



CREATINE IN **WOMEN'S** HEALTH, PREGNANCY, & INFANTS

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OVERVIEW

- Physiological considerations for female specific nutrition conversations



- Creatine specific applications

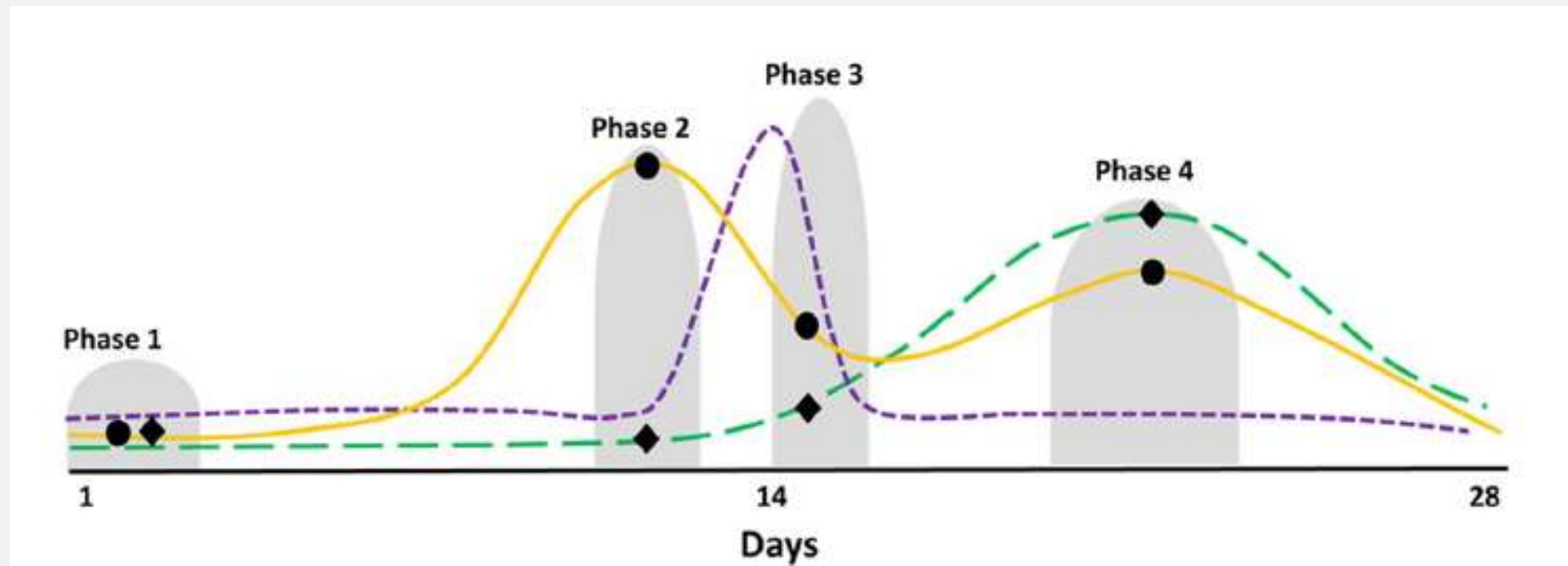
SEX SPECIFIC CONSIDERATIONS

Follicular

↑ CHO utilization
Greater CK/IL6 (inflammation)
↓ Sleep

Luteal

↑ Energy Expenditure
↑ Protein Oxidation (>1.5 g/kg)
↑ Fat oxidation
↑ Fluid Retention & ECF Shift → Dehydration



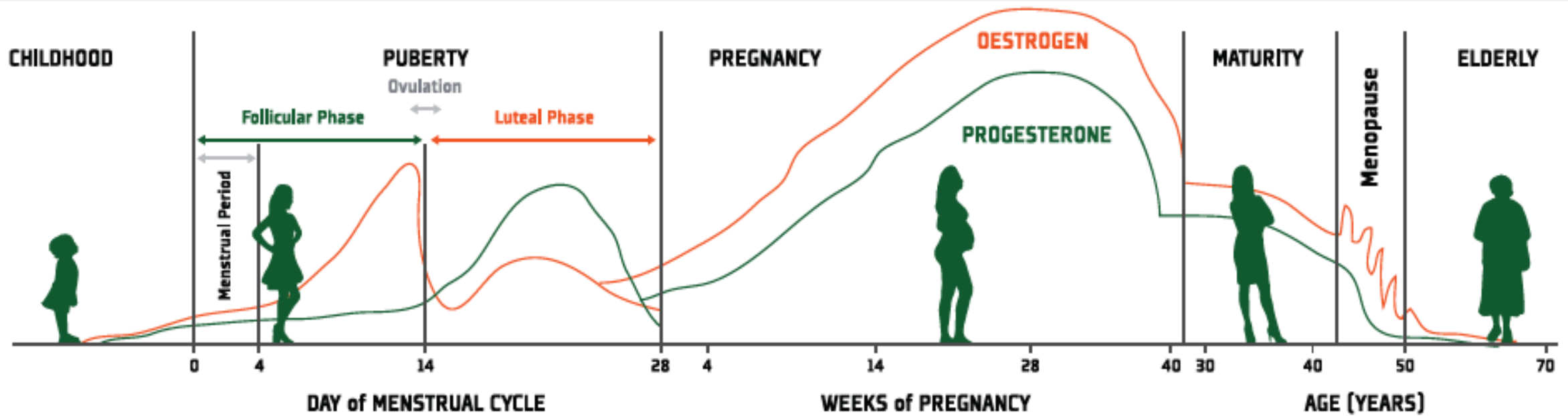
Elliott-Sale et al. Methodological considerations for studies in sport and exercise science with women as participants. Sports Medicine. 2021

Moore et al. Fuelling the female athlete: Carbohydrate and protein recommendations. EJSS 2021

Wohlgemuth, Smith-Ryan et al. Sex differences and considerations for female specific nutritional strategies. JISSN 2021




ACTIVE WOMEN – CONSIDERATIONS FOR LIFESPAN



Review

Creatine Supplementation in Women's Health: A Lifespan Perspective

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Abstract: Despite extensive research on creatine, evidence for use among females is understudied. Creatine characteristics vary between males and females, with females exhibiting 70–80% lower endogenous creatine stores compared to males. Understanding creatine metabolism pre- and post-menopause yields important implications for creatine supplementation for performance and health among females. Due to the hormone-related changes to creatine kinetics and phosphocreatine resynthesis, supplementation may be particularly important during menses, pregnancy, post-partum, during and post-menopause. Creatine supplementation among pre-menopausal females appears to be effective for improving strength and exercise performance. Post-menopausal females may also experience benefits in skeletal muscle size and function when consuming high doses of creatine ($0.3 \text{ g}\cdot\text{kg}^{-1}\cdot\text{d}^{-1}$); and favorable effects on bone when combined with resistance training. Pre-clinical and clinical evidence indicates positive effects from creatine supplementation on mood and cognition, possibly by restoring brain energy levels and homeostasis. Creatine supplementation may be even more effective for females by supporting a pro-energetic environment in the brain. The purpose of this review was to highlight the use of creatine in females across the lifespan with particular emphasis on performance, body composition, mood, and dosing strategies.

Keywords: female; dietary supplement; menstrual cycle; hormones; exercise performance; menopause; pregnancy; mood; cognition



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- Potential Mechanisms for support in Women
- Relevant Female Physiology
- Hydration
- Performance
- Depression
- Cognition





Improve muscle protein kinetics

- Satellite cell and myogenic transcription factors

Metabolic buffer

Glycogen regulation

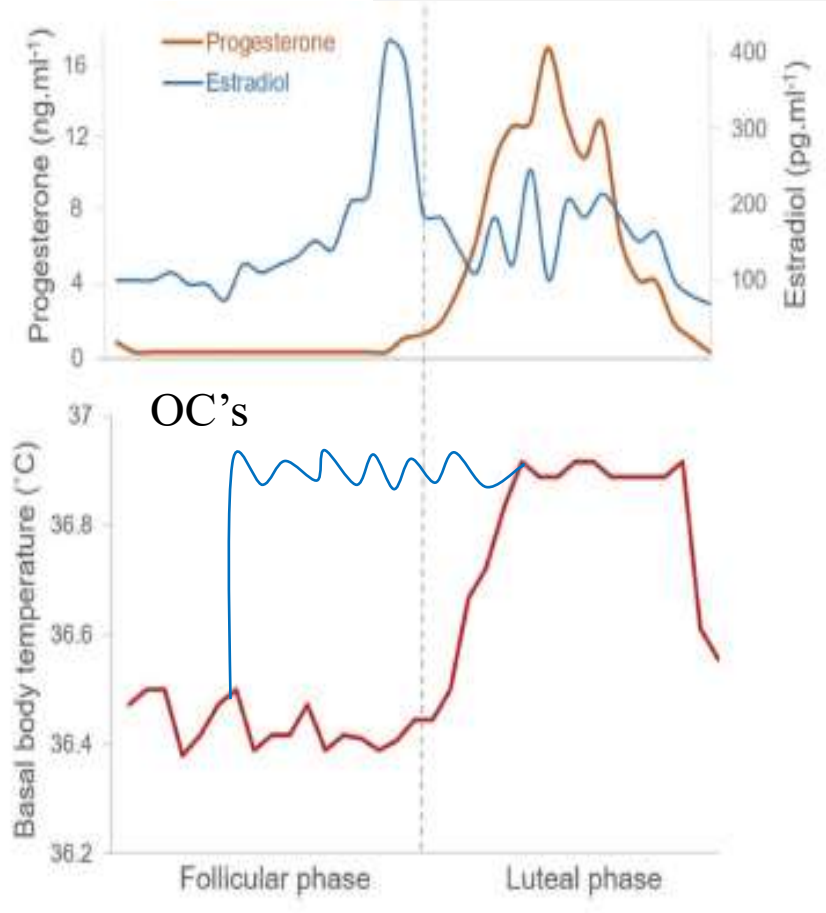
Calcium

Oxidative stress & inflammation



The Physiological Effects of Creatine Supplementation on Hydration: A Review

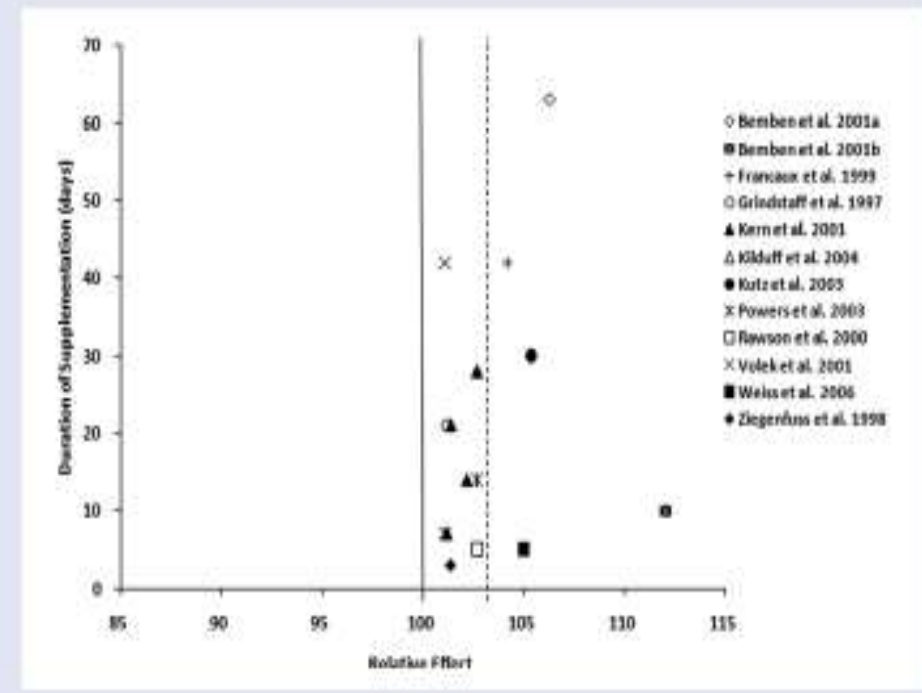
Menstrual Cycle



Creatine Supplementation

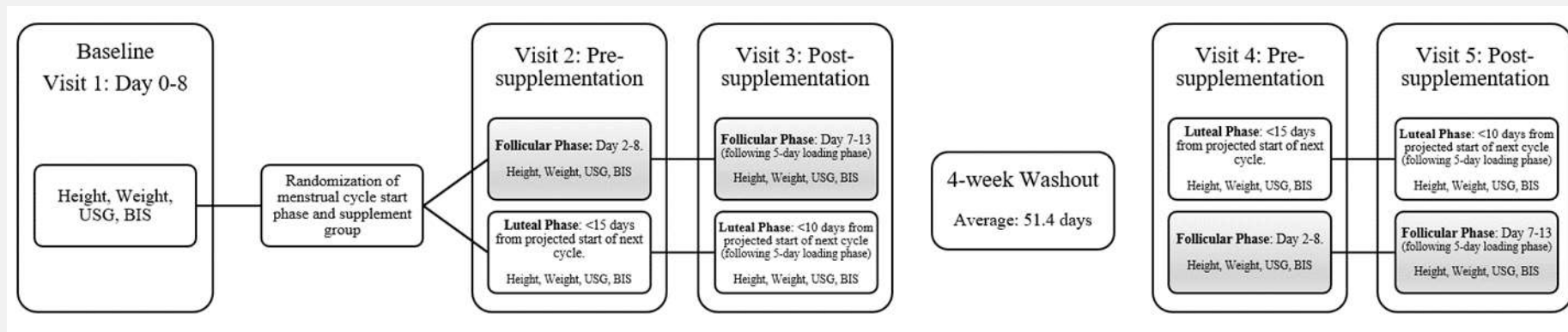
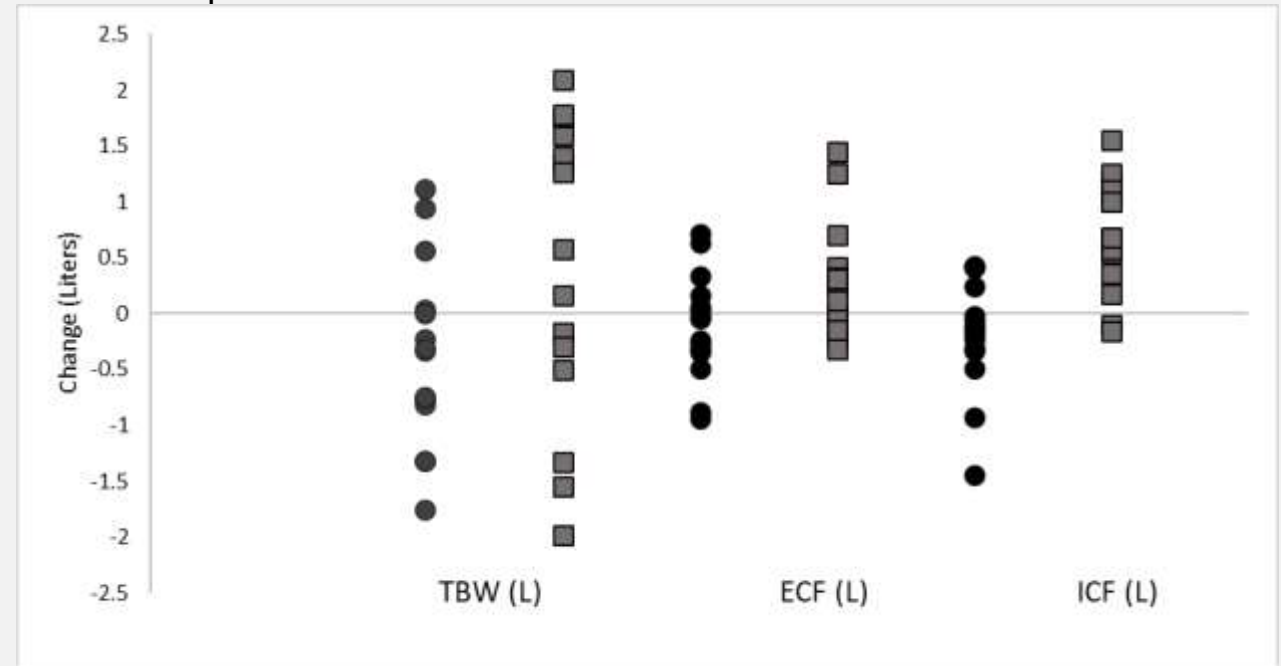
Figure 1.

Relative Effect Values of Creatine Supplementation on Total Body Water as a Function of Duration of Supplementation.



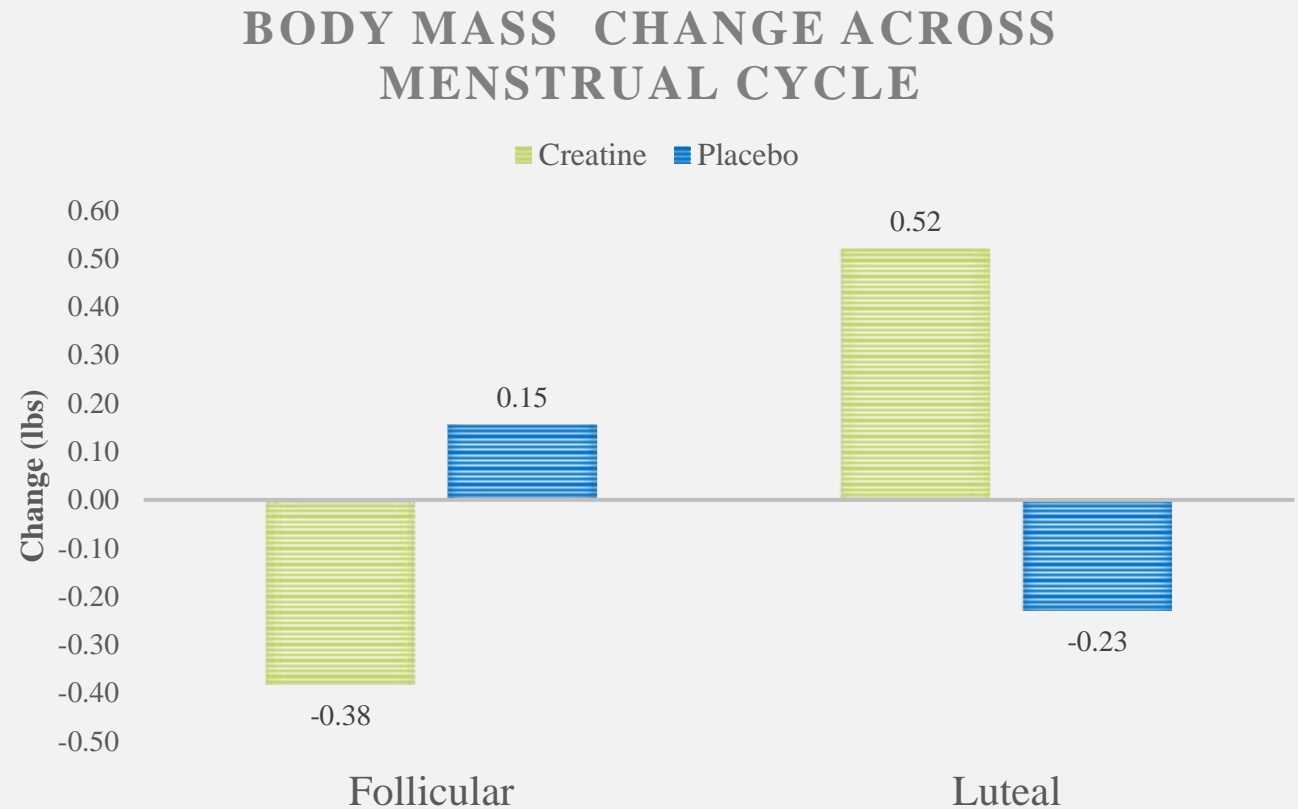
CREATINE & HYDRATION IN WOMEN

- CrM (n=15)
- PL (n=15)
- Significant increase in TBW in the LP for Cr vs. PL (p=0.021)
- Significant increase in ECF in LP for Cr (p=0.013)
- Significant increase in ICF in LP for Cr (p=0.041)



CREATINE & BODY MASS

- Body mass does not appear to increase with Cr loading – even in the luteal phase.



Creatine as an Ergogenic Aid for Female Athletes

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ABSTRACT

CREATINE (CR) IS AN EFFECTIVE ERGOGENIC AID FOR FEMALE ATHLETES, BUT MAY BE OVERLOOKED BECAUSE OF A PERCEPTION THAT IT CAUSES WEIGHT GAIN. STUDIES USING WOMEN SHOW THAT BOTH SHORT-TERM AND LONG-TERM CR SUPPLEMENTATION ENHANCES MUSCULAR STRENGTH AND POWER AND OTHER MEASURES OF ANAEROBIC AND AEROBIC EXERCISE PERFORMANCE WITH MINIMAL EFFECTS ON BODY COMPOSITION. THEREFORE, FEMALE ATHLETES INVOLVED IN SPORTS THAT REQUIRE A LOW BODY WEIGHT, AESTHETICALLY JUDGED SPORTS, AND WEIGHT-CLASS SPORTS MAY FIND CR TO BE A USEFUL DIETARY SUPPLEMENT. THE CURRENT REVIEW SUMMARIZES RESEARCH FINDINGS THAT USED WOMEN AS SUBJECTS AND PROVIDES GUIDELINES FOR SUPPLEMENTATION.

- Pre-menopausal
- Collegiate Athletes
- Sport Performance
 - Strength
 - Fatigue
 - VO₂max

Weight Gain?

↑ Strength & Power

↑ Anaerobic Performance



STRENGTH PERFORMANCE

Relative Effects

$$RE = \left(\frac{\left(\frac{Post_{Cr}}{Pre_{Cr}} \right) \times 100}{\left(\frac{Post_{PL}}{Pre_{PL}} \right) \times 100} \right) \times 100$$

Effects of Creatine Supplementation on Strength Performance



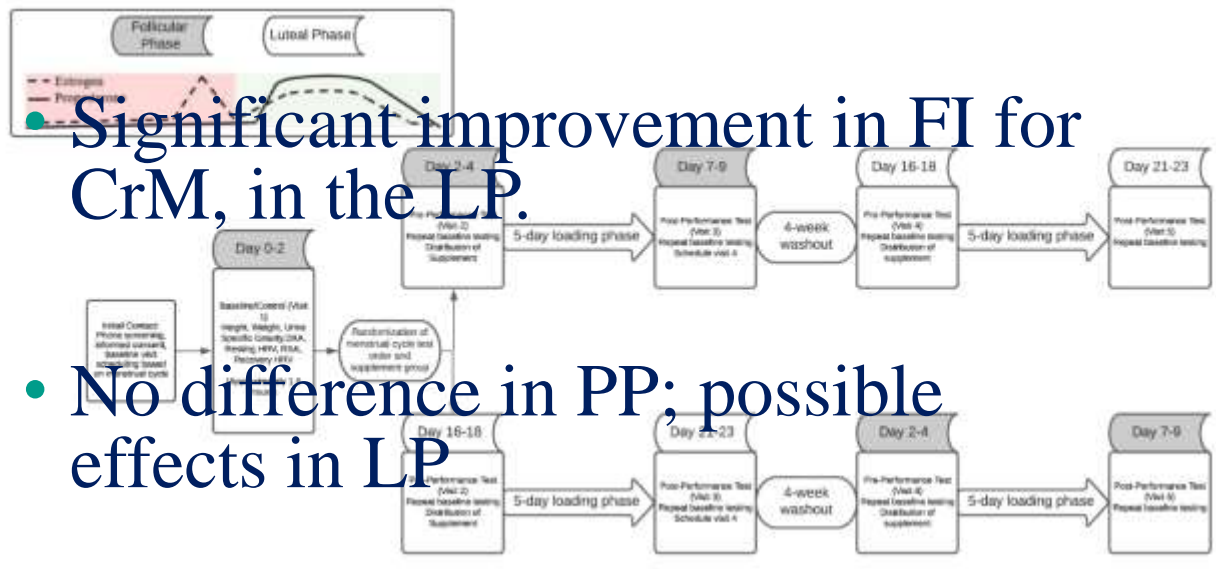
FATIGUE & EXERCISE PERFORMANCE

Effects of Creatine Supplementation on Exercise Performance



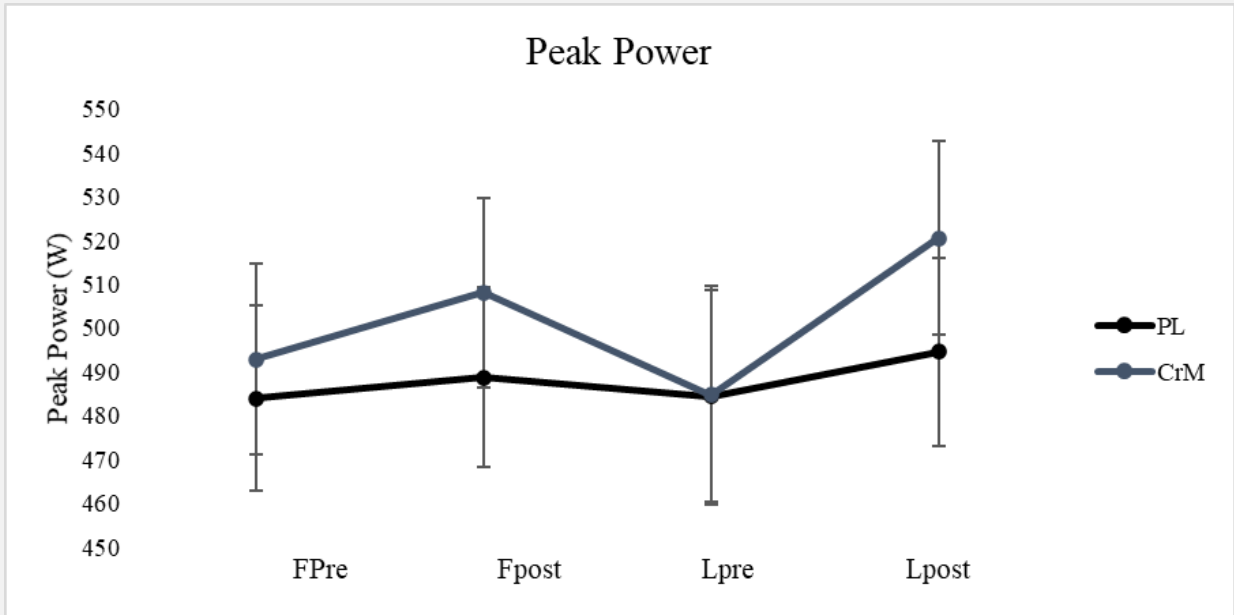
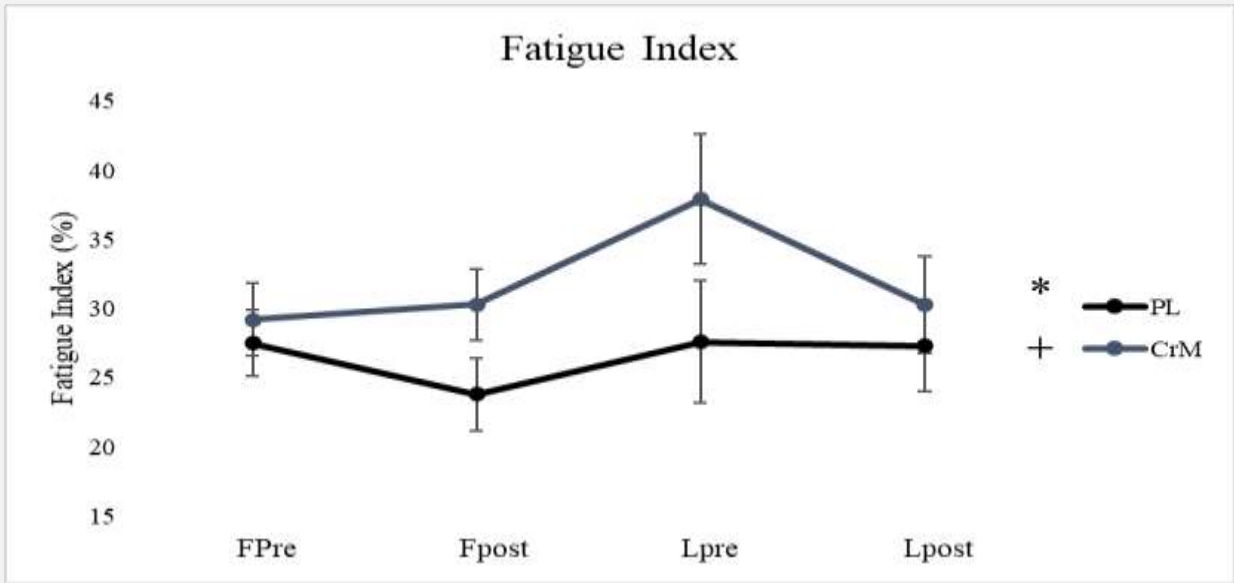
CREATINE & FATIGUE

- CrM (n=19)
- PL (n=20)
- HRV
- 10 × 6 sec sprints



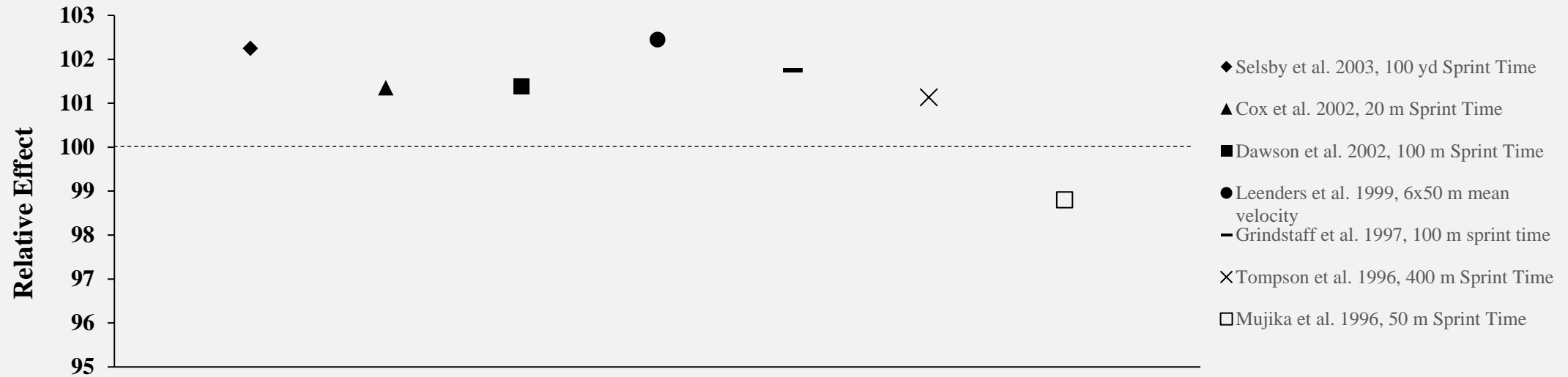
• Significant improvement in FI for CrM, in the LP.

• No difference in PP; possible effects in LP



SPORT PERFORMANCE

Effects of Creatine Supplementation on Sport Performance



CREATINE CONSIDERATIONS IN PREGNANCY

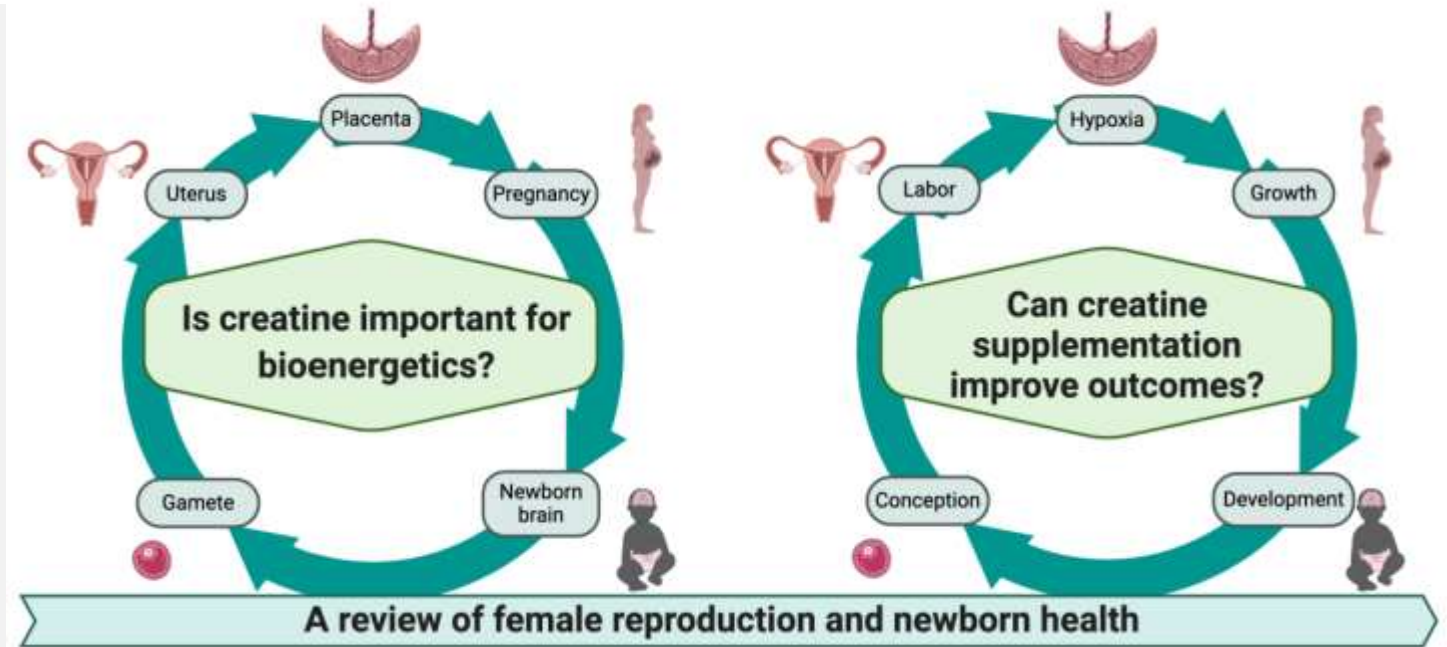


Review

Creatine Metabolism in Female Reproduction, Pregnancy and Newborn Health

Anna Maria Muccini ^{1,2}, Nhi T. Tran ^{1,3}, Deborah L. de Guingand ^{1,2}, Mamatha Philip ⁴, Paul A. Della Gatta ⁴, Robert Galinsky ^{1,2}, Larry S. Sherman ^{5,6}, Meredith A. Kelleher ⁷, Kirsten R. Palmer ², Mary J. Berry ⁸, David W. Walker ³, Rod J. Snow ⁴ and Stacey J. Ellery ^{1,2,*}

- Creatine plays a role in energy metabolism throughout reproduction
 - Fertilization
 - Endometrium/myometrium
- Shift in maternal creatine metabolism
 - Human placenta
- Prophylactic use for fetal hypoxia/perinatal brain injury, pre-term infants

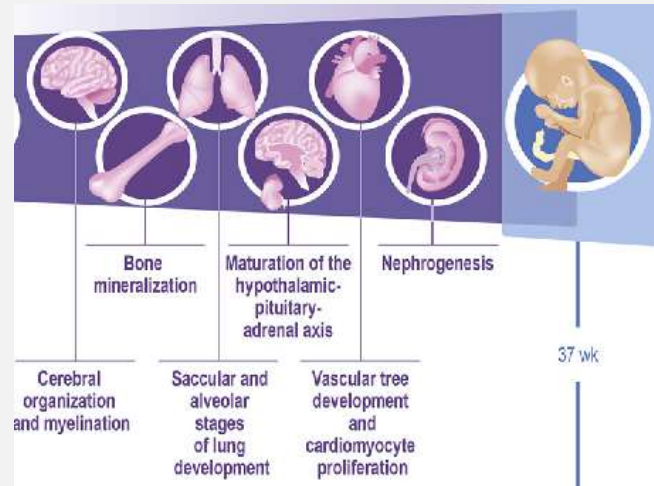


REVIEW

Open Access

Creatine supplementation during pregnancy: summary of experimental studies suggesting a treatment to improve fetal and neonatal morbidity and reduce mortality in high-risk human pregnancy

Hayley Dickinson¹, Stacey Elery¹, Zoe Ireland², Domenic LaRosa¹, Rodney Snow³ and David W Walker^{1,4*}



Acid-Base Balance → pH

Antioxidant actions

Post-ischemic recovery of protein synthesis

Improve cerebral vascular function

Benzodiazepine receptor – immature brain

Uptake of glutamate

Stabilization of lipid membranes



POST MENOPAUSAL WOMEN

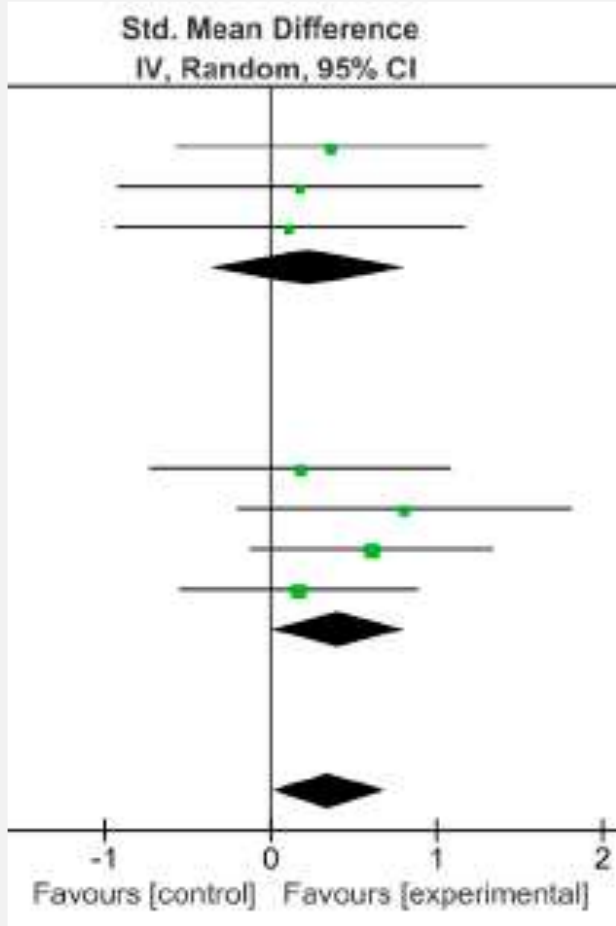


Review
Efficacy of Creatine Supplementation Combined with Resistance Training on Muscle Strength and Muscle Mass in Older Females: A Systematic Review and Meta-Analysis

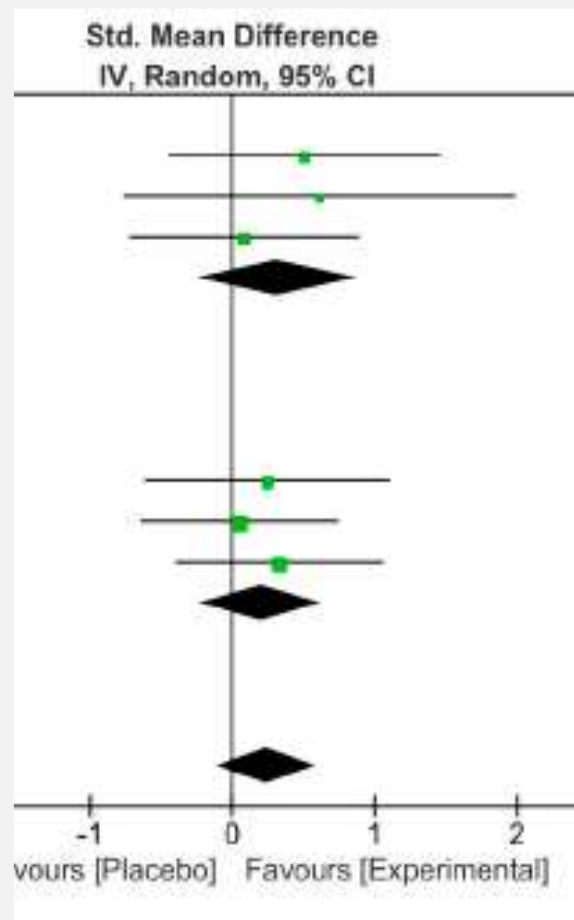
Ellem Eduarda Pinheiro dos Santos¹, Rodrigo Cappato de Araújo², Darren G. Candow³, Scott C. Forbes^{4,*}, Jaddy Antunes Guijo¹, Carla Caroliny de Almeida Santana⁵, Wagner Luiz do Prado⁶ and João Paulo Botero^{7,*}

≤ 14 Weeks

≥ 24 Weeks



Upper Body Strength



Muscle Mass

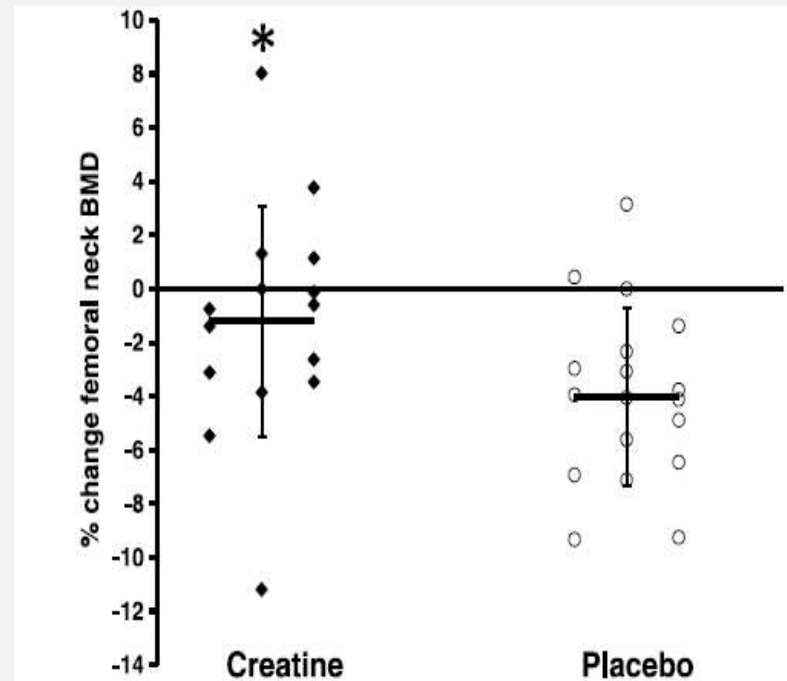


FIGURE 2—Relative changes in femoral neck BMD. Closed diamonds represent changes for individual creatine group participants, and open circles represent placebo group participants. The horizontal bars represent the group means, and the vertical bars represent the SD. *Creatine participants lost significantly less BMD at the femoral neck compared with placebo participants ($P < 0.05$).

Bone



YOUTH



NUTRITION
METABOLISM
PERFORMANCE
BODYCOMPOSITION



Review
Creatine Supplementation in Children and Adolescents

Andrew R. Jagim^{1,2,*} and Chad M. Kerksick^{1,3}

**Safety of Creatine Supplementation
in Active Adolescents and Youth: A
Brief Review**

Andrew R. Jagim^{1,2*}, Richard A. Stecker¹, Patrick S. Harty^{1†}, Jacob L. Erickson² and
Chad M. Kerksick^{1‡}

¹ Exercise and Performance Nutrition Laboratory, Department of Exercise Science, Underwood University, St. Charles, MO, United States, ² Mayo Clinic Health Systems, Oshkosh, WI, United States

- “If proper precautions and supervision are provided, creatine monohydrate supplementation in children and adolescent athletes is acceptable and may provide a nutritional alternative with a favorable safety profile to potentially dangerous anabolic androgenic drugs. However, we recommend that creatine supplementation only be considered for use by younger athletes who: (a) are involved in serious/competitive supervised training; (b) are consuming a well-balanced and performance-enhancing diet; (c) are knowledgeable about the appropriate use of creatine; and (d) do not exceed recommended dosages.”



KEY POINTS

- Women have unique nutritional needs that are influenced by:
 - Menstrual cycle
 - Age/menopause
 - OC/pregnancy
- Creatine may provide unique benefits at all these life stages
- Education and products developed for women are needed





n u t r i t i o n
m e t a b o l i s m
p e r f o r m a n c e
b o d y c o m p o s i t i o n

APPLIED PHYSIOLOGY LAB



THANK YOU

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