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Acute effects of different breakfast types on shooting accuracy in male basketball players

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Abstract

Aim: The aim of this study was to examine the acute effects of different breakfast types on shooting accuracy in male basketball players. **Method:** Sixteen male basketball players who were actively competing in official competitions voluntarily participated in the study. Participants completed three testing sessions separated by seven-day intervals under three breakfast conditions: routine breakfast, traditional breakfast, and cereal breakfast. In each session, shooting accuracy was assessed two hours after breakfast consumption following a standardized 10-minute warm-up protocol. Shooting accuracy was evaluated using shots taken from five different spots positioned 2.74 m from the basket. Participants attempted five shots from each zone, resulting in a total of 25 shots per session. The number of successful shots in each zone and total successful shots were recorded. Data were analyzed using one-way repeated-measures analysis of variance, with statistical significance set at $p < 0.05$. **Results:** No statistically significant differences were found among breakfast conditions in Zone 1 (p=0.962), Zone 2 (p=0.635), Zone 3 (p=0.729), Zone 4 (p=0.932), Zone 5 (p=0.214), or total shooting accuracy (p=0.497). Total successful shots were 13.1±2.3 for routine breakfast, 13.2±2.9 for traditional breakfast, and 12.3±2.7 for cereal breakfast. Under the present experimental conditions, no statistically significant differences in zone-specific or total shooting accuracy were observed among the breakfast conditions. **Conclusion:** These findings should be interpreted considering that the breakfast conditions were not isocaloric and that the shooting protocol did not reproduce the fatigue demands of actual match play. From a practical perspective, ensuring that athletes consume a familiar and well-tolerated breakfast before morning shooting sessions may be more relevant than focusing on breakfast type alone.

Introduction

Basketball is a high-intensity intermittent sport characterized by repeated accelerations and decelerations, with game durations ranging from 32 to 48 min depending on the level of play (Cengizel et al., 2022; Davis et al., 2022; Liveris et al., 2021; Stojanovic et al., 2018). Beyond imposing considerable physiological strain and intensive movement demands on players, basketball also requires a high degree of technical accuracy (Erculj & Supej, 2009). Among basketball-specific skills, shooting is a frequently used scoring action that directly affects the score and can be performed in different forms, including dunks, jump shots, field goals, three-pointers, layups, and free throws (Amaro et al., 2023; Li et al., 2025; Wang & Zheng, 2022). In this context, shooting technique and accuracy are considered critical elements of basketball performance, as a basketball shot involves a complex sequence of actions directed toward the hoop and requires accuracy together with coordinated lower-extremity patterns such as balance and jumping, accompanied by appropriate upper-extremity movement (Barataman & Gomez, 2024; Chen et al., 2005; Yan et al., 2023). Accordingly, shooting accuracy has been reported as a key performance indicator that directly contributes to game outcomes, with the ability to shoot accurately from different distances being one of the factors most strongly associated with winning and losing in basketball (Demir et al., 2026; Li et al., 2021). Moreover, successful two-point shooting has been shown to discriminate between winning and losing teams in basketball competitions (Lorenzo et al., 2010). Therefore, achieving a high shooting percentage requires players to maintain shooting accuracy under varying physiological and psychological conditions throughout the game (Pojskic et al., 2018).

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Breakfast is commonly described as the first meal consumed after waking and is generally defined as a meal eaten within approximately 2 h after waking, contributing about 20–35% of total daily energy intake (Clayton & James, 2016; Jabri et al., 2021). As a meal that breaks the overnight fast, breakfast is ideally consumed within the first two to three hours after waking and is recommended to include all three major macronutrients, with particular emphasis on complex carbohydrate sources (O'Neil et al., 2014). Regular breakfast consumption has been associated with several physical and mental health benefits (Ren et al., 2024), while breakfast intake after an overnight fast may suppress hunger through hormonal mechanisms involved in appetite regulation (Naharudin et al., 2020). Although breakfast is often referred to as the most important meal of the day (Stratton et al., 2025), its acute and chronic exercise-related effects appear to have been less extensively investigated. Nevertheless, the complex interplay among exercise, nutrition, and metabolism remains a central topic of interest for both sports scientists and athletes (Stratton et al., 2025), and major organizations such as the International Olympic Committee, the American College of Sports Medicine, and the American Dietetic Association agree that optimal nutrition can help athletes improve physical performance and recover more effectively after training or competition (Maughan et al., 2018; Thomas et al., 2016).

In the context of exercise, breakfast may play an important role in meeting daily carbohydrate requirements and maximizing carbohydrate availability, particularly for individuals performing morning exercise (Clayton & James, 2016). Current evidence suggests that breakfast should be consumed 1 to 4 h before morning exercise to prevent potential decrements in performance, while exercising without breakfast has been shown to impair performance compared with exercising after breakfast consumption (Clayton et al., 2015; Clayton & James, 2016). Although skipping breakfast may reduce daily energy intake, it may negatively affect performance later in the day, even after lunch has been consumed (Clayton et al., 2015). In addition to its metabolic role, breakfast consumption may influence subsequent cognitive performance, particularly attention-related processes, and these effects have been partly attributed to meal macronutrient composition and changes in blood glucose availability (Hsieh et al., 2025). Since basketball shooting requires sustained attention and motor coordination, these findings provide a rationale for examining whether different breakfast types acutely affect basketball-specific shooting accuracy. Moreover, while carbohydrates remain the primary fuel source in intermittent sports such as basketball (Čabarkapa et al., 2020), pre-exercise protein intake has also been suggested to play a supportive role in glycogen synthesis and exercise-related energy metabolism (Ormsbee et al., 2014). Given that basketball requires substantial cognitive involvement in addition to optimal physical and physiological characteristics, and that failure to achieve an ideal mood state may negatively affect athletes' well-being and performance capacity, breakfast consumption may be relevant for a precision-based task such as basketball shooting (Čabarkapa et al., 2020).

Although breakfast consumption is generally considered important for exercise preparation, evidence regarding its acute effects on performance-related outcomes is not entirely consistent. A recent systematic review reported that breakfast consumption, breakfast macronutrient composition, or breakfast content did not acutely alter cognitive performance during exercise in healthy adults (Hsieh et al., 2025). In contrast, experimental studies have suggested that breakfast characteristics may influence appetite regulation and resistance exercise performance. For example, Naharudin et al. (2020) reported that both viscous placebo and carbohydrate breakfasts reduced appetite and improved resistance exercise performance compared with a control breakfast in trained men. Similarly, when two isocaloric breakfasts were compared, a semi-solid meal reduced hunger to a greater extent and improved back squat repetition performance more than a liquid meal, suggesting that hunger suppression may positively influence resistance exercise performance (Naharudin et al., 2021). These findings indicate that the acute effects of breakfast may depend not only on breakfast consumption per se, but also on meal composition, physical form, and the specific performance outcome assessed.

From a sport-specific perspective, the timing and composition of the pre-exercise meal are important nutritional considerations because they may influence metabolism and subsequent exercise performance. In particular, consuming a meal before exercise may help maximize glycogen stores and influence substrate utilization during subsequent activity (Ormsbee et al., 2014). This may be relevant for basketball, which imposes substantial physiological demands, and high-intensity basketball training has been shown to alter electrolyte and trace element status in elite players (Wang et al., 2012). Moreover, basketball-specific skill

performance, including shooting accuracy, may be sensitive to acute nutritional and hydration status, as previous research has shown that 2% dehydration impaired, whereas a 6% carbohydrate–electrolyte solution improved, shooting accuracy in young basketball players (Dougherty et al., 2006). However, whether differences in breakfast type translate into acute changes in basketball-specific technical skills such as shooting accuracy remains unclear.

Previous studies have shown that breakfast consumption may be associated with more stable blood glucose responses and improved emotional state (Roberts et al., 2025), as well as enhanced academic and cognitive performance (Kawabata et al., 2021; Veasey et al., 2013). In exercise settings, breakfast consumption has also been reported to improve resistance exercise performance (Naharudin et al., 2020, 2021), whereas breakfast omission may negatively affect strength-related outcomes (Metcalfe et al., 2021). However, previous research has more commonly compared breakfast consumption with breakfast omission rather than examining the acute effects of different breakfast types (Čabarkapa et al., 2020; Clayton et al., 2015; Metcalfe et al., 2021; Naharudin et al., 2019; Roberts et al., 2025). Therefore, it remains unclear whether breakfasts that differ in habitual structure, energy content, and macronutrient profile produce different acute responses in basketball-specific shooting accuracy. Accordingly, the aim of this study was to examine the acute effects of different breakfast types on shooting accuracy in male basketball players. Given the potential role of breakfast composition in energy availability and attention-related processes, it was hypothesized that shooting accuracy would differ among breakfast conditions.

Methods

Participants

A priori sample size calculation was performed using G*Power (version 3.1., University of Düsseldorf, Germany) based on previous breakfast-related performance studies with repeated-measures/cross-over designs (Bougard et al., 2009; Čabarkapa et al., 2020). Using an expected effect size of f=0.35, α=0.05, power=0.80, three repeated measurements, and an assumed correlation of 0.50 among repeated measures, the minimum required sample size was calculated as 15 participants. Accordingly, a total of 16 male basketball players who were actively competing in official competitions voluntarily participated in the study (mean age: 20.4±1.5 years; basketball experience: 10.9±2.9 years; body height: 191.0±6.3 cm; body mass: 86.0±7.9 kg; body mass index: 23.6±1.9 kg.m^{-2}) (Table 1). The inclusion criteria were as follows: (a) being between 18 and 25 years of age, (b) having at least five years of basketball experience, (c) participating in regular basketball training at least four days per week, and (d) actively competing in official competitions. Players who had experienced a musculoskeletal injury or undergone surgery within the previous six months, had a diagnosed eating disorder, did not attend any of the test sessions, or had an allergy to any food included in the breakfast protocols were excluded from the study. Ethical approval for this study was obtained from the Ethics Commission of Gazi University (Research code: 2024-1241), and all procedures were conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to participation in the study.

Table 1
Characteristics of the participants.

	Mean ± SD	95% CI
Age (year)	20.4 ± 1.5	19.7 - 21.1
Basketball experience (year)	10.9 ± 2.9	9.5 - 12.3
Body height (cm)	191.0 ± 6.3	187.9 - 194.1
Body mass (kg)	86.0 ± 7.9	82.1 - 89.9
BMI (kg.m^{-2})	23.6 ± 1.9	22.7 - 24.5

Data are presented as mean ± standard deviation (SD). BMI: Body mass index, CI: Confidence interval.

Study Design

This study was conducted using a repeated-measures design to examine the acute effects of different breakfast types on shooting accuracy in male basketball players. Participants completed three separate testing sessions, each separated by a seven-day interval. In each session, a different breakfast protocol was applied, and basketball-specific shooting accuracy was assessed two hours after breakfast consumption following a standardized warm-up protocol. The breakfast conditions applied in the study were routine breakfast, traditional breakfast, and cereal breakfast. The order of the breakfast conditions was fixed for all participants and was not randomized or counterbalanced; all participants completed the routine breakfast condition first, followed by the traditional breakfast condition, and finally the cereal breakfast condition. To standardize pre-session conditions, participants were instructed to maintain similar food intake on the day before each testing session, avoid strenuous exercise and caffeine or other stimulants before testing, maintain their usual sleep duration, and attend all testing sessions at approximately the same time of day.

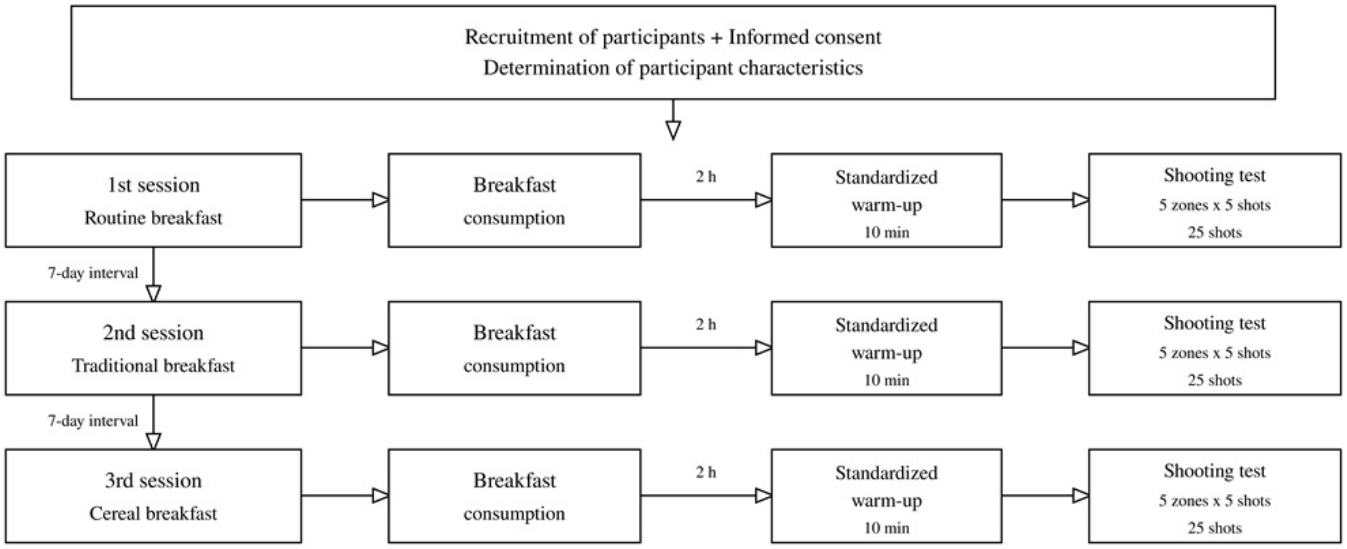


Figure 1. Study design workflow. Participants completed three breakfast conditions separated by seven-day intervals. In each session, shooting accuracy was assessed two hours after breakfast consumption following a standardized 10-min warm-up protocol.

Breakfast Types

Participants were evaluated under three different breakfast conditions: routine breakfast, traditional breakfast, and cereal breakfast. In the routine breakfast session, athletes were asked to consume the breakfast they were accustomed to in their daily lives. In the traditional breakfast and cereal breakfast sessions, the breakfast contents were determined by the researchers and consumed under supervision.

Breakfast contents were prepared by considering the athletes' body mass. The energy and macronutrient content of the breakfasts were determined based on the recommendations of the International Society of Sports Nutrition (ISSN), with the aim of providing approximately 0.75-1.2 g of carbohydrate and 0.2-0.3 g of protein per kilogram of body mass (Kreider et al., 2010). Breakfast consumption was planned to provide approximately 15-20% of total daily energy intake. The mean energy values according to breakfast type were calculated as 486.7±246.9 kcal for routine breakfast, 814.0±36.7 kcal for traditional breakfast, and 425.5±70.9 kcal for cereal breakfast (Table 2). The breakfast conditions were not designed to be isocaloric. Rather, the study aimed to compare three distinct breakfast patterns while preserving their respective meal structures and portion characteristics. In particular, the routine breakfast condition reflected each participant's habitual breakfast intake, whereas the traditional and cereal breakfasts were researcher-defined and consumed in their prescribed portions. Therefore, differences in total energy intake among conditions were retained as part of the applied breakfast protocols.

A standardized two-hour interval was allowed between breakfast consumption and the performance test in all sessions. Participants were instructed not to consume any additional food or fluid during the two hours before testing.

Table 2
Calories (kcal) according to breakfast types.

Breakfast types	Mean ± SD
RB	486.7 ± 246.9
TB	814.0 ± 36.7
CB	425.5 ± 70.9

Data are presented as mean ± standard deviation (SD). RB: Routine breakfast, TB: Traditional breakfast, CB: Cereal breakfast.

Warm-up Protocol

The same standardized warm-up protocol was applied before the shooting accuracy assessment in each testing session. The warm-up protocol lasted a total of 10 minutes; during the first five minutes, basketball-specific low- to moderate-intensity movements were performed, followed by dynamic mobilization exercises during the next five minutes. The content and duration of the warm-up were applied identically across all breakfast conditions to ensure standardization before performance measurements.

Shooting Accuracy Test

Shooting accuracy was assessed using a standardized, non-fatiguing protocol performed without time restriction or defensive opposition, with shots taken from five predetermined shooting spots on the basketball court. The shooting zones were completed in

a fixed order from Zone 1 to Zone 5, with no additional rest interval between zones. In each zone, participants performed jump shots after receiving a pass from the same researcher. Each shooting spot was positioned 2.74 m from the basket (Figure 2). Participants were asked to take five shots from each zone, resulting in a total of 25 shots in each session. No time restriction was applied during shooting. Passing and rebounding support was provided in a standardized manner by the same researchers in all testing sessions. The number of successful shots in each zone was recorded separately, and total shooting accuracy was calculated by summing the successful shots across the five zones.

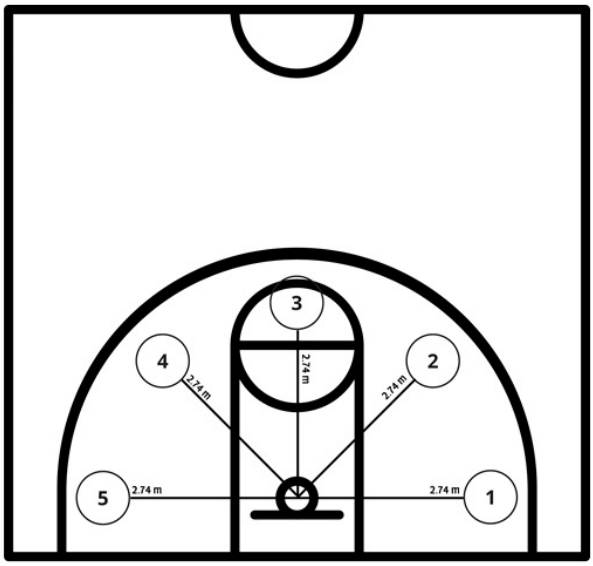


Figure 2. Shooting accuracy test protocol.

Data Analyses

Descriptive data are presented as mean ± standard deviation. The normality of the data distribution was assessed using the Shapiro–Wilk test. A one-way repeated-measures analysis of variance was performed to examine the effect of breakfast type on shooting accuracy. Statistical analyses were conducted using SigmaPlot software (Systat Software Inc., San Jose, CA, USA). The level of statistical significance was set at $p < 0.05$.

Results

Findings regarding the effects of different breakfast types on shooting accuracy are presented in Table 3. According to the one-way repeated-measures analysis of variance, no statistically significant differences were found among the routine breakfast, traditional breakfast, and cereal breakfast conditions in terms of successful shots in Zone 1 (p = 0.962), Zone 2 (p = 0.635), Zone 3 (p = 0.729), Zone 4 (p = 0.932), and Zone 5 (p = 0.214; $p > 0.05$).

No statistically significant difference was found among breakfast conditions in terms of total shooting accuracy (p = 0.497). The total number of successful shots was 13.1±2.3 in the routine breakfast condition, 13.2±2.9 in the traditional breakfast condition, and 12.3±2.7 in the cereal breakfast condition. Overall, no statistically significant differences were observed among the different breakfast types in either zone-specific shooting accuracy or total shooting accuracy.

Table 3
Acute effects of different breakfast types on shooting accuracy in male basketball players.

	Breakfast type	Mean ± SD	95% CI	p
Zone 1	RB	2.3 ± 1.1	1.7-2.9	0.962
	TB	2.3 ± 1.2	1.7-2.9	
	CB	2.4 ± 1.5	1.6-3.2	
Zone 2	RB	2.9 ± 1.2	2.3-3.5	0.635
	TB	2.6 ± 1.2	2.0-3.2	
	CB	2.5 ± 1.2	1.9-3.1	
Zone 3	RB	2.9 ± 0.7	2.5-3.3	0.729
	TB	3.0 ± 0.8	2.6-3.4	
	CB	2.8 ± 1.2	2.2-3.4	
Zone 4	RB	2.5 ± 0.9	2.0-3.0	0.932
	TB	2.6 ± 1.3	1.9-3.3	
	CB	2.5 ± 1.1	1.9-3.1	
Zone 5	RB	2.4 ± 1.4	1.7-3.2	0.214
	TB	2.8 ± 1.5	2.0-3.6	
	CB	2.1 ± 1.1	1.5-2.7	
Total	RB	13.1 ± 2.3	11.9-14.3	0.497
	TB	13.2 ± 2.9	11.7-14.8	
	CB	12.3 ± 2.7	10.9-13.7	

Data are presented as mean ± standard deviation (SD). RB: Routine breakfast, TB: Traditional breakfast, CB: Cereal breakfast.

Discussion

The aim of this study was to examine the acute effects of different breakfast types on shooting accuracy in male basketball players. The main finding was that routine breakfast, traditional breakfast, and cereal breakfast conditions did not produce statistically significant differences in shooting accuracy across any of the five shooting zones or in total shooting accuracy. Although total successful shots were slightly higher after the traditional breakfast condition compared with the routine and cereal breakfast conditions, these differences were not statistically significant. Therefore, the present findings indicate that the acute consumption of different breakfast types were not associated with statistically significant differences in basketball-specific shooting accuracy under the current experimental conditions. Accordingly, the hypothesis that shooting accuracy would differ among breakfast conditions was not supported.

In the present study, no statistically significant differences were observed among routine breakfast, traditional breakfast, and cereal breakfast conditions for shooting accuracy in any of the five shooting zones or in total shooting accuracy. Total successful shots were similar between the routine breakfast and traditional breakfast conditions, whereas the cereal breakfast condition showed a slightly lower mean value; however, this difference did not reach statistical significance (routine breakfast: 13.1±2.3; traditional breakfast: 13.2±2.9; cereal breakfast: 12.3±2.7; p=0.497). Similarly, the absence of significant differences across Zone 1 (p = 0.962), Zone 2 (p = 0.635), Zone 3 (p = 0.729), Zone 4 (p = 0.932), and Zone 5 (p = 0.214) suggests that the acute effect of breakfast type was not specific to any particular shooting location. Therefore, although the breakfast conditions differed in energy content, with the traditional breakfast providing the highest energy intake, these differences did not translate into meaningful acute changes in basketball-specific shooting accuracy under the present experimental conditions.

These findings should be interpreted in light of previous research showing that the effects of breakfast on exercise and sport-related performance are not uniform across performance outcomes, exercise modalities, or testing contexts. A recent review suggested that breakfast consumption may be beneficial for prolonged morning endurance exercise lasting more than 60 min, whereas its effects are less evident for shorter-duration exercise; the same review also indicated that skipping breakfast may consistently suppress evening sport performance even when lunch is consumed later in the day (Stratton et al., 2025). Similarly, Metcalfe et al. (2021) reported that omission of a carbohydrate-rich breakfast impaired evening endurance performance despite complete dietary compensation at lunch. In highly trained cyclists, skipping breakfast reduced mean power output during a 20-km time trial by approximately 3%, despite matched total energy and macronutrient intake across breakfast and lunch conditions and no significant differences in heart rate, blood glucose, or blood lactate concentrations (Metcalfe et al., 2021). In contrast, the present study assessed a short, skill-based shooting protocol rather than prolonged endurance performance, which may partly explain why differences in breakfast type did not significantly affect shooting accuracy.

Previous studies also suggest that breakfast may influence performance through mechanisms other than energy provision alone. Roberts et al. (2025) reported that breakfast consumption before resistance training in female collegiate athletes may positively affect emotional state, including increased happiness and reduced stress, as well as physiological responses such as more stable blood glucose. Moreover, Mears et al. (2018) showed that a nearly energy-free placebo breakfast produced a similar improvement in high-intensity cycling performance to a taste- and texture-matched high-carbohydrate breakfast, suggesting that perceptual or placebo-related mechanisms may contribute to breakfast-related performance responses. In this context, Naharudin et al. (2020) proposed that if breakfast influences performance through a placebo-related pathway, appetite or hunger suppression may mediate this response. Such findings indicate that the acute performance effects of breakfast may depend not only on energy and macronutrient content, but also on factors such as hunger, perceived readiness, mood, and the specific nature of the performance task.

The present findings are partly consistent with evidence indicating that breakfast does not always improve all types of performance outcomes. Bougard et al. (2009) showed that breakfast intake increased oral temperature, VCO_2, and respiratory exchange ratio values during early morning testing, but did not affect flexibility, muscular strength, or mean power output. Similarly, although breakfast may alter selected physiological responses, these changes may not necessarily translate into improvements in technical or

neuromuscular performance. In basketball-specific research, Čabarkapa et al. (2020) examined the relationship between breakfast consumption and shooting accuracy in adult basketball players and reported that breakfast consumption improved only free-throw accuracy, whereas other shooting outcomes, including two-point and three-point shooting, were not consistently improved. The authors suggested that balanced nutrition including regular breakfast consumption may still be a useful strategy for players seeking to optimize individual and team performance (Čabarkapa et al., 2020). However, unlike that study, the present research compared different breakfast types rather than breakfast consumption versus omission, and this may explain the absence of significant differences among conditions. Since all participants consumed breakfast before each testing session, the potential negative effects of breakfast omission were not present, and the differences among breakfast types may not have been large enough to produce measurable changes in shooting accuracy.

The present study has some limitations that should be considered when interpreting the findings. First, the sample size was relatively small and included only male basketball players; therefore, the results may not be generalizable to female players, younger athletes, or players from different competitive levels. Second, although the breakfast conditions differed in energy content, detailed macronutrient intake and physiological or metabolic responses such as blood glucose, blood lactate, insulin, appetite, or gastrointestinal comfort were not measured. Consequently, it was not possible to determine whether the absence of differences in shooting accuracy was associated with similar or different postprandial metabolic responses among the breakfast conditions. Therefore, the underlying physiological mechanisms that may have contributed to the observed performance responses could not be directly examined. Third, the study evaluated only the acute effects of breakfast type two hours after consumption; thus, the findings do not provide information about the chronic effects of regular breakfast patterns on basketball-specific skill performance. Fourth, shooting accuracy was assessed using a standardized, non-fatiguing protocol without time pressure, defensive opposition, match-related stressors, or preceding physical fatigue. Although this approach improved experimental control, it does not reproduce the dynamic physiological and psychological demands of actual match play, where shooting is frequently performed following repeated high-intensity actions and under competitive pressure. Therefore, the present findings should be interpreted as reflecting shooting accuracy under controlled, non-fatigued conditions rather than game-like shooting accuracy. Finally, participants consumed their habitual breakfast in the routine breakfast condition, which increased ecological validity but also introduced greater variability in energy and nutrient intake compared with the researcher-controlled breakfast conditions. In addition, the breakfast conditions were administered in a fixed order rather than being randomized or counterbalanced, which may have introduced potential order effects.

Conclusion

The aim of this study was to examine the acute effects of different breakfast types on shooting accuracy in male basketball players. The results showed that routine breakfast, traditional breakfast, and cereal breakfast did not produce statistically significant differences in zone-specific or total shooting accuracy. These findings suggest that, under the present experimental conditions, acute differences in breakfast type may not meaningfully influence basketball-specific shooting accuracy when all athletes consume breakfast before testing. From a practical perspective, athletes may be encouraged to consume a familiar and well-tolerated breakfast before morning shooting sessions; however, the present findings do not indicate that one of the tested breakfast conditions improves shooting accuracy more than the others. Future studies should investigate larger and more diverse samples, include physiological and perceptual measures, employ strictly isocaloric dietary conditions, and assess shooting accuracy using basketball-specific fatigue protocols or standardized match simulations that more closely reflect actual competition demands.

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Author Contributions

Study Design: SŞ, ÇÖC and EC; Data Collection: SŞ, ÇÖC; Statistical Analysis: SŞ, ÇÖC and EC; Manuscript Preparation: SŞ, ÇÖC and EC; Supervision: EC.

Ethical Approval

The study was approved by the Ethics Committee of Gazi University (Research code: 2024–1241) and it was carried out in accordance with the Code of Ethics of the World Medical Association also known as a Declaration of Helsinki.

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The authors declare that the study received no funding.

Conflict of Interest

The authors hereby declare that there was no conflict of interest in conducting this research.

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