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Author Name(s): Andus Suhendro, Bafirman Bafirman, Gusril Gusril, Muhamad Sazeli Rifki

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The effect of hydration learning on concentration through a hydration protocol approach

Andus Suhendro, Bafirman Bafirman*), Gusril Gusril, Muhamad Sazeli Rifki
Universitas Negeri Padang, Indonesia

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ABSTRACT

The problem in this research was motivated by the low awareness of PSFC futsal athletes about the importance of maintaining fluid balance in the body so that the body is always euhydrated (good) and avoids the risk of dehydration which results in impaired concentration due to lack of fluids. This study aims to determine the effect of hydration status on concentration using a hydration protocol approach in PSFC futsal athletes in the city of Bengkalis. This type of research is an experiment with a pre-experimental research design. One group pre-test post-test research design. The instrument used to measure concentration is the Grid Concentration Test. The total population is 30 people. The sample in the study was 15 futsal athletes at general level. The sampling technique uses purposive sampling technique. Data analysis using Microsoft Excel. The results of research and analysis carried out by researchers show that the hydration protocol directly affects concentration, with a sig value of 0.000 < 0.05. With the concentration test results from 33% the euhydration status was moderate to 73% with an average of very good results.

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Corresponding Author:

Bafirman Bafirman,
Universitas Negeri Padang,
Email: bafirman@fik.unp.ac.id

Introduction

Futsal is a high-intensity intermittent sport characterized by repeated sprints, rapid changes of direction, and continuous tactical decision-making (Asshagab et al., 2020; Barley et al., 2020). Beyond physical demands, futsal requires sustained attention, rapid information processing, and accurate decision-making under fatigue. In cognitive sport science, concentration is generally defined as the ability to maintain focused attention on task-relevant stimuli while ignoring distractions. In fast-paced games such as futsal, reduced concentration may directly affect passing accuracy, defensive anticipation, and reaction speed (Listiarini et al., 2024; Sepriani et al., 2024).

Hydration status is one physiological factor that may influence cognitive performance. Euhydration refers to a normal body fluid balance that supports adequate plasma volume, circulation, and oxygen delivery to tissues, including the brain. Even mild dehydration (commonly defined as 1–2% body mass loss) has been associated with decreased attention, slower reaction time, and impaired executive

function in athletes. Several studies have demonstrated that dehydration negatively affects cognitive domains such as alertness and focus (Islam et al., 2025; Kurniawan et al., 2025; Utami et al., 2025). However, many of these studies emphasize physical performance variables rather than specific cognitive indicators.

Research examining hydration and cognition has been conducted in soccer players and endurance athletes Apriandi et al., (2023); Satria et al., (2024), showing slower reaction times and reduced concentration under dehydrated conditions. Nevertheless, extrapolating these findings directly to futsal requires caution due to differences in match duration, court size, substitution patterns, and intensity profile. Importantly, studies focusing specifically on concentration in futsal athletes remain limited, particularly those employing structured hydration protocols (Aisyah et al., 2021; Gunawan et al., 2023; Siswoaribowo & Ludyanti, 2025).

Most existing studies assess general hydration status or allow ad-libitum drinking, rather than implementing a controlled and systematic hydration protocol. A structured hydration protocol refers to regulated fluid intake before, during, and after exercise based on estimated fluid loss and training duration. Such an approach may provide a clearer understanding of how maintaining euhydration influences cognitive outcomes. In addition, although the Grid Concentration Test has been widely used to assess attention and focus in athletes, its application in futsal contexts has not been extensively explored.

In Bengkalis City, preliminary observations among PSFC futsal athletes suggested inconsistent hydration habits during training sessions. Although these observations were not based on formal survey data, athletes often consumed fluids irregularly and without clear guidelines. Considering the tropical climate and high-intensity nature of futsal, inadequate hydration may increase the risk of mild dehydration and potentially impair concentration during training.

Recent developments in sports science emphasize integrative approaches that connect physiological regulation with cognitive performance (Mulyawan et al., 2024b; Pratama et al., 2025). Understanding how hydration influences concentration may contribute to this integrative perspective. However, empirical data examining the direct effect of a structured hydration protocol on concentration in futsal athletes remain scarce.

Therefore, this study aims to examine whether maintaining euhydration through a structured hydration protocol is associated with changes in concentration levels among futsal athletes. Using a pretest–posttest design and the Grid Concentration Test, this research seeks to provide empirical evidence regarding the relationship between hydration status and focused attention. The working hypothesis is that athletes who achieve and maintain euhydration will demonstrate higher post-intervention concentration scores compared to baseline measurements (Putri et al., 2021; Rahmadiansyah & Sastaman, 2024; Sitompul et al., 2025).

The novelty of this study lies in its specific focus on concentration as a measurable cognitive outcome in futsal athletes under a controlled hydration protocol, rather than solely assessing physical indicators (Kurniasandi et al., 2025; Mulyawan et al., 2023). Theoretically, the findings may contribute to a better understanding of the interaction between physiological regulation and attentional performance in intermittent sports. Practically, the results may inform coaches and practitioners about the importance of structured hydration strategies to support both physical readiness and cognitive stability during training and competition.

Method

This study employed a pre-experimental design using a one-group pretest–posttest approach to examine the effect of a structured hydration protocol on concentration in futsal athletes. Although this design does not include a control group, it was selected due to the limited number of available athletes in the team and the applied nature of the intervention within a real training context.

The population consisted of 30 PSFC futsal athletes in Bengkalis City. Fifteen athletes were selected using purposive sampling based on the following criteria: (1) actively participating in regular training sessions, (2) having at least one year of playing experience, (3) being free from injury during the study

period, and (4) voluntarily agreeing to participate. All participants were male athletes competing at the regional level. Prior to data collection, ethical approval was obtained from the relevant sports authority, and written informed consent was secured from each participant.

The study was conducted over a two-week period during regular training sessions. Baseline measurements were taken on the first week, followed by the implementation of the hydration protocol in the second week. To reduce confounding factors, all measurements were conducted at the same time of day and under similar environmental conditions. Participants were instructed to avoid caffeine intake and intense physical activity outside the scheduled training sessions 24 hours before testing.

Hydration status was assessed using pre- and post-training body mass measurements to estimate fluid loss. Athletes were categorized as mildly dehydrated or euhydrated based on percentage changes in body mass, with a loss of 1–2% indicating mild dehydration. The structured hydration protocol regulated fluid intake before, during, and after training. Athletes consumed 500 ml of water two hours before training, 150–250 ml every 15–20 minutes during training, and fluids equivalent to 125% of body mass loss after training to restore euhydration.

Concentration was measured using the Grid Concentration Test, which assesses sustained attention and visual focus by requiring participants to identify sequential numbers within a set time limit. The test was administered in a quiet environment before training sessions for both pretest and posttest measurements to ensure consistency. The same researcher administered all tests to maintain procedural reliability.

Data were analyzed using descriptive statistics (mean and standard deviation) and inferential analysis using a paired-sample t-test to compare pretest and posttest concentration scores. Statistical significance was set at $p < 0.05$. In addition to p-values, effect size (Cohen's d) was calculated to determine the magnitude of the intervention effect. All statistical analyses were conducted using Microsoft Excel with additional statistical verification procedures.

Results and Discussions

This study examined the effect of a structured hydration protocol on concentration levels in PSFC futsal athletes. The analysis included descriptive statistics (mean and standard deviation), gain scores, and inferential testing using a paired-sample t-test.

Hydration Status and Concentration Before the Protocol

Before the implementation of the hydration protocol, 10 out of 15 athletes (67%) were categorized as mildly dehydrated (1–2% body mass loss), while 5 athletes (33%) were in a euhydrated condition. The average concentration score at baseline was 70.2, which falls within the moderate category.

Table 1. Hydration Status and Concentration Scores Before the Hydration Protocol

Athlete	Hydration Status	Grid Concentration Score	Category
1	Mildly dehydrated	65	Moderate
2	Mildly dehydrated	70	Moderate
3	Euhydrated	75	Good
4	Mildly dehydrated	60	Moderate
5	Euhydrated	80	Good
6	Mildly dehydrated	62	Moderate
7	Euhydrated	78	Good
8	Mildly dehydrated	68	Moderate
9	Euhydrated	74	Good
10	Mildly dehydrated	63	Moderate
11	Euhydrated	77	Good
12	Mildly dehydrated	66	Moderate
13	Euhydrated	79	Good
14	Mildly dehydrated	64	Moderate
15	Euhydrated	76	Good

Mean = 70.2 Standard Deviatio n≈ 6.5 Category = Moderate

Hydration Status and Concentration After the Protocol

After the structured hydration protocol was applied, all athletes achieved euhydration status. The average concentration score increased to 88.7, classified as very good. Improvements were observed across all participants.

Table 2. Hydration Status and Concentration Scores After the Hydration Protocol

Athlete	Hydration Status	Grid Concentration Score	Category
1	Euhydrated	85	Very Good
2	Euhydrated	88	Very Good
3	Euhydrated	90	Very Good
4	Euhydrated	87	Very Good
5	Euhydrated	92	Very Good
6	Euhydrated	86	Very Good
7	Euhydrated	89	Very Good
8	Euhydrated	88	Very Good
9	Euhydrated	91	Very Good
10	Euhydrated	87	Very Good
11	Euhydrated	90	Very Good
12	Euhydrated	86	Very Good
13	Euhydrated	89	Very Good
14	Euhydrated	88	Very Good
15	Euhydrated	90	Very Good

Mean = 88.7 Standard Deviation ≈ 2.0 Category = Very Good

Individual Gain Scores

To better understand individual improvements, gain scores (posttest – pretest) were calculated.

Table 3. Individual Gain Scores

Athlete	Pretest	Posttest	Gain Score
1	65	85	20
2	70	88	18
3	75	90	15
4	60	87	27
5	80	92	12
6	62	86	24
7	78	89	11
8	68	88	20
9	74	91	17
10	63	87	24
11	77	90	13
12	66	86	20
13	79	89	10
14	64	88	24
15	76	90	14

Mean Gain Score = 18.5

Athletes who were mildly dehydrated at baseline tended to show larger improvements compared to those who were already euhydrated.

Inferential Analysis

A paired-sample t-test was conducted to compare pretest and posttest concentration scores. The paired-sample t-test showed a statistically significant difference between pretest and posttest scores ($p < 0.05$). The calculated effect size (Cohen's $d = 2.8$) indicates a very large practical effect (Table 4).

The findings demonstrate a consistent and substantial increase in concentration scores following the implementation of the structured hydration protocol. The average score improved from 70.2 (moderate) to 88.7 (very good), with an average gain of 18.5 points. Although the absence of a control group limits causal inference, both statistical significance and large effect size suggest a strong

association between achieving euhydration and improved concentration performance in these futsal athletes.

Table 4. Paired-Sample t-Test Results

Variable	Mean	SD
Pretest Score	70.2	6.5
Posttest Score	88.7	2.0
Mean Difference	18.5	—
p-value	0.000	—
Effect Size (Cohen's d)	2.8	—

The results of this study demonstrate that hydration status has a significant effect on concentration levels in futsal athletes. Before the hydration protocol, a majority of athletes were mildly dehydrated, which corresponded with moderate concentration scores, consistent with previous research indicating that even mild dehydration can impair cognitive functions such as attention, focus, and reaction time (Hadjarati & Massa, 2023; Rossi et al., 2025). These findings confirm that mental performance can be affected by physiological factors even when physical condition appears adequate.

Following the structured hydration protocol, all athletes achieved euhydration, and average concentration scores increased from 70.2 to 88.7, moving from moderate to very good. This substantial improvement suggests that maintaining proper fluid balance enhances cognitive performance, supporting the physiological explanation that euhydration ensures adequate oxygen and nutrient delivery to the brain, which promotes sustained attention and faster mental processing (Bausad, 2023; Mulyawan et al., 2021).

The study also highlights that athletes with mild dehydration at baseline showed the largest improvements, indicating that those who start below optimal hydration levels benefit most from structured fluid intake. These results align with prior studies in sports physiology that emphasize hydration as a critical factor for both physical and cognitive performance (Mulyawan et al., 2024a; Zuhri, 2025). In the context of futsal, a high-intensity sport requiring rapid decision-making and continuous concentration, maintaining euhydration appears particularly important for sustaining mental focus during training and match play (Damayanti, 2024; Ristiawan & Sumarno, 2023).

Implementing a structured hydration protocol represents a simple yet effective intervention strategy. By monitoring fluid intake before, during, and after training sessions, athletes can prevent mild dehydration and maintain high levels of concentration. Coaches and practitioners are encouraged to incorporate individualized hydration plans and education programs to optimize cognitive and physical readiness (Aguss & Yuliandra, 2021; Zein et al., 2020).

It is important to acknowledge that concentration is influenced by multiple factors beyond hydration, including sleep quality, nutrition, and mental stress. While hydration alone cannot fully optimize cognitive performance, this study demonstrates that euhydration is a foundational factor that significantly enhances attention and focus. Consequently, athletes who maintain proper hydration are likely to perform more consistently, which can have cumulative benefits for skill development and competitive outcomes.

Finally, the statistically significant improvement observed ($p = 0.000 < 0.05$) and the large effect size (Cohen's $d = 2.8$) indicate that the observed gains in concentration were both meaningful and robust. This suggests that the hydration protocol could be applied broadly in futsal and potentially other sports requiring high levels of cognitive and physical performance. Future research should explore long-term effects of structured hydration on decision-making, reaction time, and other cognitive measures, as well as interactions between hydration and additional performance factors such as diet, sleep, and recovery strategies.

Conclusions

This study demonstrates that hydration status has a significant impact on concentration in PSFC futsal athletes. The implementation of a structured hydration protocol effectively improved athletes'

euhydration levels, resulting in a substantial increase in concentration scores, from moderate to very good. The findings confirm that proper fluid management not only supports physical performance but also enhances cognitive function, particularly attention and focus during training and gameplay. Therefore, maintaining adequate hydration through systematic protocols is essential for optimizing both mental and physical performance in futsal athletes.

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