

# Changes in Psychological State and Self-Reported Diet During Various Phases of Training in Competitive Bodybuilders

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## Reference Data

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## ABSTRACT

This study monitored psychological state, diet, and body composition of male and female bodybuilders (BB) as they prepared for a state championship. Psychological tests administered over 12 weeks reflected a trend for the BB to become more fatigued, depressed, tense, confused, and less vigorous across time. Three-day dietary profiles indicated that daily caloric intake decreased for both sexes. Percentage of calories from carbohydrate, fat, and protein were similar for both; carbohydrate consumption changed little, but percentage of fat decreased and protein increased as competition neared. Because the BB took supplements, the RDA was exceeded for the nine vitamins and minerals analyzed. Vitamin and mineral intake determined from food alone indicated that males were above 70% RDA for all vitamins and minerals except calcium and zinc 1 week prior to competition. Females were below 70% RDA throughout the study for folacin, vitamin E, calcium, potassium, and zinc. The results indicate that BB reduced percent fat to very low levels while consuming a low calorie, low fat, high protein diet, but such an intense regimen may adversely affect psychological state.

**Key Words:** body composition, caloric intake, percent fat, weight training, aerobic training

## Introduction

The sport of bodybuilding has gained popularity among men and women in the past decade. Bodybuilding differs from most sports in that during competition the participant's physique rather than his or her athletic performance is judged. The ultimate goal of the sport is to achieve large muscle mass that is defined and symmetrical (5). In addition to exercise, preparation for bodybuilding competition includes optimizing mental attitude and nutrition.

Morgan (15) has postulated that successful athletes have superior mental and emotional health, a conclusion based on athletes who portray the iceberg profile. This profile results from scores on the Profile of Mood States (POMS) questionnaire being above the mean on vigor and below the mean on tension, depression, anger, fatigue, and confusion. Fuchs and Zaichkowsky (8) found that championship bodybuilders (BB) demonstrated the iceberg profile on the POMS questionnaire. This profile was also found in competitive female BB (7). However, the training phase at the time of data collection was not mentioned in the studies. Many factors could affect BB psychological state throughout the competitive phase such as the stress of impending competition as well as the rigor of training and dieting.

Morgan and associates (16), utilizing the POMS, found that mood disturbance was directly related to the training loads. The psychological effect of dieting remains unclear. Some researchers have found that severe caloric restriction may produce symptoms of emotional illness. Stunkard and Rush (21) concluded from a review of the literature that dieting for more than 2 weeks is consistently associated with adverse psychological symptoms. Another study found that 54% of the patients undergoing a 6-month treatment of very low-calorie dieting and behavior therapy demonstrated increases in depression of 25% or more on the Beck Depression Inventory (BDI) (25).

During the competitive phase BB attempt to achieve the lowest possible subcutaneous fat, which is accomplished through exercise and dieting. It has been reported that BB consume a relatively high protein, low fat diet (20). The female BB described by Lamar-Hildebrand et al. (11) consistently consumed less than 66% of the recommended dietary allowances (RDA) for vitamins B<sub>12</sub>, D, E, and folic acid, and the minerals calcium and zinc. However, both male and female BB use vitamin and mineral supplements, some exceeding 15 times the RDA (20, 24). None of these studies reported on nutritional intake during the different phases of training. Since nutritional intake could vary during this time, it is of interest to observe dietary intake during different phases of the training cycle.

There were two purposes for this study. One was to determine whether any changes in psychological state occur throughout the competitive phases of training. The second purpose was to describe the nutritional intakes of male and female BB throughout the competitive phase of training.

## Methods

### Subjects

Six men (minimum of 5 yrs experience, average of 7 yrs) and two women (minimum of 3 yrs experience, average of 4 yrs), ages 25 to 37, participated as volunteer subjects. These experienced BB underwent testing every 3rd week during the final 12 weeks prior to a state championship competition. Various subjects finished first, second, and fourth in the open light-heavyweight class, first in the heavyweight class, first in the overall novice division, and first in the mixed pairs division. One subject won the mixed pairs division at the national championships 2 weeks later. The five test sessions occurred 21 days apart and were designated as Week 12 (12 weeks precompetition), Week 9 (9 weeks precompetition), Week 6, Week 3, and Day 3 of Week 1 (72 hrs prior to competition). All subjects completed a health history questionnaire and informed consent prior to testing.

**Body Analysis.** Body composition was determined via densitometric analysis. Residual lung volume was determined according to the closed-circuit oxygen dilution technique by Wilmore et al. (26), utilizing the Nitralyzer 505 (Med Science, St. Louis, MO) and a 13-liter Collins spirometer. This apparatus was modified to mimic the body's position underwater and to minimize the system's dead space. Repeat residual volume determinations were made until duplicate measures were

within .05 liters. Subjects were weighed underwater on a calibrated Chatillon autopsy scale (Country Technology, Inc., Graysmill, WI). The measurement was repeated until three measurements were within 50 grams. Percent fat was calculated using the Brozek (2) equation.

**Psychological State.** All subjects completed the Profile of Mood States (POMS) questionnaire (14) and the Beck Depression Inventory (BDI) (1) to assess psychological state. The POMS measures six states of mood: tension, depression, anger, fatigue, confusion, and vigor. It has been used extensively in sport research (17, 18, 19). The BDI has been used to measure depression severity (13). The tests were administered to each subject after the hydrostatic weighing test and before their percent body fat was revealed. It took approximately 30 min to complete both tests. The tests were completed at Week 12, Week 6, and Day 3. Each subject was assured confidentiality of responses.

**Nutritional Intake.** Three-day food records were used to obtain dietary data. Each subject completed the records during Weeks 12, 6, and 1. The subjects were instructed on the details needed for accurate recording of the quantity and characteristics of the foods consumed. Standard measures were used. Intakes of vitamin, mineral, and other supplements were obtained. Food record data were analyzed using the Food Processor II, a computerized nutrition analysis system by ESHA (6).

**Data Analysis.** Means and standard deviations were computed for each variable for men and women separately, with tests of statistical significance computed for only the men, utilizing a repeated measures MANOVA statistical design. Statistical significance was set at a *P* of .05. The data for the women were reported for comparison. Since male and female psychological test results were similar, male and female data were combined for the psychological tests.

Table 1  
Body Composition Characteristics of Male (*n*=6) and Female (*n*=2) Bodybuilders Throughout Precompetition

Variable	12 week		9 week		6 week		3 week		Day 3					
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Body weight (kg)														
M	91.0	4.4	89.3	3.6	**	87.5	3.7	86.0	3.0	**	83.7	2.0		
F	58.0	0.2	57.4	0.1		58.2	1.8	55.9	2.6		55.6	3.2		
Body fat (%)														
M	9.1	1.2	**	7.4	1.5	6.6	1.4	**	5.3	1.4	**	4.1	1.3	
F	14.8	2.2		14.4	2.0	13.3	0.4		11.6	0.2		11.1	0.2	
Lean body weight (kg)														
M	82.7	3.6		82.7	2.8		81.6	2.6		81.4	1.9	*	80.3	1.2
F	49.4	1.4		49.2	1.2		50.5	1.8		49.4	2.4		49.4	3.0
Height (cm)														
M	173.6													
F	162.0													

Note. Statistical analyses were computed on male data only. Significant difference between adjacent weeks: \*\**p*<0.01; \**p*<0.05.

**Results**

As Table 1 indicates, the precompetition phase of training and dieting produced significant body composition changes in these BB. The men's body weight and body fat decreased linearly whereas their lean body weight remained constant except for a significant decrease between the last two measurements. Significant decreases in body weight and body fat were found between three of the five measurements. Over the 12-week period, the men lost 7.3 kg body weight and 5.0% body fat while the women lost 2.4 kg body weight and 3.7% body fat. The women's lean body weight remained constant.

Table 2 displays the time devoted to training, resistance and aerobic, during the off-season and precompetition phases of training. The bodybuilders had been training an average of 34 weeks off-season prior to beginning the precompetition phase. Off-season training data reflect the training program prior to the precompetition phase. Twelve-week data were collected during the last days of the off-season phase. The men significantly increased training in hours per week for both aerobic and resistance training. Both women also increased the hours each week spent in aerobic and resistance training. Only one of the six men reported doing any aerobic exercise during the off-season, while the women averaged 5 days a week of aerobic activity during this phase. However, during the precompetition phase the men increased their aerobic training to

**Table 2**  
Off-season vs. Precompetition Training Regimens of Male and Female Bodybuilders

Variable	Men (N=6)		Women (N=2)		
	M	SD	M	SD	
<b>Anaerobic weight training</b>					
Off-season	Days/wk	5.7	0.5	6.5	0.7
	Hrs/day	1.8	0.4	1.8	0.4
	Total hrs each wk	10.5	3.0	11.0	2.1
Precontest	Days/wk	6.0	0.0	7.0	0.0
	Hrs/day	2.2	0.4	2.0	0.0
	Total hrs each wk**	13.0	2.6	13.5	1.4
<b>Aerobic training</b>					
Off-season	Days/wk	0.2	0.4	3.0	1.4
	Hrs/day	0.1	0.2	0.6	0.2
	Total hrs each wk	0.1	0.2	1.5	2.1
Precontest	Days/wk	3.0	2.5	5.5	0.7
	Hrs/day	0.4	0.3	1.0	0.7
	Total hrs each wk**	1.2	1.1	5.0	2.8

\*\*Significantly different from off-season training,  $p < .01$ .

3 days a week while the women increased it to 6.5 days a week.

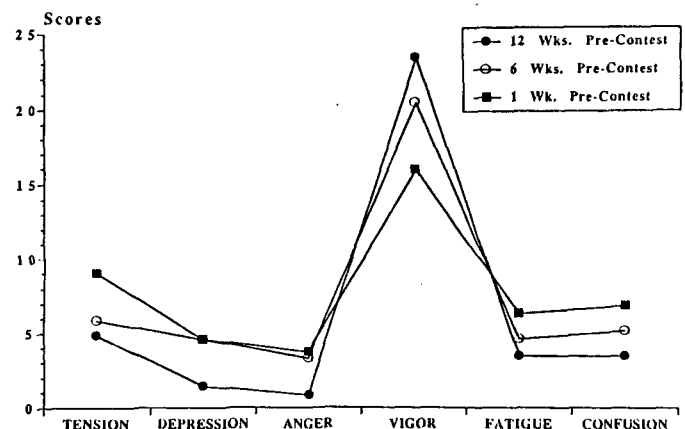
Table 3 summarizes the means and standard deviations of the psychological variables obtained from the POMS questionnaire and the BDI. Initial analysis indicated that there were no differences between men and women on these variables. Male and female data were pooled together for statistical comparison to other studies. Vigor tended to decrease across the 12 weeks, with significance reached between Weeks 6 and 12. However, though it was modified slightly, the iceberg profile (a relatively high score on vigor and relatively low scores on the other POMS subscales) was exhibited throughout the precompetition phase (Figure 1). Consistent increases in the BDI occurred across the 12-week period, with significance found between the last two measurements.

Nutrient intake data for the men and women are found in Tables 4 and 5. The men demonstrated a significant decrease in caloric and protein intake during the last 6 weeks of precompetition. However, relative protein intake remained quite high at 2.18, 2.79,

**Table 3**  
Psychological Scores of Male and Female Bodybuilders (N=8) During Precompetition

Test	12 week		6 week		1 week	
	M	SD	M	SD	M	SD
Beck POMS	2.43	2.37	2.71	2.36	4.57	3.69
Fatigue	3.43	3.55	4.57	4.57	6.29	2.63
Vigor	23.14	5.5	20.43	5.71	15.86	5.96
Confusion	3.43	2.15	5.14	4.95	6.86	7.58
Tension	4.88	4.74	5.86	5.73	9.00	6.66
Depression	1.43	1.62	4.57	8.75	4.57	7.39
Anger	.86	.90	3.29	6.97	3.71	4.46

\*Significant difference between adjacent weeks,  $p < 0.05$ .



**Figure 1.** Profile of Mood States psychological scores of male and female bodybuilders (N=8) during precompetition.

**Table 4**  
Nutrient Intakes of Male Bodybuilders  
(N=5) Throughout Precompetition

Nutrient	12 week		6 week		1 week	
	M	SD	M	SD	M	SD
Energy (kcal)	2811	747	2572	637	2041	586
Protein (g)	198	53	244	62	168	86
Carbohydrate (g)	372	139	363	143	290	73
Dietary fiber (g)	42	14	40	15	29	13
Total fat (g) <sup>†</sup>	58	17	33	10	19	18
Sat <sup>††</sup>	19	5	10	4	5	6
Mono <sup>†</sup>	20	7	11	4	7	7
Poly <sup>†</sup>	13	6	8	2	5	4
Chol (mg) <sup>††</sup>	653	148	483	222	245	182
Calories as:						
Carbohydrate	53%		56%		57%	
Protein	28%		38%		33%	
Fat	19%		14%		8%	

<sup>†</sup> $p < 0.05$  between all weeks; <sup>††</sup> $p < 0.01$  between all weeks; \* $p < 0.05$ .

**Table 5**  
Nutrient Intakes of Female Bodybuilders  
(N=2) Throughout Precompetition

Nutrient	12 week		6 week		1 week	
	M	SD	M	SD	M	SD
Energy (kcal)	1312	13	1188	672	1276	248
Protein (g)	94	6	92	50	108	42
Carbohydrate (g)	192	11	168	95	166	145
Dietary fiber (g)	22	1	19	13	18	20
Total fat (g)	27	1	23	20	20	3
Sat	9	2	8	8	6	0
Mono	10	0	8	7	7	0
Poly	7	1	5	4	5	1
Chol (mg)	217	119	156	79	180	144
Calories as:						
Carbohydrate	58%		57%		52%	
Protein	29%		31%		34%	
Fat	18%		17%		14%	

and 2.01 g per kg body weight at Weeks 12, 6, and 1, respectively. Across the 12 weeks, caloric intake dropped by 27%. No significant difference was seen for fiber and carbohydrate consumption. Fat intake was seen to decrease significantly throughout the 12 weeks, with the largest decrease coming from saturated fat intake. Total cholesterol intake decreased significantly, by 62%, during the 12-week period.

Nutrient intakes of the two women were quite consistent across the 12 weeks. The mean caloric intake for both was only 3% lower at the end of the 12 weeks; relative protein intake was 1.62, 1.58, and 1.94 g per kg body weight at Weeks 12, 6, and 1, respectively.

**Table 6**  
RDA % Met by Vitamin and Mineral Intake  
of Male Bodybuilders (N=6) Throughout Precompetition

	With supplements			Without supplements		
	12 wk	6 wk	1 wk	12 wk	6 wk	1 wk
Vit. A	219	376	436	159	274	352
Vit. B <sub>1</sub>	777	1353	1329	167	150	106
Vit. B <sub>2</sub>	678	1180	1145	168	150	90
Vit. B <sub>3</sub>	324	463	380	248	399	251
Vit. B <sub>6</sub>	3349	4782	3829	169	224	157
Vit. B <sub>12</sub>	7327	7239	7659	288	227	248
Folacin	147	174	174	106	114	96
Vit. C	673	2483	1880	220	285	308
Vit. E	245	213	369	125	93	129
Calcium	176	213	152	129	119	49
Iron	309	354	332	237	246	187
Magnesium	170	173	166	163	165	117
Phosphorus	292	283	178	287	278	170
Potassium	117	148	106	117	148	106
Zinc	330	362	550	117	103	69

**Table 7**  
RDA % Met by Vitamin and Mineral Intake  
of Female Bodybuilders (N=2) Throughout Precompetition

	With supplements			Without supplements		
	12 wk	6 wk	1 wk	12 wk	6 wk	1 wk
Vit. A	333	441	430	195	241	190
Vit. B <sub>1</sub>	12970	13026	13036	113	100	92
Vit. B <sub>2</sub>	11004	11062	13026	112	103	100
Vit. B <sub>3</sub>	1240	1328	1467	173	184	311
Vit. B <sub>6</sub>	10938	10733	10786	90	84	106
Vit. B <sub>12</sub>	1974	2084	2056	108	118	344
Folacin	289	334	355	39	34	47
Vit. C	2146	2023	1205	129	106	140
Vit. E	938	1268	1267	68	56	55
Calcium	163	163	169	55	45	49
Iron	478	347	363	64	59	70
Magnesium	373	250	256	98	83	87
Phosphorus	149	140	154	133	116	140
Potassium	107	70	77	70	64	66
Zinc	284	260	250	54	57	57

The percentages of RDA are found in Tables 6 and 7. Men achieved 90% or more of the RDA without supplements for all nutrients except for calcium and zinc at Week 1. For the women, supplementation increased all nutrient intakes well above 100% of the RDA except for potassium during the 6- and 1-week measurements. Without supplements, folacin, vitamin E, calcium, zinc, iron, and potassium intake were all consistently below 80% the RDA for females. The women were supplementing very large amounts of

some nutrients, especially vitamins B<sub>1</sub> (thiamin), B<sub>2</sub> (riboflavin), and B<sub>6</sub> (pyridoxine), all of which approximated 100 times 100% RDA.

## Discussion

The goal of BB during a precompetition phase is to reduce subcutaneous fat and maintain lean body mass. The bodybuilders did reach this goal, as evidenced by the significant reduction in subcutaneous fat and the relative maintenance of lean body mass through dieting and exercise. In addition, the results indicate that their psychological profile was similar to that of other competitive athletes. The BB displayed lower than average POMS scores on tension, depression, anger, fatigue, and confusion, and higher than average scores on vigor, demonstrating a classical iceberg profile (17, 18, 19). This supports previous research by Fuchs and Zaichkowsky (8) showing that BB, like other athletes, differ in psychological state from the normal population. However, during the 12 weeks studied there was a trend for the BB to become more fatigued, depressed, tense, confused, and significantly less vigorous. The trend was not statistically significant, and the sample size was small, demonstrating low power for acceptance of the null hypothesis. The BDI also indicates that the BB depression scores increased significantly across time but did not meet the clinical definition of depression. These results support previous findings by Morgan et al. (16) indicating that severe training stress produces mood disturbance, as well as research by Stunkard and Rush (21) who found that caloric restriction may adversely affect psychological state.

It is puzzling that the women, who maintained such a low caloric intake across the 12 weeks while increasing their duration and frequency of exercise, lost only 2.4 kg. Theoretically the women would have required more than 2,000 calories a day to support their basal metabolic rate and exercise. Although their metabolism may have slowed somewhat in response to the dieting, it is also possible that total caloric intake was underestimated.

The caloric distributions of the male and female BB in this study are similar to those reported by Sandoval and associates (20), with protein intake exceeding 25% of calories consumed. The men in this study averaged 2.3 g of protein intake per kg body weight. This is consistent with the 2.4 g per kg body weight recorded by Sandoval et al. (20). Protein intake for women was slightly lower in this study, 1.7 g per kg body weight compared to 2.9 g per kg body weight reported by Sandoval. The protein intakes of these male and female BB are similar to those reported in other studies that have found BB protein intakes greatly exceeding normal dietary recommendations (23). Whether the optimal protein requirements for hard training athletes who are either attempting to gain muscular weight or, as in this study, maintain muscular weight while losing

body fat are greater than the normal dietary recommendations is equivocal. There is support in some studies (3, 4, 9, 12) for increased protein needs for individuals undergoing intense training, but not in other studies (10, 22). Since this study only includes observations on BB and no experimental manipulation, the results neither support nor refute the need for increased protein intake by BB. However, the BB were successful in maintaining lean weight concomitant with reducing percent body fat to very low levels. Anabolic-androgenic steroid use may have influenced the results; all six men but neither of the two women admitted to taking steroids.

An interesting finding is the BB's excessive use of vitamin and mineral supplements. With supplementation, every vitamin and mineral analyzed exceeded the RDA for males. The B vitamins in particular were heavily supplemented, providing up to 47 and 72 times the RDA for B<sub>6</sub> and B<sub>12</sub> (cobalamin), respectively, 6 weeks before competition. RDA percentage values for the women were also extremely elevated. However, it should be noted that one of the women took high doses of B vitamins for treatment of carpal tunnel syndrome. These results support previous research findings of the widespread use of vitamin and mineral supplementation (24).

The RDA was nevertheless consistently met by male BB without supplements. The only nutrient that provided two-thirds or less of the RDA was calcium at 1 week precompetition. The women, however, were deficient in several vitamins and minerals, most notably folacin, calcium, iron, and zinc. This could be due to very low intakes of dairy products combined with a low calorie diet.

Two conclusions can be drawn from this study. A combined regimen of dieting and intense exercise training in preparation for competition may be related to changes in psychological state. Concerning nutrition, male BB may be able to meet the estimated RDAs without supplements, with the possible exception of calcium, while female BB with a low caloric intake may need vitamin and mineral supplements to meet the RDA.

## Practical Applications

This study suggests that BB psychological state is affected during the weeks prior to competition. A strict regimen of diet and exercise as well as the pressure of the impending competition may all play a role. The BB, trainer, and family members should be aware that the BB may feel more depressed, tense, and confused during this period. Vitamin and mineral supplementation exceeds the recommended RDA for some BB, but some supplementation seems to be warranted during this phase of low caloric intake, especially for women.

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