponder the potential for future use of more dangerous substances as well, if use of any supplement is occurring at 11 years of age. A recent 2010 brief in the California Law Review targeting the 1994 DSHEA highlighted that adolescents are often a susceptible group of consumers. This report contends that many teenagers take creatine monohydrate because of its "marketed effects" on athleticism and endurance (Azizi, 2010). However, they also stated that scientists have not made any clinical determination regarding the safety or efficacy of creatine. New Jersey has gone so far as to ban the sale of creatine to minors when they unanimously passed Bill S-1951, which would make it an offense to sell or give creatine or a creatine analog to a person 18 years of age or younger, punishable by a fine of up to $500, imprisonment for up to 30 days, or both (New Jersey Senate Democrats, 2007).

Supplement use was reported by children living most frequently with both parents, with odds greater if they only lived with the father, though this was not statistically significant. Other studies have reported that the parent or coach were among the most likely to have recommended a sport supplement to an adolescent athlete (Dunn et al., 2001). In addition, since supplement combinations such as combination herb pills may contain a variety of substances with no FDA approval required, it is of interest that children and adolescents were taking a product with a mixture of items. This should concern coaches, parents, athletic trainers, and all healthcare providers who care for the adolescent/pediatric population. Also, it is reasonably clear that the marketing of sport enhancing products is primarily aimed at males. Here, there was a statistically significant pattern of use much greater in males compared to females. And last, it should concern all parents that an older child could serve as a negative role-model for siblings in the area of sport supplement use, and this should be taken into account regarding possible education programs to inform stakeholders.

In many cases, based on the questioning in the assessment, the use of supplements related to sport performance were primarily vitamins, minerals, or herbal products not traditionally considered as sport supplements. This may indicate general supplement use by respondents rather than a direct effort to boost or enhance sport performance. However, the fact that it is reported as such may be indicative of a lack of awareness of evidence related to supplement use overall as well as use aimed at increasing sport performance. The investigators believe this indicates a need for more public education on this topic.

Limitations

First, because this is a secondary data set, questions were predetermined and responses were generated prior to our analysis. Recall bias and other limitations of survey research inherent to secondary data limit this study as well. In addition, we were limited by not knowing if the children or adolescents were participating in competitive sports programs. Taking a calcium supplement to strengthen bones in a young female is an acceptable practice but if the child is taking a combination of herbs to enhance competitive sports performance perhaps that sends the wrong message in sports at an early age. Not knowing the competitive level of the athlete is a limitation but does not take away from the concern that the mean age of respondents providing an affirmative answer on supplement use to enhance sports performance was approximately 11 years of age.

In addition to limitations on sport participation, we cannot determine what is in combination pills, which adds to the concern that children could be taking a variety of substances that may be harmful to them. A recent study demonstrated a high level of toxic contaminates in many general supplements, and there is no reason to suggest these products are made to a higher safety standard (Fox, 2010). In contrast, some supplements such as calcium for a growing child may not be increasing health risks to athletes. Further, it cannot be inferred from secondary, population data analysis those individuals who are specifically at risk. Delineation between supplements or products aimed at enhancing sport performance and simple vitamin or mineral use was difficult to assess, although parents or respondents reported use of various items specifically for these purposes in the survey. However, creatine, reportedly used by 34% of the respondents, is specifically marketed for enhancement of performance and endurance in sport.

Conclusion

A considerable number of children in the US are using a wide variety of dietary supplements, including nonvitamin minerals such as creatine, specifically to improve sports performance. A large proportion use multivitamin and/or mineral combinations. Usage may be predicted by age, gender, and level of education but less so by parent-based demographics. However, pediatric and other health groups have warned of the dangers of this population taking supplements for sport performance, and this should not be taken lightly. Further investigation could assess specific components that make up combination herbal products that are used by children, whether the level of youth sports is competitive in the sample and to what degree, and if the user has experienced any adverse events associated with taking products to enhance sport performance. Studies could also assess knowledge, attitudes, and beliefs held by parents regarding current policies as they pertain to adolescent use of supplements to enhance sport performance and their relative safety, as they may be unaware that this may be an unhealthy practice for their child. Additional research on other substance use to boost sport performance later in the child's life and any relationship to early use of dietary supplements should also be investigated as well as whether children serve as role models for future use in younger siblings.

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