The Effects of Chronic Creatine Supplementation on Performance and Body Composition of Female Athletes

by

Megan Brenner

Thesis submitted to the Faculty of Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Master of Science

in

Human Nutrition, Foods, and Exercise

Approved by:

Dr. Janet Walberg Rankin, Chairman
Dr. Don Sebolt
Dr. Lawrence Cross

August 20, 1997
Blacksburg, VA

Key words: females athletes, strength training, creatine, body composition, lactate
The Effects of Chronic Creatine Supplementation on Performance and Body Composition of Female Athletes

ABSTRACT

The purpose of this investigation was to determine the effects of five weeks of creatine monohydrate ingestion on body composition, blood metabolite, and muscular performance measures in 16 female NCAA Division 1 lacrosse players. Subjects were randomly divided into placebo (P,n=9) and creatine supplement (C,n=7) groups. The supplement group was administered 20g/d of creatine monohydrate in capsule form for 7 d and 2g/d thereafter for five weeks during which time the subjects were engaged in a pre-season conditioning program. Pre- and post-testing consisted of a three-site skinfold analysis, bioelectric impedance (BIA) measurements, hydrostatic weighing, isokinetic knee extension muscle endurance test (5 sets of 30 repetitions at 180 degrees/sec.), blood lactate response to the performance test (pre-test and 3 minutes post-test), a 1RM bench press and 1RM leg extension test. Pre-, mid-, and post- values of blood parameters (BUN and GPT) were measured in order to ensure the safety of the subjects. Data was analyzed using two-way ANOVA with repeated measures, and values are presented as mean+SEM for C and P groups, respectively. Testing revealed that 1RM bench press significantly increased in both groups (mean increase both groups: 4.5kg), and the C group improved significantly more than the P group (6.17±1.96 and 2.84±1.84 kg). Percent body fat by skinfold also decreased significantly in both groups over time (0.52%), and the C group decreased their body fat significantly more than the P group (1.2±0.92 and +0.29±0.81%). Percent body water by BIA also decreased significantly in both groups over time (2.0%), and the C group decreased their percent body water significantly more than the P group (3.0±1.06 and 1.0±0.92%). There was a trend for body fat measured by hydrostatic weighing to decrease for both groups over the 5 weeks. Although no significant differences between groups were found in all other measures, significant time effects across groups were noted (values are absolute mean increase for both groups) for body weight (0.49±3.2kg), 1RM leg extension (1.36±4.1kg), BUN (0.07±0.03mmol/L), total work across 5 bouts of isokinetic knee extension (283.5±387.3Watts), and fat-free mass by skinfold (0.70±1.18kg). These data indicate that a regimen of dietary creatine supplementation designed to increase total muscle Cr content significantly improved the 1RM bench press strength, and decreased the percent body fat as assessed by skinfold and the percent body water as assessed by BIA of a supplemented group more than a placebo group when all female subjects are engaged in a common resistance training program. Furthermore, chronic creatine supplementation appears to have no detrimental effect on blood metabolites which indicate kidney and liver function.
Acknowledgments

I would like to express my sincere gratitude to Drs. Janet Rankin, Don Sebolt, and Lawrence Cross. Without their guidance and direction, this endeavor would not have been possible.

I would also like to thank Dr. Allan Butterfield for allowing me to prepare the placebo capsules in his workplace. Thanks also to Janet Rinehart for drawing the blood from my subjects so professionally, as well as guiding me through my BUN and GPT assays.

Thank you to all the volunteer subjects in my study. As if studying, practicing, and training were not enough, you managed to give even more, to which I am very grateful. Thank you for following study guidelines even on the nights you didn’t want to.

Thank you to Mike Gentry and Jen Neziol for the help in training my subjects and allowing me to use your facility to perform the testing.

Last but not least, I would like to thank my family for the constant support and encouragement without which any of this would be possible.
TABLE OF CONTENTS

Acknowledgments v
List of Figures viii
List of Tables ix

CHAPTER I INTRODUCTION 1

Statement of the Problem 1
Significance of the Study 2
Research Hypothesis 2
Delimitations 3
Limitations 3
Basic Assumptions 3
Definitions and Symbols 3
Summary 4

CHAPTER II REVIEW OF THE LITERATURE 5

Introduction 5
Historical Background 5
Creatine Synthesis 5
Creatine Metabolism During Muscle Contraction 6
Effect of Gender, Diet, and Fiber Type on Muscle Creatine 7
Creatine and Exercise 8
Effect of Creatine Ingestion on Muscle Creatine Concentration 9
Acute Creatine Supplementation and Exercise Performance 11
Chronic Creatine Supplementation and Exercise Performance 13
Adverse Effects of Creatine Supplementation 14
Creatine and Body Composition 15
Creatine and Blood Lactate 16
Summary 19
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1.</td>
<td>40</td>
</tr>
<tr>
<td>Mean 1RM bench press values for creatine and control group before and after the experimental period</td>
<td></td>
</tr>
<tr>
<td>Figure 2.</td>
<td>41</td>
</tr>
<tr>
<td>Mean 1RM leg extension values for creatine and control groups before and after the experimental period</td>
<td></td>
</tr>
<tr>
<td>Figure 3.</td>
<td>43</td>
</tr>
<tr>
<td>Mean values for body weight for creatine and control groups before and after the experimental period</td>
<td></td>
</tr>
<tr>
<td>Figure 4.</td>
<td>46</td>
</tr>
<tr>
<td>Changes in blood lactate accumulation for creatine and control groups before and after the experimental period</td>
<td></td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table 1.</th>
<th>Test Schedule</th>
<th>Page 38</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 2.</td>
<td>Descriptive Statistics of Subjects</td>
<td>Page 39</td>
</tr>
<tr>
<td>Table 3.</td>
<td>Mean Total Work (TW) and Work Fatigue (WF) values for creatine and control groups before and after the experimental period</td>
<td>Page 42</td>
</tr>
<tr>
<td>Table 4.</td>
<td>Mean values for body composition using skinfold, hydrostatic weighing, and bioelectric impedance (BIA) techniques for creatine and control groups before and after the experimental period.</td>
<td>Page 44</td>
</tr>
<tr>
<td>Table 5.</td>
<td>Mean GPT and BUN values for creatine and control groups before and after the experimental period</td>
<td>Page 45</td>
</tr>
<tr>
<td>Table 6.</td>
<td>Blood lactate means and accumulation for creatine and control groups before and after the experimental period</td>
<td>Page 47</td>
</tr>
</tbody>
</table>