

# The Effects of Protein and Carbohydrate Supplementation, with and without Creatine, on Occupational Performance in Firefighters

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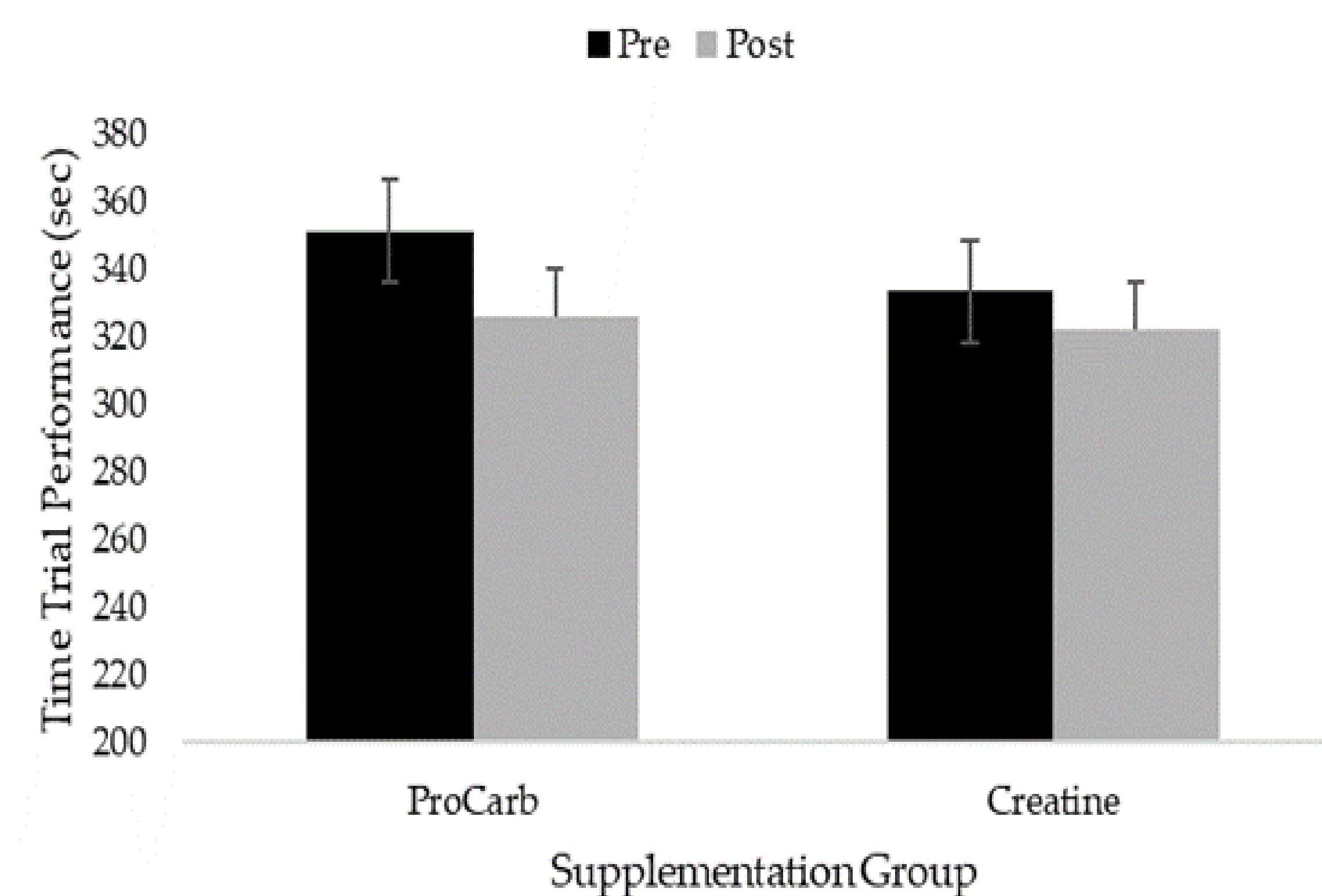
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## Introduction

- Firefighters repeatedly perform high-intensity, functional tasks at varying intervals, and are often exposed to high-temperature environments and environmental hazards, which places a high degree of physiological and thermoregulatory strain on the body [1,2].
- It is recommended that firefighters follow dietary guidelines established for active individuals. The addition of carbohydrates (~35 g) to amino acids (~6 g of a balanced amino acid mixture) has been shown to produce a net muscle protein synthetic response that was roughly equivalent to the sum of the independent effect of either nutrient in isolation [18], suggesting there may be synergistic benefits of combining protein and carbohydrates together.
- Creatine supplementation has been shown to increase intramuscular phosphocreatine stores [21,22], which in turn can increase the ability to synthesize (and re-phosphorylate adenosine diphosphate) adenosine triphosphate (ATP) [21]; thereby, playing a vital role in cellular metabolism during periods of intermittent, high-intensity exercise [20,23,24]. In addition, creatine supplementation has been shown to enhance recovery time in between bouts of activity [25] and has also been proposed to aid in thermoregulation during physical activity in hot and humid environmental conditions [26], which may confer additional benefits to firefighters during fire suppression activities.
- The ergogenic and occupation-specific benefit of various nutritional strategies in firefighters is largely unknown. Therefore, the primary aim of the current study was to examine the effects of protein and carbohydrate supplementation, with or without creatine, on occupational performance in firefighters. We hypothesized that the addition of creatine would promote greater improvements in firefighter-specific occupational performance.

## Creatine Supplementation



## Methods

- In a randomized, parallel-group, double-blind fashion, active-duty firefighters were randomly assigned to ingest whey protein isolate + carbohydrate (ProCarb Group); or B) whey protein isolate + carbohydrate + creatine monohydrate (Creatine Group) for a 21–26-day supplementation period.
- Thirty active-duty male structural firefighters were enrolled (age: 34.4 ± 8.4 yrs., height: 1.82 ± 0.07 m; weight: 88.6 ± 12.5 kg; BF%: 17.2 ± 5.8 %).
- Tasks completed:
  - Hose carry: advanced a 30.48 m section of a charged 4.45 cm hose line over a distance of 30.5 m in a straight line before flowing water for 2 seconds.
  - Rescue (body drag): consisted of firefighters being instructed to grasp a mannequin (mass 50 kg, height: 180 cm) underneath the shoulders using a “seatbelt” grip and dragging the mannequin 30.5 m backward.
  - Stair climb: climbing four flights of stairs and returning to the bottom as quickly as possible.
  - Forcible entry: struck a simulated forcible entry chopping device (Keiser FORCE Machine, Keiser Co., USA) using a 3.6 kg sledgehammer until completed.
- Supplement groups: ~24-day period (average supplementation duration was 23 ± 2 days; minimum days = 21, maximum days = 26)
  - 25-g dose of whey protein isolate + 25-g dose of carbohydrate powder (ProCarb)
  - 25-g dose of whey protein isolate + 25-g dose of carbohydrate powder + 5-gram dose of creatine monohydrate (Creatine)

## Results

- Significant main effect for time observed for rescue, stair climb, and total time to completion (p < 0.05)
- Significant group x time interaction for rescue and forcible entry (p < 0.05)
- Independent-sample t-tests indicated that the Creatine group recorded a greater reduction in completion time for the rescue (mean difference, 95% confidence intervals; 1.78 ± 0.57 sec, 95% CI: 0.61, 2.95 sec, p = 0.004), and for the forcible entry (2.66 ± 0.97 sec, 95% CI: 0.68, 4.65 sec, p = 0.01) compared to ProCarb group
- No significant group x time interactions were observed for hose line advance, stair climb, or total time to completion (p > 0.05)

Task	Group	Pre	Post	p value
Hose Line Advance (sec)	ProCarb (n=14)	9.3±1.3	9.3±2.2	T: 0.333
	Creatine (n=14)	9.5±1.0	10.1±1.6	GxT: 0.353
Rescue (body drag) (sec)	ProCarb (n=14)	12.5±4.0	12.5±4.7	T: 0.006*
	Creatine (n=14)	14.7±2.5	12.9±2.4	GxT: 0.004*
Stair Climb (sec)	ProCarb (n=14)	30.9±6.7	28.2±5.6	T: 0.044*
	Creatine (n=14)	30.3±5.0	30.1±3.6	GxT: 0.064
Forcible Entry (sec)	ProCarb (n=14)	15.8±4.4	16.7±5.1	T: 0.960
	Creatine (n=14)	18.1±6.3	17.7±6.1	GxT: 0.010*
Total (sec)	ProCarb (n=14)	68.4±12.0	67.2±14.1	T: 0.042*
	Creatine (n=14)	72.6±12.4	69.9±10.8	GxT: 0.452

\*Denotes significance at p<0.05. Data presented as mean±SD; T = time effect; GxT = group x time interaction.

## Conclusion

- The addition of supplemental protein and carbohydrates to the diet of career firefighters throughout a three-week period improves occupational performance in specific areas of high-intensity activities.
- The addition of creatine within the protein and carbohydrate supplementation lead to greater improvements in specific tests when compared to protein and carbohydrates alone.
- These findings provide preliminary evidence supporting the benefits of targeted dietary strategies for occupational performance benefits in firefighters.

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