

Effects of Nutrition Intervention on Firefighters’ Performance in subsequent hard physical efforts

Ioan Rhys Lewis 0401890.

Sport and Exercise Nutrition MSc

Background

Firefighting is acknowledged as a physically demanding profession that necessitates a blend of endurance, strength, agility, and mental resilience (Gonzalez et al., 2022; Johnson et al., 2020; Romero & Alvar, 2021). The optimal physical condition is crucial for improving occupational performance and injury prevention (Romero & Alvar, 2021; Abel et al., 2011; Andrews et al., 2019; Dennison et al., 2012). Within this context, nutrition interventions are considered pivotal under the health framework for fire-service human performance optimisation (Romero & Alvar, 2021). The operational demands categorise firefighters as tactical athletes (Scofield & Kardouni, 2016; Elstad et al., 2023), and existing studies indicate that athlete performance can significantly benefit from optimised nutrition strategies, suggesting similar benefits for firefighters (Thomas et al., 2016; Burke, 2021; Spriet, 2019; Gonzalez et al., 2022). This study aims to bridge the gap in knowledge, and assess the effects of immediate post-effort nutritional intervention specifically on firefighters’ subsequent performance, hypothesising that such interventions will maintain or improve performance in subsequent tactical events (Gonzalez et al., 2022).

Aims and objectives

Aim:To enhance our understanding of the role of nutritional interventions on the physical performance and recovery of firefighters as tactical athletes, particularly assessing the immediate effects of post-effort nutritional refueling.

Objectives:

- To assess the physical performance of firefighters before and after the implementation of an immediate refueling strategy post-hard physical effort.
- To evaluate readiness for subsequent incidents after immediate nutritional intervention.
- To analyse the impact of nutritional refueling on performance outcomes, especially in the context of firefighters’ occupational demands and recovery needs

Methods

Methodology

The study consisted of 18 adults (17M/1F) participants evenly divided into two groups: CHO fuel drink and Placebo. Each group consisted of 9 participants.

Recruitment & Sample

- Participants: 18 firefighters aged 22-54 (Mean: 35.89 ± 9.27 years), predominantly male (17M, 1F), with weights ranging from 70 to 116 kg (Mean: 86.28 ± 11.86 kg), participated in the study (Table 1), voluntarily recruited with informed consent.
- Groups: Randomly assigned to either a carbohydrate fuel drink (30g Carbohydrates) group (8M/1F) (Table 1), or a placebo group (9M) (Table 1).

Test Procedure

- Timing: Participants fasted for 3 hours, then performed the *FireFit test to simulate firefighting tasks. A second test followed 20 minutes after consuming the intervention.
- Nutritional Intervention: CHO group received a carbohydrate drink (Table 1; Figure 1); placebo group received a non-nutritive placebo (Table 1; Figure 1).

* The FireFit test is a service standardised fitness assessment designed specifically for firefighters, evaluating endurance, strength, agility, and the ability to perform under fireground-like conditions to ensure operational readiness.

Data Collection, Procedures & Analysis

- Tools: Pre-Test and Post-Test performance scores *(Time in Seconds) recorded and analysed using SPSS analysis software. Statistical significance was set at p<0.05. Data is presented as means with ±Standard Deviation (Table 1; Figure 1).

- Statistical Analysis: Two-Way ANOVA assessed main effects of Time (Pre vs. Post), and Treatment (CHO vs. Placebo), including their interaction (Table 2) to determine if there were differential changes in performance over time between the treatment groups.

Quantitative Research Approach

- Rationale: Employs structured measurements to objectively quantify the impact of nutritional interventions on firefighter performance, minimizing subjective bias and allowing for precise statistical evaluation.
- Purpose: To reliably measure performance changes and establish causal relationships between dietary intervention and firefighter readiness, and ability to perform in subsequent tactical events.

Initial findings

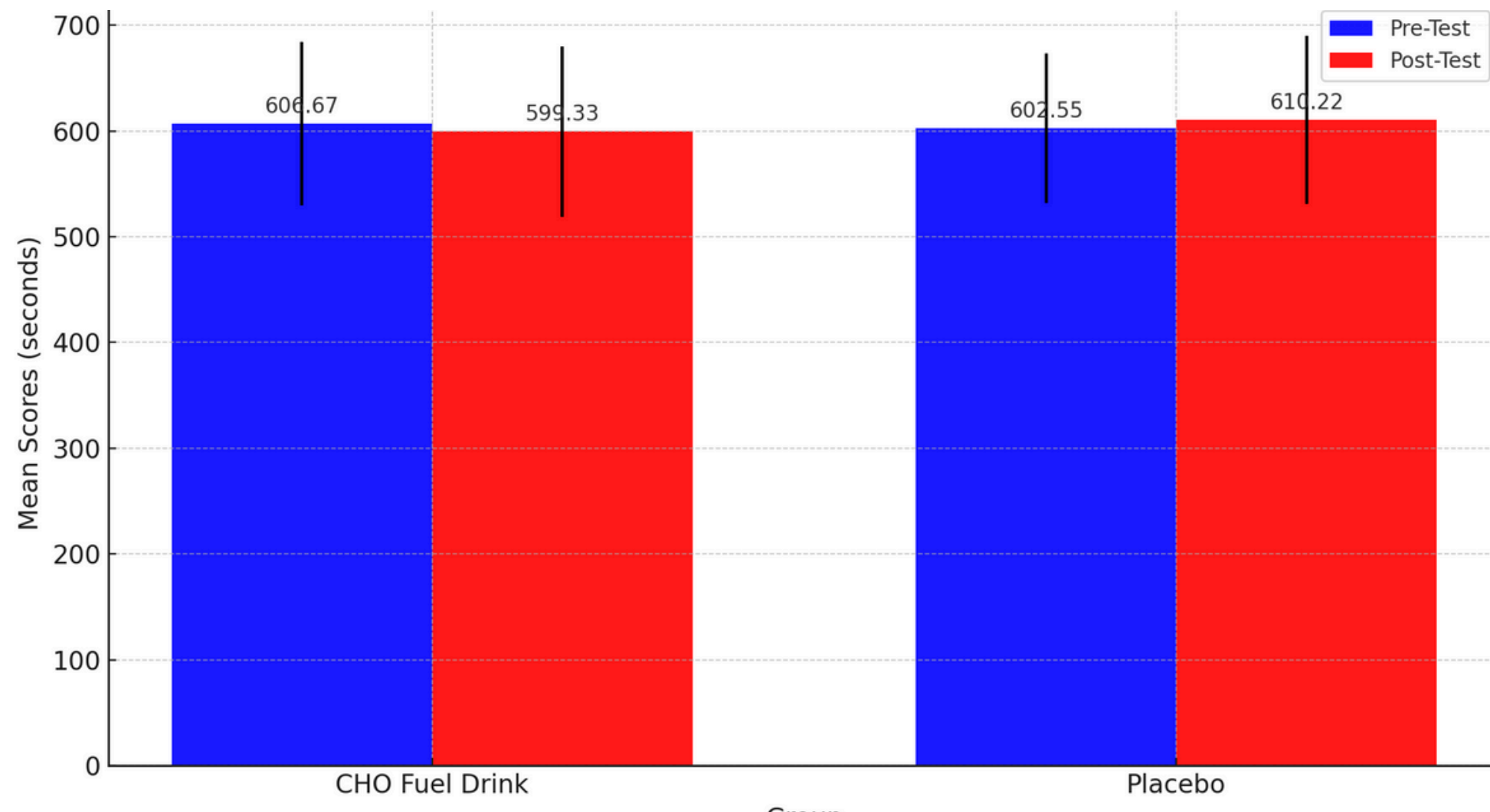


Figure 1. Pre-Test and Post-Test mean scores by Group (With Std Deviation)

Figure 1.

This figure displays the mean pre-test and post-test scores for the CHO Fuel drink group, and the Placebo group, measured in seconds. The blue bars represent pre-test scores, and the red bars represent post-test scores. Each bar includes error bars representing standard deviation (SD).

- CHO Fuel Drink Group: Pre-Test: 606.67s ± 77.15, Post-Test: 599.33s ± 80.30
- Placebo Group: Pre-Test: 606.67s ± 77.15, Post-Test: 599.33s ± 80.30

The time difference in the CHO Fuel group shows a slight decrease in the mean score from pre-test to post-test (-7.34s), suggesting a potential improvement in physical performance. Conversely, the Placebo Group exhibits an increase in mean time (+7.67s), indicating a reduction in performance.

Key Findings

1. Main Effects.

Drink: The carbohydrate drink did not produce a statistically significant improvement in performance (F=0.005, p=0.947, Partial η²=0.000). However, a physical effect was observed, suggesting some level of performance variability related to the intervention, though these changes were not significant,

Group: No significant performance differences were detected between the groups receiving carbohydrate drink and the placebo (F=0.001, p=0.980, Partial η²=0.000).

2. Interaction Effect.

The interaction between the type of drink and the group approached significance (F=3.683, p=0.073, Partial η²=0.187). This result indicates a potential differential differential response to the carbohydrate drink depending on individual or contextual factors within the groups, pointing to the complex nature of nutritional impacts on physical performance.

3. Overall Performance.

A significant intercept (F=1104.949, p<0.001, Partial η²=0.986) confirms that the tests were consistently effective across conditions, highlighting the robustness of the testing procedure in measuring performance metrics.

Interpretation

The significant main effect of time suggests that performance varied from pre-test to post-test regardless of the treatment, indicating a general effect of time on performance. However, the absence of a significant interaction between time and treatment suggests that CHO drink does not significantly alter performance trajectories compared to a placebo. Despite measurable changes within each group, the statistical analysis indicates that CHO drink does not provide a performance benefit over a placebo in terms of altering performance over time. This finding is crucial as it suggests that the consumption of CHO Drink, under the conditions tested, does not confer additional advantages for performance enhancement compared to taking a placebo.

Limitations.

The small sample size of this study may limit the generalisability of the findings and could contribute to the non-significant statistical results despite observed physical effects. This small cohort size restricts the power to detect subtle but potentially important effects. Equally, the complexity inherently associated with the standard Fire-fit test, adds an element of variability which can affect timing results, outside the context of fuelling.

Future Research.

Given the limitation of the small group size, future research should involve a larger cohort to enhance the statistical power of the study and potentially reveal more definitive effects and interactions. Exploring variables such as individual metabolic differences, optimal timing for carbohydrate fuelling, heart rate monitoring, integrating qualitative research such as feedback or wellbeing and questionnaires, employing simpler fitness tests with less margin of errors and monitoring specific physical states before activity could all further clarify how nutritional strategies can be tailored to benefit firefighters most effectively.

Conclusion.

Although the carbohydrate intervention did not significantly enhance or maintain performance on a statistical level, the physical effects observed suggest some benefit that was not captured fully by the statistical measures used. This highlights the potential for individualised or context-specific benefits of carbohydrate supplementation in enhancing performance for tasks that require high physical exertion, such as firefighting.



Initial findings

Table 1. Descriptive statistics for participants by Group

Group	N	Males	Females	Age (Years)	Weight (Kg)	Pre-Test (s)	Post-Test (s)
All Participants	18	17	1	35.89 (±9.27)	86.28 (±11.86)	604.61 (±71.88)	604.78 (±77.69)
CHO Fuel Drink	9	8	1	36.67 (±8.92)	85.53 (±12.08)	606.67 (±77.15)	599.33(±80.3)
Placebo	9	9	0	35.11 (±10.08)	86.89 (±12.32)	602.55 (±70.83)	610.22 (±79.42)

Note: The table reports the overall descriptive statistics for Gender, age, weight, and test scores before and after the intervention, for all participants, CHO Fuel drink Group and Placebo Group

Table 2. Analysis of Variance (ANOVA) Results

Source	df	F	Sig.	Partial n2
Drink (Linear)	1	.005	.947	.000
Drink x Group (Linear)	1	3.683	0.73	.187
Intercept (Linear)	1	1104.949	<.001	.986

Note: The linear effect of the drink shows no significant impact on the dependant measure. The interaction between drink and group approaches significance, suggesting a differential effect depending on the group. The intercept is significant, indicating a strong overall effect. However, there is no significant effect of group on the average measures.



References

Ioan Rhys Lewis 0401890.

Sport and Exercise Nutrition MSc

Abel, M.G., Sell, K., & Dennison, K. (2011). Design and implementation of fitness programs for firefighters. *Strength & Conditioning Journal*, 33(4), 31-42.

Andrews, K.L., Gallagher, S., & Herring, M.P. (2019). The effects of exercise interventions on health and fitness of firefighters: A meta-analysis. *Scandinavian Journal of Medicine & Science in Sports*, 29(6), 780-790.

Burke, L.M., 2021. Nutritional approaches to counter performance constraints in high-level sports competition. *Experimental physiology*, 106(12), pp.2304-2323.
Dennison, C.R., Macri, E.M. and Cripton, P.A., 2012. Mechanisms of cervical spine injury in rugby union: is it premature to abandon hyperflexion as the main mechanism underpinning injury?. *British journal of sports medicine*, 46(8), pp.545-549.

Elstad, K., Malone, C., Luedke, J., Jaime, S.J., Dobbs, W.C., Almonroeder, T., Kerksick, C.M., Markert, A. and Jagim, A.R., 2023. The Effects of Protein and Carbohydrate Supplementation, with and without Creatine, on Occupational Performance in Firefighters. *Nutrients*, 15(24), p.5134.

Gonzalez, D.E., McAllister, M.J., Waldman, H.S., Ferrando, A.A., Joyce, J., Barringer, N.D., Dawes, J.J., Kieffer, A.J., Harvey, T., Kerksick, C.M., & Stout, J.R. (2022). International Society of Sports Nutrition Position Stand: Tactical Athlete Nutrition. *Journal of the International Society of Sports Nutrition*, 19(1), 267-315.

Johnson, R.B. and Christensen, L., 2019. *Educational research: Quantitative, qualitative, and mixed approaches*. Sage publications.

Romero, M., & Alvar, B. (2021). A new model for optimizing firefighter human performance. *Strength & Conditioning Journal*, 43(4), 19-31.

Scofield, D.E., & Kardouni, J.R. (2015). The tactical athlete: A product of 21st century strength and conditioning. *Strength & Conditioning Journal*, 37(4), 2-7.

Spriet, L.L. (2019). Performance nutrition for athletes. *Sports Medicine*, 49, 1-2.

Thomas, D.T., Erdman, K.A., & Burke, L.M. (2016). Nutrition and athletic performance. *Medicine & Science in Sports & Exercise*, 48(3), 543-568.