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Supplementation Patterns of Competitive Male and Female Bodybuilders

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This study described the prevalence of supplement use by 309 male and female competitive bodybuilders. Participants completed a comprehensive survey detailing their supplementation patterns with respect to frequency of product use, spending characteristics, and reasons for use. Supplement use varied with training phase. Protein powder was more popular in the bulking phase, amino acids and fat burners in the cutting phase. Fifty-nine percent of respondents spent \$25-100 per month; 4.9% spent over \$150. The most popular reason for supplement use was "to meet extra demands of heavy training." In the bulking phase, both weight gain and anabolic supplements were reportedly consumed more frequently by men than women. In the cutting phase, "fat burners" were reportedly consumed by a greater percentage of females than males. The information provided by this study can help sport nutritionists identify supplements most often consumed by bodybuilders and can aid counselors as they guide bodybuilders towards more healthful nutrition practices.

Key Words: nutrition, weight lifting, training phase, dietary misconceptions, athletes

Supplementation is widespread within the bodybuilding community. Misconceptions regarding the effects of supplements on the development of muscle size, definition, and symmetry are commonplace (4, 10, 14, 22, 28). Scientific evidence overwhelmingly supports the conclusion that most supplements do not effectively increase athletic performance or provide strength athletes with a competitive edge (3, 10, 14, 18, 20, 24, 28, 29). Moreover, supplements may contain unusual or unidentifiable ingredients and may, if used in excess, represent a potential health hazard (17).

Few studies on the supplement practices of a large group of competitive athletes have been reported in the literature, and none of these studies has specifically focused on bodybuilders. Comparative evaluations of gender differences in supplement use, costs, reasons for use, and variations in use during

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different phases of the training period are all of considerable interest. The objectives of this research included determining what types of supplements were most commonly consumed by bodybuilders; describing changes in supplement use during different training phases; reporting differences in supplement use between gender and age groups; estimating monthly costs of supplement use among competitive male and female bodybuilders; and assessing reasons for supplement use.

Methods

A registration list of all bodybuilders who competed in Florida in the 1991/1992 season was obtained from the National Physique Committee (NPC). Questionnaires and stamped return envelopes were mailed to the entire list of Florida bodybuilding competitors (sanctioned by the NPC), 1,251 subjects (939 males and 312 females). The sample consisted of 309 respondents, a 25% return rate. Respondents ranged in age from 13 to 70 years old, more than half (51.5%) had been training for over 4 years, and 43.3% reported training 10–15 hr per week during the competitive season. Ninety-five percent had at least a high school education and 37.3% had completed college (Table 1).

Instrument

The nutrition questionnaire covered use of food supplements, vitamins, and minerals and included questions relating to diet and precompetition training regimens. The questions were primarily fixed alternative, multiple choice to obtain objective information. A few open-ended questions were included to assess subjective information such as nutrition beliefs. A reply was indicative of an informed consent.

The instrument was reviewed by several bodybuilders, gym owners, and experts in the field of sport nutrition. Changes were made based on their recommendations to enhance respondent comprehension. A pilot study was conducted to identify unclear questions and improper terminology in the questionnaire.

Procedure

Each questionnaire had a code number with a corresponding code number on a second mailing list. The coding facilitated the process of sending follow-up postcards. Twelve days following the initial mail-out date, reminder cards were mailed.

For data compilation, the answers to each survey were individually sorted and coded for statistical analyses. Partially answered questionnaires were used in the data analysis. It was determined before the initiation of the study that if 50% or less of the questions were answered, the questionnaire would be discarded.

Data Analysis

The data from the responses to the questionnaire were tabulated and analyzed statistically using the Statistical Package for the Social Sciences (SPSS Inc., Chicago). Frequency distributions and percentages were reported for all re-

Table 1 Characteristics of Respondents

Variable		Frequency	Percent
Gender	Male	210	68.0
	Female	99	32.0
		309	100.0
Age (years)	13-18	12	3.9
	19-24	49	15.9
	25-30	92	29.9
	31-35	63	20.5
	36-40	42	13.6
	Over 40	50	16.2
		308	100.0
Education	Grade school	1	0.3
	Some high school	12	3.9
	Completed high school	34	11.1
	Some college/voc	115	37.3
	Finished voc	31	10.1
	Finished college	82	26.6
	Graduate school	33	10.7
		308	100.0
Years in training to compete	Under 1	5	1.6
	1-2	46	15.0
	2-3	46	15.0
	3-4	52	16.9
	Over 4	158	51.5
		307	100.0
Hours/week training in competitive season	Under 5	3	1.0
	5-10	70	22.8
	10-15	133	43.3
	15-20	77	25.1
	Over 20	24	7.8
		307	100.0

Note. Voc = vocational school.

sponses. As we analyzed gender and age differences, chi-square and *t* tests were performed where appropriate (on all non-multiple-response questions) and significant differences were reported, in addition to some interesting trends. Descriptive statistics (cross tabulations) were conducted on multiple-response questions, since statistical significance is not measured with this type of question. Two sample *t* tests were used to ascertain any differences between the behaviors of men and women. A *p* value less than .05 was the criterion for statistical

significance. Nonparametric chi-square statistical tests and cross tabulations were used to compare the different preferences males and females exhibited on certain questions. A one-way analysis of variance followed by a Tukey procedure was used to evaluate the differences in responses and the prevalence of supplement use by age and education.

Limitations to the study include a poor response rate (25%) and the fact that the data were self-reported, thus introducing the potential for misinterpretation and inaccurate reporting.

Much of the literature has previously examined the dietary food intake of bodybuilders (1, 5, 8, 9, 11, 13, 15, 19, 22, 26); therefore, these data were not collected. Additional areas investigated included sources of nutrition information, precontest dietary practices (behaviors) and strategies, and nutrition and training beliefs. These findings will be described in future publications.

Results

For the purposes of this study, "bulking" refers to the period when athletes strive to increase muscle size, during which time weight gain is common. "Cutting" refers to the precontest preparation of losing body fat that has accumulated during the bulking phase of training. Bodybuilders often train months in advance of competition to "bulk up." As the contest approaches they will "cut" for competition, referring to weight and fat loss (9, 19).

The frequencies of supplement use during the bulking and cutting phases of training are listed in Table 2. Vitamins and amino acids were popular in both phases. Weight gain formulas were more frequently consumed during the bulking phase (26.0% vs. 1.7%) in contrast to "fat burners," which were more popular in the cutting phase (52.5% vs. 15.5%).

The numbers of different types of supplements used during the different training phases are summarized in Table 3. The majority of the respondents took at least three different types of supplements during the bulking phase and four different types of supplements during the cutting phase. These frequencies were not significantly different.

Products consumed by the subjects at least once per week during training (no differentiation of training phase) are presented in Table 4. Protein powder was the most popular supplement, with 57.5% reporting usage. Carbohydrate-loading drinks were listed by 31.3% of the respondents. Approximately 17% reported taking none of the supplements listed. The next most frequently reported supplements were medium-chain triglycerides, inosine, power bars, and carnitine.

The monthly costs of supplements are presented in Table 5. Costs varied depending on training phase. Protein powder represented the greatest cost during the bulking phase as compared to amino acids, which cost the most during the cutting phase.

The most frequent (70.3%) reason for using supplements was "to meet the extra demands of heavy training" (Table 6). Additionally, "to improve training performance," "to help me gain muscle," and "to help me lose fat" were frequently listed reasons for supplement use (53.9%, 53.3%, and 35%, respectively). Approximately 6% of the subjects chose "I don't use supplements" as a response.

Table 2 Supplements Most Frequently Taken by Bodybuilders in Each Training Phase

Training phase	Supplement	Total		Male		Female	
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Bulking	Vitamins	219	72.0	146	70.2	73	76.0
	Protein powder	179	58.9	127	61.1	52	54.2
	Amino acids	163	53.6	106	51.0	57	59.4
	Minerals	157	51.6	102	49.0	55	57.3
	Weight gain formulas	79	26.0	72	34.6	7	7.3
	Carbohydrate formulas	53	17.4	44	21.2	9	9.4
	Anabolic supplements	52	17.1	41	19.7	11	11.5
	Energy boosters	38	12.5	28	13.5	10	10.4
	Fat burners	47	15.5	24	11.5	23	24.0
	Human GH releasers	32	10.5	25	12.0	7	7.3
	Liver supplements	32	10.5	25	12.0	7	7.3
	Other	22	7.2	12	5.8	10	10.4
	Sterols	5	1.6	3	1.4	2	2.1
		<i>(n</i> = 304)		<i>(n</i> = 208)		<i>(n</i> = 96)	
Cutting	Vitamins	233	77.4	157	77.3	76	77.6
	Amino acids	193	64.1	125	61.6	68	69.4
	Minerals	181	60.1	121	59.6	60	61.2
	Fat burners	158	52.5	93	45.8	65	66.3
	Protein powder	127	42.2	92	45.3	35	35.7
	Energy boosters	54	17.9	32	15.8	22	22.4
	Anabolic supplements	39	13.0	30	14.8	9	9.2
	Human GH releasers	33	11.0	24	11.8	7	7.1
	Liver supplements	31	10.3	25	12.3	8	8.2
	Carbohydrate formulas	28	9.3	22	10.8	6	6.1
	Other	18	6.0	13	6.4	5	5.1
	Sterols	5	1.7	4	2.0	1	1.0
	Weight gain formulas	5	1.7	4	2.0	1	1.0
		<i>(n</i> = 301)		<i>(n</i> = 203)		<i>(n</i> = 98)	

Note. GH = growth hormone.

Gender Differences

The chi-square statistic revealed that men and women bodybuilders differed significantly in their age categories ($p < .03$) and the number of years in training to compete ($p < .01$) (Table 7). The majority of women (57.6%) were between 25 and 35 years old, whereas most of the men (47.9%) appeared to be between the ages of 19 and 30. Fifty-six percent of the men had been in training to compete for over 4 years as compared to 40.8% of women in training for this period.

Table 3 Supplement Use Frequency by Bodybuilders in Each Training Phase

Training phase	Number of listed supplements taken	Frequency	Percent
Bulking (<i>n</i> = 309)	0	5	1.6
	1	47	15.4
	2	49	15.9
	3	65	21.0
	4	57	18.4
	5	46	14.9
	6	19	6.1
	7	8	2.6
	8	9	2.9
	9	2	0.6
	10	2	0.6
			100.0
Cutting (<i>n</i> = 309)	0	8	2.6
	1	38	12.3
	2	47	15.2
	3	58	18.8
	4	69	22.4
	5	43	13.9
	6	30	9.7
	7	8	2.6
	8	4	1.3
	9	2	0.6
	10	1	0.3
	12	1	0.3
			100.0

Gender differences were noted regarding reasons for supplement use (Table 8), supplement spending characteristics, and frequency of supplement use (Tables 2 and 4). Women were more likely than men to list "to help lose fat" as a reason for supplement use (41.8% vs. 31.7%). A greater percentage of men chose the reason "to help gain muscle" (57.2% vs. 44.9%). Average monthly costs for supplements and the type of supplement the most money was spent on per month were similar among males and females.

During the bulking phase, vitamins, protein powder, amino acids, and minerals were popular supplements with both men and women. Weight gain formulas, carbohydrate formulas, and anabolic supplements were more frequently consumed by men, whereas fat burners were more popular among women. During the cutting phase, vitamins, amino acids, minerals, fat burners, and protein powders were popular with both genders. Fat burners, however, were used by a greater percentage of women than men during the cutting phase (66.3% and

Table 4 Products Taken by Bodybuilders at Least Once Per Week When Training

Product name	Total		Male		Female	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Protein powder	168	57.5	114	57.3	54	58.1
CHO-loading drinks	91	31.3	75	37.7	16	17.2
None of the above	50	17.1	32	16.1	18	19.4
MCTs	44	15.1	28	14.1	16	17.2
Inosine	42	14.4	25	12.6	17	18.3
Power bars	33	11.3	17	8.5	16	17.2
Carnitine formulas	33	11.3	12	6.0	21	22.6
Smilax	25	8.6	19	9.5	6	6.5
Meal replacements	25	8.6	18	9.0	7	7.5
Herbal energy formulas	22	7.5	11	5.5	11	11.8
Glandular formulas	19	6.5	14	7.0	5	5.4
Lactic acid buffers	12	4.1	7	3.5	5	5.4
Coenzyme Q10	12	4.1	8	4.0	4	4.3
Sublingual BCAAs	10	3.4	6	3.0	4	4.3
DMG (vitamin B ₁₅)	9	3.1	6	3.0	3	3.2
Other	6	2.1	1	0.5	5	5.4
Carbohydrate wafers	3	1.0	3	1.5	0	0.0
Serene	2	0.7	2	1.0	0	0.0
Rehydration formulas	2	0.7	1	0.5	1	1.1
Silymarin	1	0.3	1	0.5	0	0.0
	<i>(n</i> = 292)		<i>(n</i> = 199)		<i>(n</i> = 93)	

Note. CHO = carbohydrate; MCT = medium-chain triglycerides; BCAA = branched-chain amino acids; DMG = N,N-dimethylglycine; vitamin B₁₅ = calcium gluconate + N,N-dimethylglycine.

45.8%, respectively) (Table 2). Seventy-one percent of the males reported taking supplements year-round versus 66.7% of the females.

Products consumed by the male and female bodybuilders at least once per week during training are summarized in Table 4. No specific training stage was specified in the question. Carbohydrate-loading drinks were more popular with male bodybuilders. Power bars, carnitine formulas (fat burners), and herbal energy formulas were used by a greater percentage of females (17.2%, 22.6%, 11.8%) than males (8.5%, 6.0%, 5.5%).

Age Differences

Responses to questions were analyzed by age group (13 to 24 years old, 25 to 35 years old, and over 35 years old). When subjects were analyzed for differences in response by age, the two older age groups were significantly ($p < .001$) more educated (more likely to have attended at least some college) and had been in training to compete longer than the younger group ($p < .001$).

Table 5 Summary of Selected Characteristics of Supplement Spending in Bodybuilders

Variable		Frequency	Percent
Estimate of amount spent/month	\$0-24	83	27.0
	\$25-49	107	34.9
	\$50-99	72	23.5
	\$100-150	30	9.8
	Over \$150	15	4.9
		307	100.0
Supplement on which the most money/month was spent in the bulking phase	Protein powder	84	27.9
	Amino acids	64	21.3
	Vitamins	44	14.6
	Weight gain formulas	44	14.6
	Other	39	13.0
	Human GH releasers	5	1.7
	Carbohydrate formulas	5	1.7
	Sterols	1	0.3
	Liver supplements	1	0.3
	Minerals	0	0.0
	Fat burners	0	0.0
	Anabolic supplements	0	0.0
	Energy boosters	0	0.0
		301	100.0
Supplement on which the most money/month was spent in the cutting phase	Amino acids	99	33.0
	Fat burners	62	20.7
	Protein powder	46	15.3
	Other	36	12.0
	Vitamins	34	11.3
	Anabolic Supplements	9	3.0
	Human GH releasers	7	2.3
	Carbohydrate formulas	3	1.0
	Weight gain formulas	2	0.7
	Energy boosters	1	0.3
	Minerals	1	0.3
	Sterols	0	0.0
	Liver supplements	0	0.0
		300	100.0

A cross tabulation of the data on supplement use by age indicated an increase in the use of several supplements from the youngest to the oldest groups in the study sample during the bulking phase. Protein powder (63.3%), amino acids (60%), vitamins (80%), and minerals (64.4%) were the most popular supplements among the bodybuilders over age 35. In contrast, weight gain formulas

Table 4 Products Taken by Bodybuilders at Least Once Per Week When Training

Product name	Total		Male		Female	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Protein powder	168	57.5	114	57.3	54	58.1
CHO-loading drinks	91	31.3	75	37.7	16	17.2
None of the above	50	17.1	32	16.1	18	19.4
MCTs	44	15.1	28	14.1	16	17.2
Inosine	42	14.4	25	12.6	17	18.3
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Smilax	25	8.6	19	9.5	6	6.5
Meal replacements	25	8.6	18	9.0	7	7.5
Herbal energy formulas	22	7.5	11	5.5	11	11.8
Glandular formulas	19	6.5	14	7.0	5	5.4
Lactic acid buffers	12	4.1	7	3.5	5	5.4
Coenzyme Q10	12	4.1	8	4.0	4	4.3
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DMG (vitamin B ₁₅)	9	3.1	6	3.0	3	3.2
Other	6	2.1	1	0.5	5	5.4
Carbohydrate wafers	3	1.0	3	1.5	0	0.0
Serene	2	0.7	2	1.0	0	0.0
Rehydration formulas	2	0.7	1	0.5	1	1.1
Silymarin	1	0.3	1	0.5	0	0.0
	(<i>n</i> = 292)		(<i>n</i> = 199)		(<i>n</i> = 93)	

Note. CHO = carbohydrate; MCT = medium-chain triglycerides; BCAA = branched-chain amino acids; DMG = N,N-dimethylglycine; vitamin B₁₅ = calcium gluconate + N,N-dimethylglycine.

45.8%, respectively) (Table 2). Seventy-one percent of the males reported taking supplements year-round versus 66.7% of the females.

Products consumed by the male and female bodybuilders at least once per week during training are summarized in Table 4. No specific training stage was specified in the question. Carbohydrate-loading drinks were more popular with male bodybuilders. Power bars, carnitine formulas (fat burners), and herbal energy formulas were used by a greater percentage of females (17.2%, 22.6%, 11.8%) than males (8.5%, 6.0%, 5.5%).

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Responses to questions were analyzed by age group (13 to 24 years old, 25 to 35 years old, and over 35 years old). When subjects were analyzed for differences in response by age, the two older age groups were significantly ($p < .001$) more educated (more likely to have attended at least some college) and had been in training to compete longer than the younger group ($p < .001$).

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	\$25-49	107	34.9
	\$50-99	72	23.5
	\$100-150	30	9.8
	Over \$150	15	4.9
		307	100.0
Supplement on which the most money/month was spent in the bulking phase	Protein powder	84	27.9
	Amino acids	64	21.3
	Vitamins	44	14.6
	Weight gain formulas	44	14.6
	Other	39	13.0
	Human GH releasers	5	1.7
	Carbohydrate formulas	5	1.7
	Sterols	1	0.3
	Liver supplements	1	0.3
	Minerals	0	0.0
	Fat burners	0	0.0
	Anabolic supplements	0	0.0
	Energy boosters	0	0.0
		301	100.0
Supplement on which the most money/month was spent in the cutting phase	Amino acids	99	33.0
	Fat burners	62	20.7
	Protein powder	46	15.3
	Other	36	12.0
	Vitamins	34	11.3
	Anabolic Supplements	9	3.0
	Human GH releasers	7	2.3
	Carbohydrate formulas	3	1.0
	Weight gain formulas	2	0.7
	Energy boosters	1	0.3
	Minerals	1	0.3
	Sterols	0	0.0
	Liver supplements	0	0.0
		300	100.0

A cross tabulation of the data on supplement use by age indicated an increase in the use of several supplements from the youngest to the oldest groups in the study sample during the bulking phase. Protein powder (63.3%), amino acids (60%), vitamins (80%), and minerals (64.4%) were the most popular supplements among the bodybuilders over age 35. In contrast, weight gain formulas

Table 6 Most Common Reasons for Supplement Use ($n = 306$)

Reason	Frequency	Percent
To meet the extra demands of heavy training	215	70.3
To improve training performance (increase energy)	165	53.9
To help me gain muscle	163	53.3
To help me lose fat	107	35.0
To make up for a below-optimal diet	89	29.1
To get the competitive edge	60	19.6
I don't use supplements	19	6.2
None of the above	4	1.3

Table 7 Age and Training Differences Between Male and Female Bodybuilders

Variable		Male		Female	
		<i>n</i>	%	<i>n</i>	%
Age* (years) ($n = 308$)	13-18	10	4.8	2	2.0
	19-24	37	17.7	12	12.1
	25-30	63	30.2	29	29.3
	31-35	35	16.7	28	28.3
	36-40	24	11.5	18	18.2
	Over 40	<u>40</u>	<u>19.1</u>	<u>10</u>	<u>10.1</u>
		209	100.0	99	100.0
Years in training to compete** ($n = 307$)	Under 1	2	1.0	3	3.1
	1-2	28	13.4	18	18.4
	2-3	34	16.3	12	12.2
	3-4	27	12.9	25	25.5
	Over 4	<u>118</u>	<u>56.4</u>	<u>40</u>	<u>40.8</u>
		209	100.0	98	100.0

* $p < .03$. ** $p < .01$.

(47.5%) and carbohydrate formulas (20.3%) were the most popular with the youngest group and least popular with the oldest group. During the cutting phase there was a similar trend. Protein powder (45.5%), amino acids (69.3%), and minerals (68.2%) were the most popular among the older group. Fat burners were also used by a higher percentage of the subjects over 35 years old (60.2%) as compared to 25- to 35-year-olds (54.2%) and the 13- to 24-year-olds (35.6%).

A cross tabulation of the data regarding supplement spending by age indicated that the older bodybuilders tended to spend the most money per month during the bulking phase on protein powders (31.9%) and amino acids (27.5%),

Table 8 Differences Between Male and Female Bodybuilders' Reasons for Supplement Use

Reason	Male		Female	
	<i>n</i>	%	<i>n</i>	%
To meet the extra demands of heavy training	146	70.2	69	70.4
To help gain muscle	119	57.2	44	44.9
To improve training performance (increase energy)	110	52.9	55	56.1
To help lose fat	66	31.7	41	41.8
To make up for a below-optimal diet	58	27.9	31	31.6
To get the competitive edge	45	21.6	15	15.3
I don't use supplements	14	6.7	5	5.1
None of the above	3	1.4	1	1.0
	(n = 208)		(n = 98)	

whereas the younger group spent the most money on weight gain formulas (25.4%). During the cutting phase, a greater percentage of the older bodybuilders (27.8%) spent the most money per month on fat burners as compared to the 25- to 35-year-olds (19.2%) and the 13- to 24-year-olds (13.8%).

A cross tabulation of the data on reasons for supplement use by age indicated that "to help me lose fat" was a more popular reason among the over-35 age group (41.3%) than with the 25- to 35-year-olds (35.3%) and the 13- to 24-year-olds (25.0%) in this sample. The most popular reason for supplement use among the over-35 group, the 25- to 35-year-olds, and the 13- to 24-year-olds was "to meet the extra demands of heavy training" (73.9%, 71.2%, and 63.3%, respectively).

Educational Differences

Data were divided into three educational groups (those who had completed grade school and some high school, those who had completed high school and attended some college or vocational school, and those who had completed college or graduate school) and analyzed statistically for differences by educational level. Surprisingly, there were no statistical differences in the type, costs, or reasons for using supplements among these three educational levels.

Discussion

Several studies have suggested that the use of supplements among bodybuilders is widespread (8, 11, 12, 15, 19, 22, 26). The data from this study clearly illustrate that bodybuilders do in fact take a variety of supplements (despite the overwhelming scientific opinion that dietary supplements do not enhance athletic performance or help to maximize lean body mass). This study directly quantifies the immense popularity of supplement use in a large group of competitive bodybuilders. Approximately 94% of all respondents took some type of supplement.

Other studies have similarly documented supplement popularity among bodybuilders. Walberg-Rankin et al. (26) reported supplement use in 100% of subjects. Kleiner et al. (11) noted supplement use in 100% of female subjects and 90% of male bodybuilders studied.

It is also evident that some bodybuilders may cycle supplements depending on their stage of training. Different supplements were more popular at different times (Table 2). Fat burners, for example, were more popular during the cutting phase of training because loss of body fat is a common goal of bodybuilders during precompetition training (8, 9, 15, 19, 22, 27). Steen (22) documented the use of choline, inositol, and methionine by a male bodybuilder in an effort to "burn fat" during the cutting stage of training. The present study shows that weight gain powder was more commonly used during the bulking phase of training than during the cutting phase of training.

Data suggest that vitamin and mineral supplementation is widespread among athletes, with over 50% reporting regular consumption (7). Nieman et al. (16) documented that 69% of the marathon runners in their study were at least occasional supplement users and 29% used them daily. Nieman et al. (16) reviewed the literature and reported that approximately 50% to 75% of elite endurance athletes took supplements daily. The results of the present study indicate that vitamins and minerals also are frequently consumed by bodybuilders and in fact were the most prevalent supplements used by subjects in this study. During both training phases, vitamins were consumed by 72% (bulking phase) and 77.4% (cutting phase) of the respondents. Minerals were consumed by 51.6% of the subjects during the bulking phase and by 60.1% during the cutting phase.

The prevalence of use of some supplements varied by gender and age. Young males preferred weight gain formulas, whereas older bodybuilders and females used "fat burners" more frequently. This trend is interesting and for women may reflect the ubiquitous search for thinness. Walberg and Johnston (25) reported that women weight lifters were extremely fearful of becoming fat. This also appeared to be a concern of female bodybuilders in this study. Older men may be seeking to lose the increase in body fat that often accompanies the aging process. Young men, adolescents in particular, want to increase body size and often turn to the sport of bodybuilding and to weight gain formulas in order to increase body mass and self-esteem.

A wide range of plant derivatives and other food and nonfood substances are marketed to athletes as purported ergogenic aids (17). Virtually no scientific evidence exists to demonstrate that these products have any potential benefit for the strength athlete in terms of decreasing body fat or increasing muscle size.

Manore et al. (15) reported the consumption of medium-chain triglycerides (MCTs) by a male bodybuilder training for competition. This product was popular with a relatively small percentage of the respondents (15.1%). Medium-chain triglycerides, which are used to replace long-chain dietary fats in the treatment of malabsorption, are not known to enhance athletic performance. Purported ergogenic benefits of MCTs include increasing energy, extending endurance, increasing muscularity, enhancing metabolism, and decreasing body fat (18).

Both inosine and carnitine supplements were taken by a small percentage of bodybuilders (14.4% and 11.3%, respectively). Inosine is manufactured from adenosine. Athletes are led to believe that inosine enhances energy availability. Supposedly, inosine increases the oxygen-carrying capacity of red blood cells,

thereby delaying the onset of muscle fatigue. Scientific evidence indicates that inosine is not converted to adenosine triphosphate intracellularly; the end product is uric acid, which if produced in excess could lead to gout in susceptible individuals (4, 18).

Carnitine is an amino acid derivative manufactured in the human body and obtained from exogenous sources. Carnitine is required for transporting long-chain fatty acids across the mitochondrial membrane. The purported benefits include burning of stored fat, increased muscle strength, and energy production. Clarkson (2) reviewed the effects of carnitine supplementation in athletes. There is currently insufficient scientific data available to either support or refute the effectiveness of carnitine as an ergogenic aid. It has been theorized that carnitine supplements may improve endurance in athletes by increasing fatty acid oxidation. There are no studies to date, however, that suggest carnitine supplements would be beneficial for the strength athlete. There is no evidence that carnitine is an effective aid in reducing body fat. Bodybuilders should be alerted to the fact that the D-carnitine form of the supplement can cause adverse health effects.

Pangamic acid (vitamin B₁₅) is a mixture of calcium gluconate and N,N-dimethylglycine (DMG). Gray and Titlow (6) reported that the FDA has called vitamin B₁₅ a hoax and has attempted to remove it from the market. The FDA considers vitamin B₁₅ a food additive and states that it is illegal to sell it as a dietary supplement. Despite the FDA's stand, DMG is widely used today by athletes with the belief that it will keep the muscles operating at peak efficiency and will reduce lactic acid buildup (6). A relatively small percentage of bodybuilders (3.1%) in this study reported using DMG.

The retail sale of dietary supplements (including vitamins and minerals) was estimated at \$3.3 billion in 1990 (4). Fifty-eight percent of the bodybuilders in this study spent between \$25 and \$100 per month on dietary supplements; 4.9% spent over \$150 per month (over \$1,800 per year).

Protein and amino acid supplements were very popular among these bodybuilders during both training stages. Walberg-Rankin et al. (26) reported a similar pattern of amino acid use during the cutting phase in their study of female bodybuilders. Steen (22) and Manore et al. (15) found a similar trend of amino acid popularity in their single case reports. Philen et al. (17) determined that unspecified amino acids were the most frequently mentioned ingredient in advertised products in a survey of health and bodybuilding magazines. Thus, it is no surprise that bodybuilders in this study spent the most money per month on amino acid supplements.

There is widespread opinion among bodybuilders that taking protein powders and amino acids will produce maximum strength gains and muscle size. However, there is little scientific evidence to support these beliefs.

The large majority of bodybuilders (70.3%) surveyed reportedly used supplements in order to meet the extra demands of heavy training. Over half of the respondents (53.9%) used them to improve training performance and increase energy, in addition to helping them gain muscle. These responses indicate that many bodybuilders have attached false hopes to these products. Nutrition education is needed to help athletes make informed decisions regarding various supplements.

Conclusions

The results of this study describe the prevalence and characteristics of supplement use among a group of bodybuilders. During the bulking phase, vitamins and minerals, protein powder, amino acids, and weight gain formulas were most popular. During the cutting phase, vitamins and minerals, amino acids, fat burners, and protein powder were often consumed. Carbohydrate-loading drinks, medium-chain triglycerides, inosine, power bars, and carnitine formulas were additional products taken weekly by bodybuilders.

This study gives evidence that supplement use is an important part of the training routines of many bodybuilders. Insight is also given into why supplementation is widespread among bodybuilders. Bodybuilders believe supplements are required to support their intensive training routines and are effective aids in fat loss and muscle gain. The strong belief in the efficacy of supplements and the typical supplement history these athletes exhibit (i.e., cost, frequency, and timing of supplement use, and preferential use of supplements by age and gender) must be considered when counseling this group. The information obtained in this study can be used to help the counselor formulate acceptable alternatives and suggestions regarding supplement use for the competitive bodybuilder. Guidance can be provided in the evaluation of the myriad of products on the market. Additionally, this study will help prepare the counselor to identify and direct appropriate questions regarding supplement use.

Future research should be directed at evaluating the acute and chronic effects of supplement use in this population. Additional research could also determine if these results are representative of supplementation patterns of competitive bodybuilders in other areas of the United States.

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