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Combination of gradual and rapid weight loss: Effects on physical performance and psychological state of elite judo athletes

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Abstract

The aim of the present study was to examine the effects of a combination of gradual and rapid body mass loss on the physical performance and psychological state of elite judo athletes. Participants were divided into two groups: the experimental (diet) group needed to reduce body mass by 2–6%, whereas the control group did not need to lose body mass. Body mass, percentage of body fat, vertical jump, repetitions of judo movements, rowing with additional loads, and the Profile of Mood States were assessed at 4 weeks before a championship and again one day before the same championship. Compared with 4 weeks before the championship, the experimental group showed a significant decrease in body mass ($-4 \pm 1.1\%$, $P < 0.05$), estimated body fat ($-10 \pm 4.0\%$, $P < 0.05$), and judo movement repetitions over 30 s (-4.5 ± 2.7 , $P < 0.05$), and an increase in scores for confusion (-14.6 ± 7.9 , $P < 0.05$) and tension (-10.1 ± 12.5 , $P < 0.05$), but a decrease in vigour (11.3 ± 8.5 , $P < 0.05$), one day before the championship. There was no difference in squat jump or countermovement jump performance or in judo movement repetitions over 5 s. Our results show that for the experimental group some aspects of performance were impaired one day before a competition, but performance of judo movements over 5 s was not affected.

Keywords: *Judo, psychological state, body mass loss*

Introduction

Most athletes participating in combat sports with specific body mass categories such as wrestling, boxing, and judo can compete in a class 10% below their usual body mass (Brownell, Steen, & Wilmore, 1987). Thus body mass control may be as important an issue as performance (Fox, 1993).

In sports in which body mass plays a decisive role, the athletes can resort to passive (sauna) and active sweating (through intensive exercise in plastic suits) as well as reducing the amount of food and liquids they consume. Rapid body mass loss (i.e. in 3–4 days) has been reported to be detrimental to performance in terms of power, force, resistance, flexibility, and skilfulness (Filaire, Maso, Degoutte, Jouanel, & Lac, 2001; Fogelholm, Koskinen, Laasko, Rankinen, & Ruokonen, 1993; Guastella, Wygand, Davy, & Pizza, 1988; Hall & Lane, 2001; Houston, Marring, Green, & Thomson, 1981; Tarnopolsky et al., 1996; Webster, Rutt, & Weltman, 1990). Dehydration, depleted glycogen stores, and a reduced lean muscle mass may explain such performance

decrements. Moreover, such a procedure may influence cognitive performance and mood negatively (Choma, Sforzo, & Keller, 1998; Filaire et al., 2001; Hall & Lane, 2001; Landers, Arendt, & Lutz, 2001). The mood states of anger, fatigue, and tension assessed by the Profile of Mood State (POMS: McNair, Lorr, & Droppleman, 1971) are significantly higher after a rapid body mass loss, whereas vigour is significantly lower (Filaire et al., 2001; Hall & Lane, 2001).

Some studies have examined the consequences of a more gradual body mass loss (i.e. over 3–4 weeks) by a moderate dietary restriction (Fogelholm et al., 1993; Kowatari et al., 2001; Umeda et al., 2004). Kowatari et al. (2001) showed that the rate of neutrophil-producing reactive oxygen species decreased before a judo competition, whereas oxidative burst activity per cell increased markedly, which resulted in a significant increase in total oxidative burst activity. However, there was no significant effect of dietary restriction on oxidative burst activity. Kowatari et al. (2001) suggested that the increase in oxidative burst activity reflected the effects of

exercise training. Nevertheless, no physical performance was evaluated. Fogelholm et al. (1993) studied wrestlers and judo athletes during two body mass reductions (gradual vs. rapid procedure) and showed that sprint performance (30-m run) and performance in a 1-min maximal cycling test were similar throughout the study. There was no effect on vertical jump performance with rapid weight loss but an improved performance with the gradual weight loss procedure, suggesting a better muscle mechanical functioning after such a procedure. However, Umeda et al. (2004) suggested that dietary restriction in addition to intense exercise training had an adverse effect on power during maximal cycling exercise and elevated serum creatine kinase concentration, leading to an increased susceptibility of muscle tissue to injury. Furthermore, all studies to date have examined the effect of weight loss on the performance of males not females.

In summary, alterations in performance may depend on the type of body mass loss, on the type of sport undertaken, and on the type of dietary restriction. Thus, the effect of dietary restriction on power and on specific judo performance remains unclear (Fogelholm et al., 1993; Rankin, Ocel, & Craft, 1996; Umeda et al., 2004; Webster et al., 1990). In addition, elite combat sports athletes often prefer a third weight loss strategy that combines gradual and rapid weight loss. Thus, the aim of this study was to assess the effects of such a combined procedure on the physical performance and psychological states of elite male and female judo athletes.

Methods

Participants

Twenty national or international judo contestants (10 females and 10 males; mean age 17.0 years, $s = 1.0$) from a national training centre (Pole France Judo) in France volunteered to participate in the experiment. All participants had qualified for the French Junior National Championship in all body mass categories, except +100 kg in men and +78 kg in women. On average, the participants had participated in judo for 9.0 years ($s = 2.4$). They undertook 10–14 h of training per week and their technical level ranged between first and second *dan* black belt. All participants (or their parents when participants were under 18) and the trainer signed a letter of informed consent after being informed of the risks involved. All procedures were approved by the local ethics committee.

The two experimental groups of judo contestants were competing as normal. The participants in the control group maintained their body mass or lost less than 2% of their body mass (5 females aged

16.8 years, $s = 0.5$ and 5 males aged 17.6 years, $s = 0.9$) and were asked to follow the same nutrient intake as that identified by the dietician one month earlier. Members of the experimental (diet) group (5 females aged 16.5 years, $s = 0.5$ and 5 males aged 17.5 years, $s = 1.0$) were asked to lose between 2 and 6% of their body mass. The experimental group followed the same body mass loss procedure for 4 weeks. One month before the body mass loss procedure, a dietician and the judo trainer questioned the participants on their dietary habits and obtained nutrient intakes values from a 7-days record kept during a period of body mass maintenance for both groups. Meals and food weights were recorded daily by each participant and food intake weight per day was calculated. Starting 4 weeks before the national championship, the experimental group were asked to decrease daily energy intake by 4 MJ for the next 21 days. The dietician prepared the menus of the five daily meals for the 5 weekdays, while the participants were asked to follow detailed verbal and written instructions as accurately as possible on weekend days. During the last 6 days before the competition, the experimental group lost body mass by sweating through exercise in plastic suits to increase water loss during judo training and conditioning sessions. The six judo training sessions consisted of judo skills and *randori* in *ne-waza* and *nage-waza* (fighting practice on the ground and in standing positions) with varying intensities above 90% of maximum oxygen consumption ($\dot{V}O_{2max}$). Each session lasted for 2–3 h per day. The two 45-min conditioning sessions consisted of running at intensities of up to 90% $\dot{V}O_{2max}$.

Procedure

All participants took part in two test sessions: the first 4 weeks before the national championship and the second the day before the national championship. All measurements were performed on both occasions. Body mass was determined wearing only underclothes and percent body fat was estimated from four skinfold thicknesses (Durnin & Rahaman, 1967). The performance tests, which consisted of vertical jumps, repetitions of judo movements, and rowing movements, were completed in the same order on both test occasions. The vertical jump test consisted of three vertical jumps performed from a standing position without a preliminary countermovement jump (i.e. SJ), and three with a preliminary countermovement jump (i.e. CMJ) (Finni, Komi, & Lepola, 2000). A 5-min rest was allowed after each vertical jump. Vertical jump height was measured by kinematic analysis (Dartfish v.1). For both squat and countermovement jump, the best performance was used for further analysis. Repetitions of favourite

judo movements were continued for 5 s (TW-5) (three trials) with a 5-min rest and 30 s (TW-30) (one trial) with a 5-min rest. A set of 10 rowing movements was completed as rapidly as possible at 70% of the participants' maximal developed load (1-MR) (Cometti, 1988). The duration of this set was used to calculate the mean power developed.

A French version of the POMS (Cayrou, Dickes, Dolbeault, Gauvain-Piquard, & Desclaux, 2000) was used to assess changes in tension, anger, confusion, vigour, depression, and fatigue. Measurements were not made on the day of competition, because the national championship was the most important event of the season for these athletes.

Statistical analysis

The data were analysed using a 2 (sex) \times 2 (group) \times 2 (procedure) multivariate analysis of variance (MANOVA) with repeated measures on the last factor. POMS scores were analysed using a 2 (sex) \times 2 (group) \times 2 (procedure) \times 6 (state) MANOVA, in which states were viewed as a dependent factor. Statistical significance was set at $P < 0.05$. When necessary, Tukey *post hoc* tests were used to examine differences among means. Data are expressed as means and standard deviations (*s*).

Results

Anthropometric data (body mass and estimated body fat) are shown in Table I. Body mass decreased significantly from the first to the second test session, with the experimental group losing more body mass than the control group (procedure main effect: $P < 0.01$; group \times procedure interaction: $P < 0.05$). Specifically, the body mass of the experimental group decreased by 3.9% from the first to the second test session. Estimated body fat decreased from the first to the second test session, with the experimental group decreasing estimated body fat more than the

control group (procedure main effect: $P < 0.001$; group \times procedure interaction: $P < 0.01$). Specifically, the estimated percent body fat of the experimental group decreased by 10% from the first to the second test session.

The performance test results for the experimental and control groups (SJ, CMJ, mean power, TW-5, and TW-30) are shown in Table II. Males were superior to females in standing jump, countermovement jump, and mean power on both the first and second test sessions. The results did not differ between the first and second test sessions. No significant difference was observed in the SJ/CMJ ratio between the first and second test sessions. Performance in TW-5 was not significantly different between the first and second test sessions for both groups. Performance in TW-30 decreased significantly from the first to the second test session, with the decrement in performance greater in the experimental group than in the control group (procedure main effect: $P < 0.01$; group \times procedure interaction: $P < 0.05$).

POMS scores expressed are shown in Table III. The POMS scores increased from the first to the second test session (procedure main effect: $P < 0.01$). The mood states of confusion in male judo athletes, and tension and confusion in female judo athletes, increased significantly from the first to the second test session ($P < 0.05$). Moreover, vigour decreased significantly in both male and female athletes in the experimental group ($P < 0.05$).

Discussion

The aim of this study was to examine the effects of a combined body mass loss procedure on judo performance and mood. Between the first and second test sessions (4 weeks and one day before the national championship respectively), the experimental group showed a significant decrease in body mass and estimated body fat but squat jump

Table I. Body mass and estimated body fat for the control and experimental groups 4 weeks before (T1) and one day before (T2) competition (mean \pm *s*).

	Control group		Diet group	
	T1	T2	T1	T2
Body mass (kg)				
Males	70.5 \pm 17.8 ^a	70.3 \pm 18.9 ^a	72.3 \pm 12.1	69.9 \pm 11.8 ^{b,c}
Females	66.7 \pm 18.9 ^a	66.3 \pm 19.1 ^a	72.6 \pm 14.3	69.3 \pm 14.5 ^{b,c}
Estimated body fat (%)				
Males	13.7 \pm 5.4 ^d	13.6 \pm 5.2 ^d	11.8 \pm 2.8 ^d	10.4 \pm 2.1 ^{a,b,d}
Females	23.6 \pm 6.6 ^d	23.1 \pm 6.5 ^d	22.5 \pm 7.5 ^d	20.5 \pm 2.6 ^{a,b,d}

Notes: Procedure main effect T1 vs. T2: ^b $P < 0.05$, ^c $P < 0.01$.

Sex main effect: ^a $P < 0.05$, ^d $P < 0.01$.

Procedure \times group interaction: ^c $P < 0.01$.

Table II. Performance test results for the control and experimental groups 4 weeks before (T1) and one day before (T2) competition (mean \pm s).

	Control group		Diet group	
	T1	T2	T1	T2
SJ (cm)				
Males	56.0 \pm 6.3	54.6 \pm 8.1	58.6 \pm 6.2	58.8 \pm 4.8 ^a
Females	43.0 \pm 8.9	42.4 \pm 7.0	45.6 \pm 1.7	46.8 \pm 2.9 ^a
CMJ (cm)				
Males	55.8 \pm 7.9	54.8 \pm 6.6	61.6 \pm 5.0	59.0 \pm 6.4 ^a
Females	43.6 \pm 8.6	42.8 \pm 7.2	47.0 \pm 3.9	47.4 \pm 3.1 ^a
MP (W)				
Males	209.6 \pm 10.3	221.6 \pm 16.6	213.0 \pm 17.2	208.1 \pm 20.7 ^a
Females	179.8 \pm 18.5	204.4 \pm 31.1	179.5 \pm 21.1	177.8 \pm 25.0 ^a
TW-5 (n)				
Males	8.2 \pm 0.4	8.2 \pm 0.4	8.8 \pm 0.8	8.8 \pm 0.4
Females	8.8 \pm 0.4	8.6 \pm 0.5	8.3 \pm 0.4	8.2 \pm 0.8
TW-30 (n)				
Males	44.4 \pm 7.2	43.0 \pm 7.3	48.4 \pm 5.4	42.6 \pm 5.1 ^{b,c}
Females	45.0 \pm 4.9	43.0 \pm 3.7	40.0 \pm 2.3	36.8 \pm 3.8 ^{b,c}

Notes: SJ: squat jump; CMJ: countermovement jump; MP: mean power; TW-5: tokui-waza during 5 s; TW-30: tokui-waza during 30 s.

Procedure main effect: ^a $P < 0.05$.

Sex main effect: ^b $P < 0.05$.

Procedure \times group interaction: ^c $P < 0.05$.

Table III. Psychological profiles for the control and experimental groups 4 weeks before (T1) and one day before (T2) competition (mean \pm s).

	Control group		Diet group	
	T1	T2	T1	T2
Tension				
Males	44.2 \pm 2.2	51.4 \pm 1.8	46.5 \pm 1.1	48.0 \pm 2.1
Females	42.8 \pm 1.7	43.9 \pm 1.9	34.0 \pm 2.0	52.8 \pm 2.0 ^a
Depression				
Males	32.4 \pm 3.0	39.4 \pm 1.4	34.4 \pm 2.3	41.0 \pm 1.6
Females	37.3 \pm 2.9	40.4 \pm 1.1	36.2 \pm 0.9	42.8 \pm 1.2
Anger				
Males	42.1 \pm 1.2	47.7 \pm 0.7	40.3 \pm 0.8	48.2 \pm 2.6
Females	45.5 \pm 1.1	55.6 \pm 2.0	42.5 \pm 0.9	43.5 \pm 1.1
Vigour				
Males	53.3 \pm 0.8	51.0 \pm 0.4	58.4 \pm 0.4	48.6 \pm 0.8 ^a
Females	58.1 \pm 0.4	52.4 \pm 0.8	59.4 \pm 0.7	48.6 \pm 0.5 ^a
Fatigue				
Males	51.2 \pm 1.5	49.5 \pm 1.2	53.0 \pm 1.2	55.6 \pm 1.7
Females	42.7 \pm 0.6	49.6 \pm 1.5	43.8 \pm 0.9	52.8 \pm 2.3
Confusion				
Males	38.4 \pm 2.4	47.2 \pm 1.1	38.6 \pm 1.1	49.6 \pm 1.3 ^a
Females	40.5 \pm 2.3	43.1 \pm 0.8	34.1 \pm 1.9	52.2 \pm 2.7 ^a

Notes: Procedure \times sex \times group interaction: ^a $P < 0.05$.

performance, countermovement jump performance, and repetitions of judo movements were not significantly different between the two test sessions. Thus, this body mass loss procedure did not have an effect on the short and intense efforts.

A possible reason for the lack of an effect of the combined body mass loss on short and intense efforts in the present study is that water loss could have been lower than that experienced using other diet procedures and was not sufficient to affect acid-base balance (Filaire et al., 2001) and serum creatine kinase concentration (Umeda et al., 2004). The body mass loss (3.9 %) of the experimental group may have been partly due to a reduction in fat mass (10 %) as well as to dehydration, as is observed when a rapid weight loss procedure is followed (Filaire et al., 2001). We suggest that muscle ATP and creatine phosphate concentrations were maintained and that immediate contractile energy sources were sufficient to generate appropriate force (Houston et al., 1981).

The ratio between standing jump and countermovement jump showed no significant difference between the two test sessions. This result does not confirm the hypothesis proposed by Filaire et al. (2001) on possible changes in the visco-elastic properties of the muscular system. Between the two test sessions, the performance of the experimental group decreased when the effort was prolonged to 30 s or more. The two test sessions, when the effort was prolonged to 30 s or more, a very slight though not significant decrease in mean power (-3.6 W) and significant decrease in TW-30 (-6%) illustrate that the experimental group's performance was adversely affected. In contrast, we observed a non-significant increase in mean power ($+20.6$ W) and non-significant decrease in TW-30 (-2%) in the control group.

Our results appear to support studies suggesting that even if the body mass loss was gradual, a long dietary restriction might affect protein catabolism (Horswill, Hickner, Scott, Costill, & Gould, 1990; Umeda et al., 2004; Yarrows, 1988) or muscle glycogen (Houston et al., 1981). This decrement in performance could be problematic for judo athletes in competition conditions according to Sikorski and colleagues (Sikorski, Mickiewicz, Majle, & Laksa, 1989), who showed that during a judo combat of 5 min, the average confrontation time was 30 s interspersed with ~10 s rest.

Our mood states results show that both groups were characterized by the “iceberg” profile 4 weeks before the championship. Lane and Terry (2000) defined “mood as a set of feelings, ephemeral in nature, varying in intensity and durations, and usually involving more than one emotion” (Lane & Terry, 2000, p. 16). Mood is proposed to be a more effective predictor of performance in sports of a short duration, when the sport involves open skills, and when performance is assessed through a self-reference criterion (Beedie, Terry, & Lane, 2000). Based on Morgan’s Mental Health Model (Morgan, 1980a, 1980b), it is proposed that positive emotional health and successful athletic performance are correlated. Indeed, athletes who are less anxious, angry, depressed, confused and fatigued, and more vigorous are more successful than those who exhibit the opposite profile, as assessed by the Profile of Mood States. Nevertheless, some studies have not provided support for such a profile in combat sports (Hall & Lane, 2001; McGowan and Miller, 1989; McGowan, Miller, & Henschen, 1990; Terry & Slade, 1995). Terry and Slade (1995) classified winners and losers in karate according to their pre-performance mood profiles and found high scores for anger in winners. These results suggest that anger may facilitate performance in karate competition. We suggest that the difference in anger is due to the type of sport. Indeed, boxing (Hall & Lane, 2001) and karate (McGowan and Miller, 1989; McGowan et al., 1990; Terry & Slade, 1995) are percussion combat sports, whereas judo is a “gripping” combat sport.

The mood state of confusion in male judo athletes, and those of tension and confusion in female judo athletes, increased significantly between the two test sessions, whereas vigour decreased significantly in both male and female athletes in the experimental group. The approach of the competition and the body mass loss may have had an influence on profiles obtained one day before competition in the experimental group, confirming previous results in sports using body mass loss (Filaire et al., 2001; Hall & Lane, 2001; Newton, Hunter, Bammon, & Roney, 1993; Steen and Brownell, 1990). Body mass loss and/or the approach of competition may affect the

mood profile by lowering the positive mood state of vigour and increasing the negative mood states of tension and confusion. Lane and Terry (2000) proposed that tension can have a motivating effect when it is experienced independently from depression. Thus, athletes may use tension positively. Nevertheless, the pre-competitive status of the athlete alone could produce the mood state profile. For example, judo athletes who are likely to perform well are not likely to be overly stressed during competition and as a result they should demonstrate positive pre-competitive mood states. In contrast, borderline athletes may be more likely to perceive pressure because they are less likely to perform well. However, some studies have reported an increase in fatigue after body mass loss (Filaire et al., 2001; Hall & Lane, 2001). We found no effect on fatigue in the present study. Thus, we suggest that a combined procedure of body mass loss could affect mood to a lesser extent.

A limitation of the present study was that the athletes were allowed a period of 1–2 h after the weigh-in and before the start of competition during which food and fluids were allowed. The present study assessed anthropometric data, physical performance, and psychological parameters one day before a judo national championship (Filaire et al., 2001; Kowatari et al., 2001; Umeda et al., 2004). Thus physical performance could not be assessed just before or after the recovery period between the weigh-in and the competition. Moreover, mood profiles obtained at the second test session in the present study did not represent the mood profile immediately before competition because the POMS was administered one day before the championship. Degoutte et al. (2006) assessed maximum strength of the forearms and hands before a 7-day food restriction (baseline) and on the morning of a simulated judo competition (judo athletes had breakfast after the weigh-in). Results showed that a rapid reduction in body mass altered maximum muscular strength. Moreover, tension, fatigue, and anger increased while vigour decreased compared with baseline.

In conclusion, our results suggest that a combined body mass loss procedure does not have an effect on short-duration performance or visco-elastic properties of the muscular system. However, this procedure, in common with other methods to reduce body mass reported in the literature, does adversely affect prolonged physical performance and the psychological state of male and female elite judo athletes. Future studies could address the possible reasons for the effect on performance of longer duration, including changes in muscle metabolite concentrations. There is also a need to examine the impact of the recovery period between the weigh-in and judo competition.

References

- Beedie, C., Terry, P. C., & Lane, A. M. (2000). The Profile of Mood States and athletic performance: Two meta-analyses. *Journal of Applied Sport Psychology, 12*, 49–68.
- Brownell, K. D., Steen, S. N., & Wilmore, J. H. (1987). Weight regulation practices in athletes: Analysis of metabolic and health effects. *Medicine and Science in Sports and Exercise, 19*, 546–556.
- Cayrou, S., Dickes, P., Dolbeault, S., Gauvain-Piquard, A., & Desclaux, B. (2000). French validation of the Profile of Mood States (POMS). *Psycho-Oncology, 9*, 208.
- Choma, C. W., Sforzo, G. A., & Keller, B. A. (1998). Impact of rapid weight loss on cognitive function in collegiate wrestlers. *Medicine and Science in Sports and Exercise, 30*, 746–749.
- Cometti, G. (1988). *Les méthodes modernes de musculation. Tome 1, données théoriques*. Dijon: UFR STAPS, Université de Bourgogne.
- Degoutte, F., Jouanel, P., Begue, R. J., Colombier, M., Lac, G., Pequinot, J.-M. et al. (2006). Food restriction, performance, biochemical, psychological, and endocrine changes in judo athletes. *International Journal of Sports Medicine, 27*, 9–18.
- Durnin, J. V., & Rahaman, M. M. (1967). The assessment of the amount of fat in the human body from measurements of skinfold thickness. *British Journal of Nutrition, 21*, 681–689.
- Filaire, E., Maso, F., Degoutte, F., Jouanel, P., & Lac, G. (2001). Food restriction, performance, psychological state and lipid values in judo athletes. *International Journal of Sports Medicine, 22*, 454–459.
- Finni, T., Komi, P. V., & Lepola, V. (2000). *In vivo* human triceps surae and quadriceps femoris muscle function in a squat jump and counter movement jump. *European Journal of Applied Physiology, 83*, 416–426.
- Fogelholm, G. M., Koskinen, R., Laakso, J., Rankinen, T., & Ruokonen, I. (1993). Gradual and rapid weight loss: Effects on nutrition and performance in male athletes. *Medicine and Science in Sports and Exercise, 25*, 371–377.
- Fox, K. R. (1993). Weight management: Coaching in a cult of slenderness. *Coaching Focus, 22*, 14–16.
- Guastella, P., Wygand, J., Davy, K., & Pizza, F. (1988). The effects of rapid weight loss on aerobic power in high school wrestlers. *Medicine and Science in Sports and Exercise, 20*, S2.
- Hall, C. J., & Lane A. M. (2001). Effects of rapid weight loss on mood and performance among amateur boxers. *British Journal of Sports Medicine, 35*, 390–395.
- Horswill, C. A., Hickner, R. C., Scott, J. R., Costill D. L., & Gould, D. (1990). Weight loss, dietary carbohydrate modifications, and high intensity, physical performance. *Medicine and Science in Sports and Exercise, 22*, 470–476.
- Houston, M. E., Marrin, D. A., Green, H. J., & Thomson, J. A. (1981). The effect of rapid weight reduction on physiological functions in wrestlers. *Physician and Sportsmedicine, 9*, 73–78.
- Kowatari, K., Umeda, T., Shimoyama, T., Nakaji, S., Yamamoto, Y., & Sugawara, K. (2001). Exercise training and energy restriction decrease neutrophil phagocytic activity in judoists. *Medicine and Science in Sports and Exercise, 33*, 519–524.
- Landers, D. M., Arendt, S. M., & Lutz, R. S. (2001). Affect and cognitive performance in high school wrestlers undergoing rapid weight loss. *Journal of Sports and Exercise Psychology, 23*, 307–316.
- Lane, A. M., & Terry, P. C. (2000). The nature of mood: Development of a conceptual model with a focus on depression. *Journal of Applied Sport Psychology, 12*, 16–33.
- McGowan, R. W., & Miller, M. J. (1989). Differences in mood states between successful and less successful karate participants. *Perceptual and Motor Skills, 68*, 505–506.
- McGowan, R. W., Miller, M. J., & Henschen, K. P. (1990). Differences in mood states between belt ranks in karate tournament competitors. *Perceptual and Motor Skills, 71*, 147–150.
- McNair, D., Lorr, M., & Droppleman, L. F. (1971). *Manual for the Profile of Mood States*. San Diego, CA: Educational and Industrial Testing Service.
- Morgan, W. P. (1980a). Test of champions: The iceberg profile. *Psychology Today, 14*, 92–108.
- Morgan, W. P. (1980b). The trait psychology controversy. *Research Quarterly for Exercise and Sport, 51*, 50–76.
- Newton, L. E., Hunter, G., Bammon, M., & Roney, R. (1993). Changes in psychological state and self-reported diet during various phases of training in competitive bodybuilders. *Journal of Strength and Conditioning Research, 7*, 153–158.
- Rankin, J. W., Ocel, J. O., & Craft, L. (1996). Effect of weight loss and refeeding diet composition on anaerobic performance in wrestlers. *Medicine and Science in Sports and Exercise, 28*, 1292–1299.
- Sikorski, W., Mickiewicz, G., Majle, B., & Laksa, C. (1989). Structure of the contest and work capacity of the judoist. *Report of the International Congress on Judo: "Contemporary problems of training and judo contest"* (pp. 58–65), Vienna.
- Steen, S. N., & Brownell, K. D. (1990). Patterns of weight loss and regain in wrestlers: Has the tradition changed? *Medicine and Science in Sports and Exercise, 22*, 762–768.
- Tarnopolsky, M. A., Cipriano, N., Woodcroft, C., Pulkkinen, W. J., Robinson, D. C., Henderson, J. M. et al. (1996). Effects of rapid weight loss and wrestling on muscle glycogen concentration. *Clinical Journal of Sport Medicine, 6*, 78–84.
- Terry, P., & Slade, A. (1995). Discriminant effectiveness of psychological state measures in predicting performance in karate competitions. *Perceptual and Motor Skills, 81*, 275–286.
- Umeda, T., Nakaji, S., Shimoyama, T., Yamamoto, Y., Totsuka, M., & Sugawara, K. (2004). Adverse effects of energy restriction on myogenic enzymes in judoists. *Journal of Sports Sciences, 22*, 329–338.
- Webster, S., Rutt, R., & Weltman, A. (1990). Physiological effects of a weight loss regimen practised by college wrestlers. *Medicine and Science in Sports and Exercise, 22*, 229–234.
- Yarrows, S. A. (1988). Weight loss through dehydration in amateur wrestling. *Journal of the American Dietetic Association, 88*, 491–493.