ALBION® HUMAN NUTRITION

RESEARCH NOTES

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Mg Creatine Chelate Research Threads 2001-2009

We are very pleased to have this edition of Albion's Research Notes written for us by Dr. Lorrie Brilla, Professor, Western Washington University, Center for Fitness Evaluation and Adult Fitness Program, Bellingham, Washington.

Overview

The use of creatine as a sport supplement gained widespread popularity in the early 1990s. The Exercise Physiology Laboratory at Western Washington University entered into agreement with Albion Laboratories to conduct the three research studies, one each in 2001, 2006, and 2009 on the Creatine MagnaPower® (magnesium creatine chelate) supplement. The 2001 and 2006 projects were 2 week supplementation regimens and the 2009 project was 4 weeks of supplementation. A series of tests were conducted pre and post of supplementation, at a level of 5 g creatine and 800 mg magnesium per day, with either the chelate or stacked forms; serial tests were conducted every 2nd day in the 2006 project to attempt to identify a breakpoint when creatine effects might be demonstrated. In 2009, the stacked treatment was replaced with alkaline creatine. A placebo group was included in each study for comparison. All subjects completed dietary and physical activity records to substantiate that there were no changes so that any differences would be attributed to the treatments.

Key findings, which may be attributed to the treatments, included the changes presented below.

2001(N=36):

- Body weight: both creatine groups gained weight with only the chelate group reaching statistical significance
- Total body water and intracellular and extracellular water compartments: there were no significant differences between groups (P>0.05).
- There were significant differences in %TBW (total body water) for stack condition (P=0.007)
- There were significant differences in %ICW (intracellular water) and %ECW (extracellular water) for the chelate condition (P=0.019); Liters of ICW increased, 26.29 L to 28.0 L (P=0.039) and Liters of ECW decreased, 15.75 L to 14.9 L (P=0.009).
- The compartmental shifts may correspond to the osmotic effect of intracellular creatine due to supplementation effects. The statistically significant effects in chelate, but not stack, may indicate a greater availability of creatine in the chelate supplemented group.
- Anaerobic power as determined by the Wingate test, specifically peak power and mean power in repeat tests: There were no significant differences for group contrasts (P>0.05). However, there were within group differences (P0<.05). Chelate subjects had an increased peak power comparing the 1st test in each pair, pre-post (P<0.05). This change was the only significant difference in peak power for any of the treatment groups.
- Anaerobic threshold in a treadmill running test to exhaustion at 90% of maximal capacity as determined from a graded exercise test: There were no significant differences in lactates or Exercise Time to Exhaustion (ETT) at 90% of maximal functional capacity (P>0.05). The ventilatory threshold from oxygen and carbon dioxide measures estimated anaerobic threshold (AT). There was a significant interaction effect (P<0.05). There may be a trend towards reaching AT later in exercise, especially in the magnesium-creatine groups that may demonstrate a greater contribution from other energy systems before relying on glycolysis.
- Peak torque, total work, and power measurements on an isokinetic strength testing device: there were no significant differences between groups (P>0.05). Significant differences were noted within groups for various parameters and in specific sets.

2006 (N=44):

- Only the chelate group had significant body weight gains (P<0.05) although both creatine groups gained weight; stack P=0.17.
- Total body water and intracellular and extracellular water compartments: the chelate group had a trend for slightly higher body water compared to placebo but there were no within or between group differences (P>0.05).
- No significant differences were noted in the one-minute hand grip test within or between groups.
- Anaerobic power as determined by the Wingate test; no significant differences in serial tests over 12 days although the chelate group gains in mean power was 14.5% compared to stack at 1.6%; (Figure 2) **only the chelate group showed better peak power** (Table 1) in the posttest although it was not significant.

Table 1.

Group	Peak Power Pre	Peak Power Post	Mean Power Pre	Mean Power Post
Placebo	10.8 ± 1.5	10.0 ± 1.9	5.2 ± 1.1	5.2 ± 1.2
Stack	11.2 ± 1.7	10.7 ± 1.8	5.6 ± 0.8	5.7 ± 1.2
Chelate	12.1 ± 2.9	13.1 ± 3.0	5.3 ± 1.1	6.2 ± 1.1

All values are $W \cdot kg^{-1}$

Figure 1.

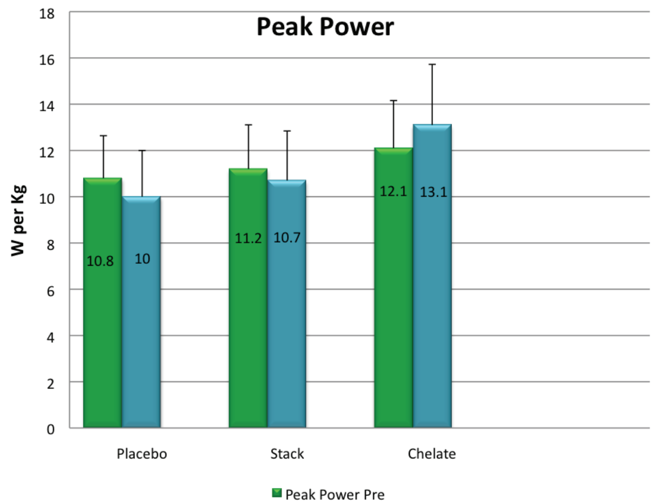
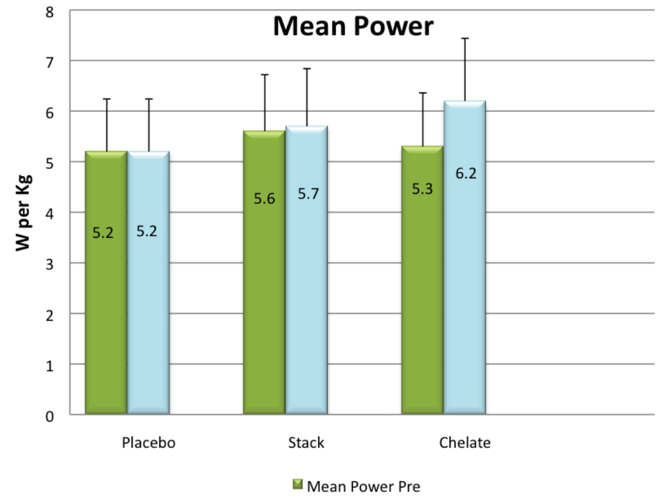


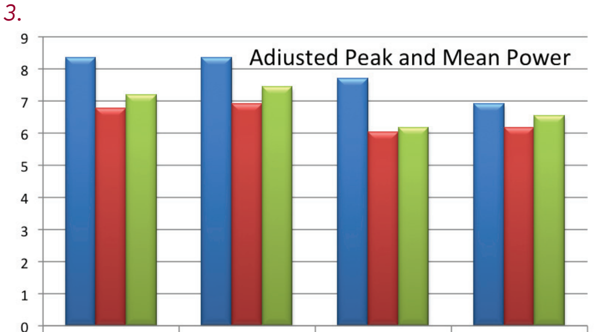
Figure 2.



2009 (N=36):

- Body weight yielded no significant differences within or between groups (P>0.05).
- Total body water and intracellular and extracellular water compartments: There were no significant differences between groups (P>0.05). There was a trend for increased intracellular water in the creatine-magnesium chelate subjects (P=0.08), with a larger variation in the post testing.
- Hand grip strength: there were no significant differences in maximal hand grip pre-post or across groups (P>0.05). The hand grip fatigue test exhibited statistical significance for all groups (P<0.05), pre-post, for total work improvements.
- Anaerobic power as determined by the Wingate test; there were no significant differences from the treatment on peak power, mean power, adjusted peak power for weight, or adjusted peak power for weight (P>0.05) in the Wingate Anaerobic Test. **Both creatine treatments resulted in greater mean power, 2.4% for alkaline creatine and 12% for the chelate condition** with peak power improvements of 2.1 % and 3.3%, respectively. (Figure 3 below)
- Isokinetic strength and fatigue tests: there were no significant effects on isokinetic maximal isometric torque measured in Nm (P>0.05). All groups improved on concentric peak torque at 90 deg/s over the course of the study (P<0.05). There was no difference between groups (P>0.05) on total work performed during the 30 consecutive maximal repetitions. All groups improved on total work done during 30 maximal effort trials at 90 deg/s over the course of the study (P<0.05).
- Delayed onset muscle soreness [DOMS]: **The creatine groups did have significant main effects pre to post testing in delayed onset muscle soreness [DOMS]** using a visual analog scale after a 5-minute eccentric bout of exercise (P<0.05). The effects were observed at 12, 24, and 36 hour intervals for the alkaline creatine subjects and at 12 hour intervals up to the 60 hour interval for the magnesium-creatine chelate group. There were no significant effects between groups.

Figure 3.



	Pre Adj. PP	Post Adj. PP	Pre Adj. MP	Post Adj. MP
Placebo	8.35	8.36	7.69	6.92
AlkCreatine	6.77	6.92	6.03	6.18
Mg Cre Chelate	7.19	7.44	6.18	6.55

Research Threads

The 2001 and 2009 projects were most similar in design: three groups with pre-post treatment testing. The salient group difference was in supplementation: stacking magnesium oxide and creatine in 2001 and utilizing alkaline creatine in 2009 compared to magnesium creatine chelate and placebo conditions. The period of supplementation also differed: 2 weeks in 2001 and 4 weeks in 2009.

Due to the statistically significant findings in some tests, notably body water and anaerobic power, in the 2001 study, these tests were repeated in the 2009 project. There were no significant differences between groups in these tests.

However, within groups, **the magnesium creatine chelate subjects had significantly greater intracellular water [ICW] in 2001** with a trend towards increased ICW in 2009. Increased ICW may represent cell swelling indicative of protein synthesis as published in the 2003 article. **The chelate condition was the only one which resulted in peak torque increases in the earlier study.** In 2001, the stack condition did have significant increases in total body water, but the change in ICW was not significant; the placebo group exhibited no significant changes. **There was essentially no ICW change in placebo and alkaline creatine conditions in the 2009 project.** The 2009 results are presented below.

Anaerobic power was tested via the Wingate Anaerobic Test [WANT] in all three projects. Peak Power tends to be the most varied measure in this test application. In 2001, **only the chelate group had significant improvements in Peak Power.** In 2009, there were no significant changes although the chelate condition improved ~7% while the alkaline chelate and placebo groups were essentially unchanged. There were no significant differences in Mean Power, although in 2009 the chelate condition improved more than the alkaline condition. A caveat must be considered when interpreting percent changes without statistical significance. There were no significant differences in the 2006 study, although inspection of the means showed that there may be a slight improvement in Peak and Mean Power with the chelate condition. (Figure 1 & 2)

In isokinetic strength and fatigue testing, creatine regardless of form impacted strength and fatigue. The chelate group did perform more total work in the 2001 study but this finding was not replicated in the 2009 study.

Hand grip testing showed no significant differences in the 2006. More total work was done by all groups as noted in the 2009 study, although the absolute maximal strength trials did not significantly change. This finding infers that there was less fatigue over the 3-minute course of repetitive contractions.

An exercise test to exhaustion [ETT] was performed only in the 2001 study. Only the chelate (Creatine MagnaPower®) group had a slight improvement in time, although it was not statistically significant. There was a trend towards reaching anaerobic threshold in both creatine groups, stacked and chelate conditions.

Delayed onset muscle soreness [DOMS] was assessed after a bout of eccentric exercise only in the 2009 study. There were no significant differences between groups. The alkaline creatine had significantly less DOMS post treatment at 12 hour intervals up to 36 hours and the creatine chelate condition elicited amelioration of DOMS at 12 hour intervals up to 60 hours; DOMS was measured for 72 hours post exercise.

Overall, creatine did have performance enhancing effects. **The chelate condition in the studies had slightly greater improvements on some measures, especially noted in body and compartmental water which may suggest an enhanced protein synthesis.** The Wingate test had mixed results but there is an indication that the chelate condition resulted in better anaerobic performance to some extent. The improvement in DOMS in both creatine conditions is worthy to note. The chelate condition had a slightly better influence. The chelate condition was contrasted to the same components delivered in a stack fashion or to an alkaline creatine compound.

Part of the difficulty in creatine research on physical performance is that there is no sensitive test for anaerobic power. However, there may be other markers, such as the body and compartmental water, DOMS, and possibly ETT testing that can be used as surrogates which may infer an enhanced physical performance. Another factor affecting creatine research is literature reporting that up to 30% of subjects may be non-responders. That supplementation may affect parameters measured without an intervening standardized training program is noteworthy.

Table 2.

Groups		Pre TBW (L)	Post TBW (L)	Pre ICW (L)	Post ICW (L)	Pre ECW (L)	Post ECW (L)
Placebo	Mean	41.29	41.73	26.97	26.31	14.79	15.45
	SD	9.88	9.43	7.50	6.87	2.39	2.69
AlkCreatine	Mean	42.92	41.55	26.34	26.30	16.58	16.32
	SD	11.10	12.92	8.13	8.14	3.68	3.75
Mg Creatine Chelate	Mean	42.39	44.52	26.75	.30.75	16.87	17.90
	SD	9.36	9.74	6.41	13.14	3.05	5.63

Summary

The findings of the studies by Dr. Brilla, et al, have shown the benefits of creatine supplementation , and has further pointed out that Albion's Creatine MagnaPower® (magnesium creatine chelate) has some important effects on the body that are beyond that of other creatine forms, as stated in Dr. Brilla's conclusions. The advantages of the Creatine MagnaPower® have held true over the course of three different clinical studies by Dr. Brilla and company.

Published reports from the studies are listed below. There are no publications yet from the 2009 study. However, manuscripts will be prepared, with the first paper in progress reporting the DOMS results.

Brilla, L.R., Giroux, M.S., Taylor, A., and Knutzen, K.M. (2003). Magnesium creatine supplementation effects on body water. Metabolism. 52(9):1136-1140.

Brilla, L.R. Kennedy, J.S., and Knutzen, K.M. (2002) Magnesium-creatine supplementation effects on exhaustive exercise. American Journal of Clinical Nutrition. 75:419S.

Brilla, L.R., Giroux, M.S., Taylor, A., and Knutzen, K.M. (2002) Magnesium-creatine supplementation effects on anaerobic power and fatigue. The FASEB Journal, pt. II, 16:A783.

Brilla, L.R., Giroux, M.S., Taylor, A., Kennedy, J.S., Ramirez, R.E., Puz, D., and Knutzen, K.M. (2002) Magnesium-creatine supplementation on total body water, ICF and ECF compartments. Medicine and Science in Sports and Exercise. 34(5S):S3.

Brilla, L.R., Kennedy, J., Ramierez, R.E, Puz, D. and Knutzen, K.M. (2003) Magnesium-creatine supplementation: stacking vs. chelate on knee extension torque. Medicine and Science in Sports and Exercise, 35(5):S217.

Brilla, L.R., Schwerdtfeger, K. L. Varland, C. R., and Tomulty, T. (2007) Effects of magnesium and creatine on the break point of anaerobic performance. Medicine and Science in Sports and Exercise, 39(5): S44.

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