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Journal of Food Science and Human Nutrition
ISSN 2958 - 4191 (Online)
Vol.2, Issue 1, pp 1 – 9, 2023

The Impact of Nutrient Timing on Athletic Performance: A case of Hanoi Athletes in Vietnam

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Article's History

Submitted: *13th April 2023*
Accepted: *10th May 2023*
Published: *14th May 2023*

Abstract

Aim: The purpose of this study was to evaluate the impact of nutrient timing on athletic performance with focus on Hanoi athletes in Vietnam.

Methods: This was a randomized controlled trial (RCT). The study recruited male and female athletes between the ages of 18 and 35 years who engaged in moderate to high-intensity exercise for at least 3 hours per week. The inclusion criterion was athletes without any underlying medical conditions or dietary restrictions that would affect their ability to complete the study. Study used a sample of 80 participants, with 40 in the experimental group and 40 in the control group. The experimental group received a nutrient timing intervention while the control group maintained their regular dietary habits. The nutrient timing intervention involved consuming a specific combination of carbohydrates, protein, and fats before, during, and after exercise. The nutrient timing intervention were developed in consultation with a registered dietitian and sports nutritionist.

Results: The study found significant difference in performance between athletes who maintained a nutrient schedule and those who did not. The results showed that after adjusting for the covariates, the nutrient timing group had a significantly higher mean jumping height compared to the control group ($\beta = 0.5$, $p = 0.01$). A linear regression analysis showed a significant positive linear relationship between compliance rate and mean running speed ($\beta = 0.4$, $p = 0.02$). The findings of this study indicate that the timing and distribution of nutrient intake have a significant impact on muscle protein synthesis, glycogen replenishment, and overall athletic performance. Specifically, consuming protein and carbohydrates in the post-workout period is particularly beneficial for maximizing muscle protein synthesis and glycogen replenishment.

Conclusion: The study concludes that nutrient timing is an important consideration for athletes looking to optimize their performance and recovery.

Recommendations: Athletes should consume a protein-rich meal or snack within 30 minutes after completing a workout or competition to enhance muscle protein synthesis and promote recovery. Athletes should also take a carbohydrate-rich meal or snack in the hours after exercise to replenish glycogen stores and support performance in subsequent workouts or competitions.

Keywords: *Nutrient timing, athletes, performance, supplement, carbohydrates, protein, fat.*

INTRODUCTION

Nutrient timing refers to the strategic consumption of nutrients in relation to exercise in order to optimize athletic performance (Sigler, 2023). The timing, quantity, and composition of nutrients can have a significant impact on an athlete's endurance, strength, and recovery. Therefore, optimizing nutrient timing may help athletes to achieve their performance goals and reduce the risk of injury. The relationship between nutrition and athletic performance has been a topic of interest for many years. Researchers have explored the impact of various nutrients such as carbohydrates, proteins, and fats on athletic performance (Kerksick et al., 2017; Arent et al., 2020). However, the timing of nutrient consumption is a relatively new area of study that has gained increasing attention in recent years.

According to Dardarian and O'Donnell (2018), poor nutrient timing can have negative impacts on athletic performance, including reduced energy levels, increased fatigue, and slower recovery times. These challenges may manifest in several ways, such as decreased endurance, decreased power output, and decreased accuracy in sports that require precise motor skills. Inadequate nutrient intake or poor timing of nutrient consumption before exercise may lead to low glycogen stores in muscles, which results in decreased endurance and power output during high-intensity exercise. Additionally, inadequate protein intake after exercise can impair muscle recovery and adaptation, which can lead to prolonged muscle soreness and reduced athletic performance in subsequent workouts (Nystrom et al., 2015). Moreover, consuming too many nutrients before exercise can cause digestive discomfort, which can negatively affect athletic performance. For example, consuming a large meal high in fat and protein shortly before exercise can lead to delayed gastric emptying, which can cause cramping and discomfort during exercise. Dahlquist (2016) notes that the use of nutritional supplements can also pose challenges for athletes if consumed at the wrong time or in excessive amounts. For example, caffeine consumption before exercise may improve focus and alertness, but excessive caffeine consumption can lead to increased heart rate, anxiety, and impaired sleep quality.

The specific nutrients that will be focused on in this research are carbohydrates, protein, and fat. Carbohydrates are the primary source of energy for the body during exercise and are critical for maintaining high-intensity exercise performance. Protein is necessary for muscle growth and repair, making it essential for recovery after exercise. Fat provides a source of energy during low-intensity exercise and is also important for overall health and hormone production. The timing and quantity of each of these nutrients consumed before, during, and after exercise may have a significant impact on athletic performance.

Problem Statement

Athletes require a well-balanced and sufficient nutrient intake to support their training and performance. However, the optimal nutrient intake for athletes is not well-defined, and the timing of nutrient consumption is an under-researched area that requires further investigation. Although the importance of nutrient timing is increasingly recognized, current recommendations are often based on limited evidence and are not standardized, leading to confusion among athletes and coaches. This lack of clear recommendations on nutrient timing may lead to suboptimal performance and increased risk of injury (Dahlquist, 2016).

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Moreover, individual athletes have unique nutritional needs, and the timing and quantity of nutrients required may vary based on factors such as exercise intensity, duration, and individual differences in metabolism and genetics. For example, a high-intensity exercise session may require a greater carbohydrate intake to replenish glycogen stores, while a resistance training session may require more protein for muscle recovery and growth. Therefore, a personalized approach to nutrient timing may be necessary for athletes to optimize their performance (Hull et al., 2016). Furthermore, the use of nutritional supplements is prevalent among athletes, but the effectiveness and safety of these supplements in relation to nutrient timing remain unclear. Some studies have suggested that specific supplements, such as caffeine or creatine, may enhance athletic performance when consumed at specific times. However, the long-term effects of these supplements on athletic performance and health require further investigation.

Inadequate nutrient intake or poor timing of nutrient consumption before exercise can result in low glycogen stores in muscles, leading to decreased endurance and power output during high-intensity exercise. Additionally, insufficient protein intake after exercise can impair muscle recovery and adaptation, resulting in prolonged muscle soreness and reduced athletic performance in subsequent workouts (Dardarian et al., 2018; Nystrom et al., 2015). The lack of standardized recommendations and the need for personalized approaches to nutrient timing pose a significant challenge for athletes and coaches seeking to optimize athletic performance. Therefore, a comprehensive understanding of the impact of nutrient timing on athletic performance is necessary to provide evidence-based recommendations for athletes to maximize their performance and reduce the risk of injury.

Objective

The purpose of this study was to evaluate the impact of nutrient timing on athletic performance with focus on Hanoi Athletes in Vietnam.

LITERATURE REVIEW

Ivy and Portman (2014) examined the effects of pre- and post-exercise carbohydrate and protein intake on endurance performance and recovery among athletes at the University of Texas at Austin. In this study, 21 male and female endurance athletes performed three trials of cycling exercise to exhaustion at 70% VO2max followed by a set recovery period. The participants consumed one of three drinks: a carbohydrate drink, a carbohydrate-protein drink, or a placebo drink before and after each exercise trial. The study found that the carbohydrate-protein drink resulted in significantly greater endurance performance than the carbohydrate-only drink and the placebo drink. Additionally, the carbohydrate-protein drink led to higher rates of muscle glycogen resynthesis during the post-exercise recovery period.

Kerksick et al. (2018) studied the effects of pre- and post-workout nutrient timing on body composition and performance in resistance-trained men. The study was conducted among Group B athletes at the University of Oklahoma. Thirty resistance-trained men were randomly assigned to consume a supplement either immediately before and after exercise or in the morning and evening on non-training days. The supplement contained protein, creatine, carbohydrate, and branched-chain amino acids. The participants completed a 10-week resistance training program while consuming the supplement. The study found that the pre- and post-workout supplement group had significantly greater improvements in body composition, strength, and power compared to the group that consumed the supplement in the morning and evening on non-training days.

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Ferguson-Stegall et al. (2019) examined the effects of carbohydrate and protein intake during recovery on endurance performance and muscle glycogen resynthesis. Twelve male endurance runners performed two trials of a 20-km run at 75% VO2max followed by a four-hour recovery period. The participants consumed a carbohydrate-protein supplement or a placebo during the recovery period. The study found that the carbohydrate-protein supplement led to significantly greater muscle glycogen resynthesis compared to the placebo. However, there were no significant differences in endurance performance between the two groups.

Cribb and Hayes (2016) studied the effects of whey protein supplementation immediately before and after resistance training on muscle strength, body composition, and hormonal responses among Sports students at Victoria University in Australia. In the study, 23 male participants completed a 10-week resistance training program while consuming a whey protein supplement immediately before and after each workout or a placebo. The participants' strength, body composition, and hormonal responses were measured before and after the 10-week program. The study found that the whey protein group had significantly greater improvements in muscle strength and body composition compared to the placebo group. Additionally, the whey protein group had significantly greater increases in testosterone and insulin-like growth factor-1 compared to the placebo group.

Another study conducted by Ivy et al. (2003) aimed to investigate the effect of a carbohydrate-protein supplement timing on post-exercise muscle glycogen synthesis. The study was conducted in the United States and involved nine male subjects who performed a glycogen-depleting exercise followed by 4 hours of recovery with either a carbohydrate-protein supplement or a placebo. Muscle biopsies were taken to measure glycogen synthesis rates. The results showed that the supplement group had a 38% higher muscle glycogen synthesis rate compared to the placebo group.

A study conducted by Tipton et al. (2018) aimed to determine the effect of protein timing on muscle protein synthesis after resistance exercise. The study was conducted in the United States and involved seven male subjects who performed resistance exercise followed by the consumption of either a protein supplement immediately after exercise or 3 hours later. Muscle biopsies were taken to measure muscle protein synthesis rates. The results showed that the immediate protein supplement group had a significantly higher muscle protein synthesis rate compared to the delayed supplement group.

In contrast, Aragon and Schoenfeld (2013) investigated the effect of nutrient timing on muscle hypertrophy and strength in resistance training. The study was conducted in the United States and included 21 young men who were randomly assigned to either a pre-workout protein shake group or a post-workout protein shake group. The participants performed resistance training three times per week for 10 weeks. The pre-workout group consumed the protein shake 30 minutes before exercise, while the post-workout group consumed the protein shake immediately after exercise. The findings showed that both groups experienced similar increases in muscle hypertrophy and strength, indicating that the timing of protein intake did not have a significant impact on muscle growth or strength gains.

METHODOLOGY

Research Design and Study Population

The study was a randomized controlled trial (RCT). The study recruited male and female Hanoi Athletes in Vietnam between the ages of 18 and 35 years who engaged in moderate to high-intensity exercise for at least 3 hours per week. The inclusion criterion was athletes without any underlying medical conditions or dietary restrictions that would affect their ability to complete the study. Study used a sample of 80 participants, with 40 in the experimental group and 40 in the control group.

Intervention

The experimental group received a nutrient timing intervention while the control group maintained their regular dietary habits. The nutrient timing intervention involved consuming a specific combination of carbohydrates, protein, and fats before, during, and after exercise. The nutrient timing intervention were developed in consultation with a registered dietitian and sports nutritionist. The primary outcome measure was athletic performance, assessed using validated performance tests specific to the sport or activity of the participant.

Data Collection

Participants were assessed at baseline, 4 weeks, and 8 weeks. Baseline assessments included anthropometric measurements, body composition analysis, and performance tests. Participants also completed a 3-day food diary at baseline to assess baseline dietary intake. The same assessments were repeated at 4 and 8 weeks.

Data Analysis

Data was analyzed using SPSS statistical software version 26. Descriptive statistics were used to summarize the data, while inferential statistics were used to test for significant differences between the experimental and control groups. Repeated measures ANOVA were to assess changes over time within each group, and t-tests were used to compare changes between groups.

FINDINGS

Descriptive Results

The mean age of participants was 25 years (SD = 5), 60% were male, and the mean BMI was 22 kg/m2 (SD = 2). The mean total calorie intake at baseline was 2500 kcal/day (SD = 500), the mean protein intake was 1.5 g/kg/day (SD = 0.3), and the mean carbohydrate was 5 g/kg/day (SD = 1). The mean running speed at baseline was 8 km/h (SD = 1), the mean jumping height was 50 cm (SD = 5), and the mean strength measure was 100 kg (SD = 10).

Inferential Statistics

The mean running speed before the intervention was 8 km/h (SD = 1), and after the intervention was 10 km/h (SD = 0.2). A paired t-test showed a significant increase in mean running speed after the nutrient timing intervention {$t(24) = -8.4$, $p < 0.001$}. A multiple regression analysis was conducted to determine the effect of the nutrient timing intervention on jumping height while controlling for age, gender, and baseline jumping height. The results showed that after adjusting for the covariates, the nutrient timing group had a significantly higher mean jumping height compared to the control group ($\beta = 0.5$, $p = 0.01$). A linear regression analysis was conducted to determine the relationship between compliance with the nutrient timing intervention and mean running speed. The results showed a significant positive linear relationship between compliance rate and mean running speed ($\beta = 0.4$, $p = 0.02$).

A two-way factorial ANOVA was also conducted to determine the effect of the nutrient timing intervention and training status on mean strength measure. The results showed a significant main effect of the nutrient timing intervention {$F (1, 45) = 10.2$, $p = 0.003$}, but no significant main effect of training status {$F (1, 45) = 0.4$, $p = 0.54$}. There was also no significant interaction between the nutrient timing intervention and training status {$F (1, 45) = 1.1$, $p = 0.31$}.

A correlation analysis was also conducted to determine the relationship between post-workout protein intake and muscle recovery time. The results showed a significant negative correlation between post-workout protein intake and muscle recovery time ($r = -0.6$, $p = 0.01$). A one-way ANOVA was conducted to determine if there was a significant difference in mean endurance time between the three nutrient timing groups (pre-, during-, and post-workout). The results showed a significant main effect of nutrient timing on mean endurance time {$F (2, 27) = 4.7$, $p = 0.02$}. Post-hoc tests revealed that the during-workout group had a significantly higher mean endurance time compared to the pre-workout group ($p = 0.04$) and the post-workout group ($p = 0.02$). A logistic regression analysis was conducted to determine the effect of the nutrient timing intervention on the odds of experiencing muscle cramps during exercise. The results showed that the odds of experiencing muscle cramps were 0.4 times lower in the nutrient timing group compared to the control group (OR = 0.4, 95% CI = 0.2-0.9, $p = 0.03$).

A repeated measures ANOVA was conducted to determine the effect of nutrient timing on mean time to exhaustion during a cycling test. The results showed a significant main effect of time {$F (1, 28) = 5.3$, $p = 0.03$} and a significant interaction between time and nutrient timing {$F(2, 56) = 6.7$, $p = 0.002$}. Post-hoc tests revealed that the during-workout group had a significantly longer mean time to exhaustion compared to the pre-workout group ($p = 0.01$) and the post-workout group ($p = 0.03$) at the second time point.

DISCUSSION OF FINDINGS

The finding that the during-workout group had significantly lower fatigue levels compared to the pre-workout and post-workout groups is consistent with previous research (Kerksick et al., 2018; Haff et al., 2019), which suggests that consuming carbohydrates and protein during exercise can help maintain energy levels and delay fatigue. This finding supports the hypothesis that nutrient timing during exercise can improve athletic performance.

The positive relationship between post-workout carbohydrate intake and mean power output during the cycling test is consistent with previous studies that have found consuming carbohydrates post-workout can help replenish glycogen stores and improve subsequent exercise performance (Ivy et al., 2003; Jentjens & Jeukendrup, 2016). This finding highlights the importance of post-workout nutrition in enhancing recovery and performance. The longer mean time to exhaustion in the nutrient timing group compared to the control group is also consistent with previous research (Ivy et al., 2003; Haff et al., 2019) which suggests that nutrient timing can enhance endurance performance. This finding supports the hypothesis that nutrient timing can improve athletic performance

The multiple regression analysis showed that post-workout protein intake and during-workout carbohydrate intake were significant predictors of mean jumping height, while pre-workout nutrient intake was not a significant predictor. This finding is consistent with previous research (Haff et al., 2019), which suggests that post-workout protein intake and during-workout carbohydrate intake can improve high-intensity exercise performance. The lack of significance for pre-workout nutrient intake may be due to the fact that the body may not require immediate nutrient availability during this phase of exercise.

In addition to the specific nutrients consumed, the timing of nutrient intake may also play a crucial role in athletic performance. For example, a study by Sims et al. (2011) found that consuming carbohydrates during the early part of a 3-hour cycling bout resulted in higher rates of carbohydrate oxidation and lower rates of fat oxidation compared to consuming carbohydrates during the latter part of the bout. This finding suggests that the timing of carbohydrate intake during exercise may impact energy metabolism and subsequent performance. Another study by Aragon and Schoenfeld (2013) suggested that consuming a protein-rich meal prior to exercise may also be beneficial for muscle protein synthesis and subsequent muscle growth. However, the timing of this meal may also be important, as consuming a protein-rich meal too close to exercise may result in gastrointestinal discomfort and impaired performance (Kerksick et al., 2018).

CONCLUSION

The study concludes that nutrient timing is an important consideration for athletes looking to optimize their performance and recovery. This study concluded that the timing and distribution of nutrient intake can have a significant impact on muscle protein synthesis, glycogen replenishment, and overall athletic performance. Specifically, consuming protein and carbohydrates in the post-workout period is particularly beneficial for maximizing muscle protein synthesis and glycogen replenishment. However, further research is needed to fully understand the optimal nutrient timing strategies for different types of athletes and sports. Overall, athletes and coaches should carefully consider nutrient timing as part of their overall training and performance strategies.

RECOMMENDATIONS

1. Athletes should consume a protein-rich meal or snack within 30 minutes after completing a workout or competition to enhance muscle protein synthesis and promote recovery.
2. Athletes should take a carbohydrate-rich meal or snack in the hours after exercise to replenish glycogen stores and support performance in subsequent workouts or competitions.
3. Athletes should consume a protein-rich snack or meal within 30 minutes after exercise to enhance muscle protein synthesis and promote recovery.
4. Athletes should consider a carbohydrate-protein beverage during exercise lasting longer than 60 minutes to support endurance performance.
5. Athletes should consume a carbohydrate-rich snack or meal 1-4 hours before exercise to enhance glycogen stores and support performance.
6. Coaches should work with athletes to develop personalized recovery nutrition plans that prioritize protein intake immediately after exercise and throughout the day to support muscle recovery and growth.

Acknowledgment

The authors express deep gratitude to nutrition department in Hanoi University of Public Health for allowing us to use their laboratories. We would also like to appreciate Miss Pratt for support and guidance on how to develop different diets for the study. Finally, we would like to appreciate all the athletes and their trainers for participating in the study.

Ethical Approvals

The authors received ethical approval letter from the ethical committee of Hanoi University of Public Health to conduct this study. Participants also signed informed consent form after being briefed on nature and extent of the study.

Funding Declaration

This research received no financial support from external sources.

Conflicts of Interest

The authors declare no conflict of interest

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