12 (1) (2025) 167 - 174

Journal of Physical Education, Health and Sport

https://journal.unnes.ac.id/journals/jpehs

Analysis Hydration Status of National Triathlon Athletes Towards SEA GAMES 2025

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History Article

Received July 2025
Approved July 2025
Published vol 12 no 1 2025

Keywords

Hydration Status; Triathlon; National Training

Abstract

Hydration status plays a pivotal role in maintaining athlete performance, especially in endurance sports such as triathlon, which involve prolonged and intense physical exertion. This study aimed to analyze the hydration status of Indonesian triathlon athletes undergoing national training in preparation for the 2025 SEA Games. Using a quantitative descriptive method with a cross-sectional design, data were collected from 10 purposively selected athletes. Instruments included Omron Karada Scan for anthropometric assessment and urine test strips with color charts to evaluate hydration levels pre- and post-time trial. Results showed that 90% of athletes experienced weight loss averaging 0.8–0.9 kg, indicating fluid loss. Urine analysis revealed that 50% of athletes were mildly dehydrated, 30% adequately hydrated, and 20% well hydrated. One athlete showed increased body weight with a light urine color, suggesting effective fluid intake. These findings highlight the need for tailored hydration strategies and regular monitoring during training to minimize dehydration risks and support optimal performance. Coaches and sports health professionals are advised to incorporate hydration management protocols into daily training regimens for triathletes.

How to Cite

Muthmainnah, A. J., Mulyana, B., & Santoso, G.A. (2025). Analysis Hydration Status of National Triathlon Athletes Towards SEA GAMES 2025. Journal of Physical Education, Health and Sport, 12 (1), 167-174.

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p-ISSN 2354-7901
e-ISSN 2354-8231

INTRODUCTION

Hydration status is a physiological condition that reflects the balance between fluid intake and output. This balance is an important indicator in maintaining stable body function during physical activity, especially in athletes with high training loads. In practice, hydration status is classified into three conditions, namely euhydration (balanced), dehydration (lack of fluids), and overhydration (excess fluids). Assessment of this status can be done through simple methods such as observing urine color, or a more accurate laboratory approach, depending on field conditions and equipment availability (Fathimah & Mulyati, 2015). Monitoring hydration status is a crucial step in athlete health and performance management, considering that optimal body condition is highly dependent on adequate fluids.

Dehydration is a condition in which the body experiences a lack of fluids due to greater fluid output than intake. Most of the human body is composed of fluids, so when the body lacks fluids, various disorders can arise. Dehydration causes the body to become sleepy more easily, have difficulty concentrating, and be more susceptible to muscle and soft tissue injuries. In the context of sports, dehydration can reduce physical and mental performance, and accelerate fatigue. Excess fluid output that is not balanced with adequate intake will trigger disruption of the body›s homeostasis as a whole (Fathimah & Mulyati, 2015).

More severe dehydration conditions can cause clinical manifestations in the form of severe headaches, excessive fatigue, muscle spasms, and loss of consciousness. These symptoms are caused by a decrease in intravascular volume that disrupts the supply of oxygen and nutrients to vital organs. If not treated quickly, this condition has the potential to cause organ failure and death (Mujib & Pramono, 2020). In the scope of competitive sports, especially in sports with high duration and intensity such as triathlon, the risk of dehydration increases significantly, requiring special attention in managing body fluids.

Triathlon as a combined sport of swimming, cycling, and running has unique and complex physical characteristics. The three disciplines are carried out sequentially and require high aerobic and anaerobic capacity. Swimming and cycling before running causes increased oxygen demand and greater body fluid expenditure compared to single sports such as running (Guezennec, 1996). The resulting fluid loss can disrupt the body›s physiological functions, including temperature regulation, cardiovascular function, and motor skills, thus directly impacting the decline in athlete performance.

Inadequate fluid intake during training and competition is one of the main factors causing a decrease in the hydration status of athletes. Inadequate fluids can inhibit the metabolic process, slow reaction time, reduce concentration, and increase the risk of injury and muscle cramps (Sudiana, 2021). Ironically, most athletes still use thirst as an indicator to drink, even though thirst appears when the body is already experiencing a fluid deficit and entering a mild to moderate dehydration phase (Fédération internationale de natation, 2018). Therefore, education on fluid management and hydration strategies must be strengthened in athlete training programs.

In one hour of triathlon activity, the body can lose up to 1.1 liters of fluid due to evaporation through sweat and breathing. Sweat production will increase along with the intensity of exercise and environmental temperature. The main function of sweat is to help the process of thermoregulation or body temperature regulation. However, if the lost fluid is not replaced properly, there will be a decrease in body weight, concentration, and physical endurance of the athlete (Walsh et al., 1994)Therefore, monitoring body fluids should be an integral part of the training protocol, including weighing before and after exercise.

According to Jeukendrup (2011), triathlon athletes are advised to weigh themselves periodically to assess how much fluid they have lost during a training session or race. Losing more than 2–3% of their initial body weight indicates significant dehydration and should be addressed immediately. In addition, a comprehensive evaluation of hydration status can also be done by combining various parameters such as urine color, urine volume, body mass index, and the athlete›s thirst perception.

A comprehensive evaluation of hydration status can be an effective monitoring tool in training. The use of indicators such as urine color and urine volume can provide a practical and quick picture of the athlete›s hydration condition (Agusty, 2017). Even this simple method has been widely used in various sports as an initial strategy to anticipate the risk of dehydration. Assessment of thirst perception, body weight, and urine composition proved effective in detecting mild to moderate dehydration, although it cannot replace a full laboratory test (Kuswari & Gifari, 2020).

Knowledge of hydration status and

fluid management greatly determines athletes› awareness and behavior in meeting their body›s fluid needs. Athletes who understand the importance of hydration will be more attentive to the amount and type of fluid consumed before, during, and after exercise. Conversely, lack of knowledge leads to inappropriate drinking behavior, which ultimately has a negative impact on performance and post-exercise recovery (Maffeis et al., 2016). Therefore, education about hydration should be an important part of sports education.

In addition to behavior, biological factors such as body mass index (BMI) also play a role in determining hydration status. In a study, obese individuals had higher urine osmolality values compared to those with normal BMI. This suggests that the higher the BMI, the greater the risk of dehydration (Zulfa, 2018). Therefore, BMI monitoring needs to be done routinely to assess individual fluid needs more personally.

Gender also affects the rate of fluid loss. Men are known to have higher muscle mass and metabolic rates than women, so their fluid needs are greater. Research by Kuswari & Gifari (2020) shows that men lose about 1.5% of their body weight due to fluids during physical activity, while women lose about 1.3%. Thus, men are more susceptible to dehydration (Nabila, 2019).

Environmental conditions such as temperature and humidity also affect the hydration status of athletes. High temperatures increase sweat production, while high humidity slows sweat evaporation, thereby increasing the body›s thermoregulatory burden. The accumulation of these two conditions can accelerate fluid loss and increase the risk of heat stroke and electrolyte disorders (Leksana, 2015). Therefore, coaches need to take environmental factors into account when designing training sessions, especially for outdoor sports such as triathlon.

A study conducted by (Mujib & Pramono, 2020), on 12 East Java Puslatda pencak silat athletes showed that as many as 42% of athletes were in the moderate dehydration category based on urine color analysis. This study provides an illustration that dehydration is a real problem among athletes, even in sports that are not as complex as triathlon. To date, limited research has focused specifically on the hydration status of triathlon athletes, particularly in the context of national-level training for major competitions such as the SEA Games. This study is among the first in Indonesia to integrate both body composition analysis and urine-based hydration assessment in elite triathletes preparing for international events, thereby providing novel empirical data for tailored hydration strategies in endurance sports.

Triathlon has a much more complex physiological burden because it combines three sports with long running times. With training and competition durations reaching more than an hour without a break, triathlon athletes are at greater risk of dehydration. Therefore, there needs to be more in-depth research on the hydration status of triathlon athletes, especially those who are members of the national training as part of the preparation for the 2025 SEA Games.

Based on this background, this study aims to examine the hydration status of triathlon athletes in the 2025 SEA Games national training.

METHOD

This study used a quantitative descriptive method with a cross-sectional design. This approach aims to describe the hydration status of triathlon athletes in the 2025 SEA Games national training camp at a certain time objectively and systematically (Zhou & Creswell, 2012). The subjects in this study were triathlon athletes who were members of the national training camp, with sampling using a purposive sampling technique based on certain criteria: registered as triathlon athletes, undergoing SEA Games preparation, and having a personal best under 1 hour 10 minutes.

The sample consisted of 10 active athletes, including five men and five women, all of whom were willing to participate in the research procedures. The study was conducted on June 14, 2025, at the Indonesian national triathlon training center, located on Jalan Pajajaran No. 37, Bandung City. The main instrument used was the Omron Karada Scan, which measured body weight, body mass index (BMI), and body fat percentage of the athletes before and after the training session (Oyaert & Delanghe, 2019). Urine test strips were employed to analyze the chemical composition of urineincluding glucose, protein, and pH levels as well as urine color, which served as an indicator of hydration status. These strips had previously been validated for accuracy and reliability by Oyaert & Delanghe (2019). Additionally, a urine color chart was used as a visual tool to assess hydration levels based on urine color, as applied in the research conducted by (Mujib & Pramono, 2020), on martial arts athletes.

The data collection procedure was carried out before and after the time trial session. Athletes underwent initial anthropometric measurements, then completed simulation exercises, followed by re-measurements and urine sampling. Maximum heart rate data were collected via each athlete's smartwatch. All data were then analyzed descriptively using SPSS version 24 software to see the athlete's hydration status after physical activity (Fadluloh et al., 2024).

RESULTS AND DISCUSSION

Ten Indonesian triathlon athletes, five men and five women, aged between 16 and 26, were monitored during their time trial participation. The following are the results:

Figure 1. Showed that (BZ) had an average HR of 166 BPM with a maximum HR of 182 BPM, while athlete (AP) recorded an average HR of 173 BPM and a maximum HR of 204 BPM. Both data were obtained using the same smartwatch device.

These differences in heart rate values may reflect each athlete's physiological response. Higher heart rates in AP athletes may indicate greater work intensity or differences in individual fitness and hydration status.

Figure 1. The HR measurement results

Figure 2. Showed that (KK) had an average HR of 161 BPM with a maximum HR of 186 BPM, while athlete (RZ) recorded an average HR of 156 BPM and a maximum HR of 180 BPM. Both data were obtained using the same smartwatch device.

Figure 2. The HR measurement results

Figure 3. Showed that (MZ) had an average HR of 140 BPM with a maximum HR of 172 BPM, while the (WT) athlete recorded an average HR of 154 BPM and a maximum HR of 180 BPM. Both data were obtained using the same smartwatch.

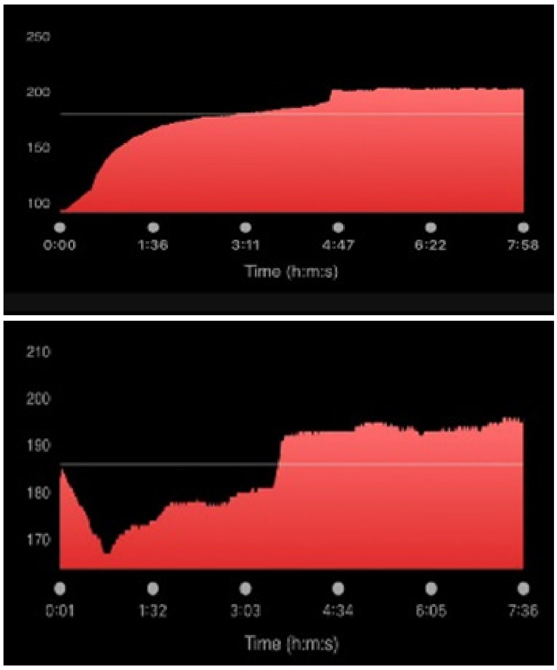

Figure 3. The HR measurements

Figure 4. Showed that (KN) had an average HR of 186 BPM with a maximum HR of 196 BPM, while athlete (JP) recorded an average HR of 180 BPM and a maximum HR of 204 BPM. Both data were obtained using the same smartwatch.

Figure 4. The HR measurements

Figure 5. Showed that (DN) had an average HR of 174 BPM with a maximum HR reaching 193 BPM.

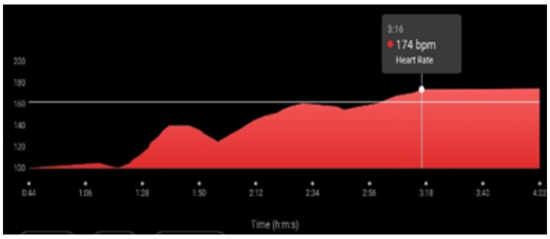

Figure 5. The results of HR measurements

Figure 6. Show that (MA) has an average HR of 166 BPM with a maximum HR reaching 190 BPM.

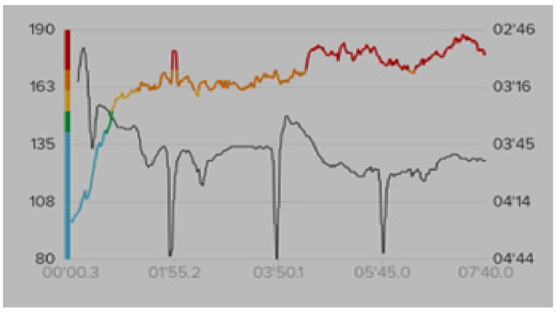

Figure 6. The results of HR Measurements

Table 1. Heart Rate data

Name	Average HR (BPM)	MaxHR (BPM)
KN	186	196
BZ	166	181
KK	161	186
JP	180	204
MA	166	190
MZ	172	140
AP	173	204
WT	154	180
RZ	156	180
DN	176	193

The measurements revealed that the athlete with the highest average heart rate was KN, at 186 BPM, while the lowest was found in the WT athlete with 154 BPM. Overall, the average heart rate for the athletes was 169 BPM.

Meanwhile, for maximum heart rate, the highest values were achieved by JP and AP, each recording 204 bpm. Conversely, the lowest value was recorded by MZ, with 140 bpm. The average maximum heart rate for all athletes was 185 bpm.

An analysis of 10 triathletes showed that their average heart rate (HR) ranged from 154–186 bpm, with a mean of 169 bpm. Meanwhile, their maximum heart rate was recorded between 140–204 bpm, with an average of 185 bpm.

Referring to the results of the Shapiro-Wilk normality test, which was used due to the relatively small sample size in this study (n = 10), all variables height, weight, body mass index (BMI), and body fat percentage showed significance values above 0.05. This indicates that the data are normally distributed, so further analysis can use a parametric approach that conforms to the assumption of a normal distribution.

Table 2. Heart Rate data

name	Height (cm)	weight	weight	Body mass index (1)	Body mass index (2)	Fat percentage(%)	Fat percentage(%)	Hydration status	information
KN	155	48	47,5	19,9	19,8	21,5	20,6	light	hydrated
BZ	165	52,8	52	19,3	19,1	21,4	21,2	dark yellow	Mild dehydration
KK	155	47	46,2	18,9	18,7	27,8	27,3	yellow	normal
JP	162	49,7	49,1	19,2	19	21,2	20,9	dark yellow	Mild dehydration
MA	150	52,6	52	23,4	23,2	26.4	25	dark yellow	Mild dehydration
MZ	167	64,4	64	23,2	22,9	14	13,5	dark yellow	Mild dehydration
AP	172	61,9	62,1	20,9	21,1	16,1	15,9	light	hydrated
WT	170	60,9	60,5	22,1	21,9	17,1	16,9	yellow	normal
RZ	175	69,3	68,8	22,6	22,5	13,6	13,6	dark yellow	Mild dehydration
DN	169	51	50,2	18	17,9	11,4	11,2	yellow	normal

Displays the results of the athlete's anthropometry before and after the simulation and shows the urine color and hydration status as seen using a urine color chart.

The data presented includes the results of anthropometric measurements of athletes, both before and after the time trial, to determine changes in body composition due to intensive physical activity. Furthermore, the data also includes observations of each athlete's urine color after the time trial, which is then analyzed using a urine color chart as a visual assessment tool to determine hydration status. This method can determine whether an athlete is hydrated, mildly dehydrated, or in a normal hydration state based on the color of the urine.

The study aimed to analyze the hydration status of triathlon athletes participating in the national training for the 2025 SEA Games. First, heart rate (HR) data obtained from ten triathlon athletes showed significant variations in both average and maximum HR. The average HR ranged from 154 to 186 BPM, while the maximum HR ranged from 140 to 204 BPM. The overall average HR value was 169 BPM, with an average maximum HR reaching 185 BPM.

The athlete with the highest average HR (KN) was 186 BPM and a maximum HR of 196 BPM, while the athletes with the highest maximum HR were (JP) and (AP), both of whom recorded a maximum HR of up to 204 BPM. Conversely, athlete (MZ) recorded the lowest maximum HR of 140 BPM despite a relatively high average of 172 BPM. This difference is likely due to individual physiological responses to the intensity of the time trial and the body's ability to make cardiovascular adaptations during the time trial session.

Increased heart rate during exercise is related to changes in hydration status and body composition. Lack of fluids causes dehydration, decreases blood plasma volume, and forces the cardiovascular system to work harder to maintain circulation, which is indicated by an increased heart rate as a physiological response (Kiran & Medabala, 2025a). One of the interesting things about the results of this study was seen in the athlete (JP). The average and maximum heart rates indicated that his heart was working very hard during the activity. Although the loss of weight, fat, and body mass index (JP) was not significant, the color of his urine indicated mild dehydration. This means that JP's body was likely dehydrated even though his performance appeared quite good. This condition serves as a reminder that fluid intake is crucial, because even if performance appears optimal, lack of hydration can impact recovery and long-term health.

The data above shows that the athletes' weight measurements were taken using an Omron Karada Scan device. The same device was also used to measure body fat percentage and Body Mass Index (BMI). To determine hydration status, each athlete was given a special tube to collect a urine sample after completing the time trial. After the tube was filled with their urine, the urine color was observed and compared to a urine color chart to assess their hydration levels.

Based on the measurements, it was found that 9 out of 10 athletes experienced weight loss, averaging 0.8 to 0.9 kg. This weight loss was also accompanied by a decrease in Body Mass Index (BMI) and body fat percentage, indicating changes in body composition following the activity.

Overall, two athletes demonstrated good hydration status, one of whom was identified as (KN). KN's urine color was relatively light, indicating that he was adequately hydrated during the time trial. Furthermore, his weight loss during the activity was within reasonable limits, preventing excessive fluid loss. KN's heart rate remained stable, indicating that good hydration plays a crucial role in maintaining the body's physiological response during exercise. This demonstrates how KN was able to maintain his physical condition throughout the activity (Kiran & Medabala, 2025b; Sawka et al., 2015).

Interestingly, based on the analysis, the research subjects (AP athletes) showed a weight gain of 0.3 kg. Despite this weight gain, their body fat percentage actually decreased. This is supported by observations of the light or clear color of their urine samples, indicating good hydration status. Therefore, it can be concluded that the athletes consumed adequate fluids during the simulation (Casa et al., 2019).

The weather during the time trial was 25 degrees Celsius, as it was held at 9:00 a.m. Many athletes experienced mild dehydration, as indicated by the color of their urine. Fifty percent of the population experienced this, 30% were fairly normal, and 20% were quite hydrated (Cheuvront & Sawka, 2015).

This study is expected to provide a contribution in the form of empirical data that is useful in developing the right hydration strategy, both from the coach's side and the athlete's side. Through this approach, it is expected that athlete performance can be maximized and health risks due to dehydration can be minimized.

CONCLUSION

Based on the results of research on the analysis of the hydration status of triathlon athletes in the National Training Center for the 2025 SEA Games, it can be concluded that the athletes' hydration status experienced significant changes after participating in the time trial. The measurement results showed that most athletes (90%) experienced an average weight loss of 0.8 to 0.9 kg, which was accompanied by a decrease in Body Mass Index (BMI) and body fat percentage. This indicates a reduction in body fluids during intensive physical activity. Evaluation of hydration status based on urine color showed that 50% of athletes experienced mild dehydration, indicated by dark yellow urine color, 30% of athletes were in a normal hydration state, and only 20% of athletes were in a well-hydrated state. These findings confirm that the hydration strategy implemented before and during training was not optimal for most athletes.

In particular, the case of one athlete (AP) showed an increase in body weight accompanied by a decrease in body fat, as well as light urine color, which indicates good hydration status. This shows that adequate rehydration during exercise can maintain hydration status and minimize body fluid loss, even supporting improved body composition. From this case, monitoring hydration status regularly and periodically and making appropriate rehydration strategies are very important to maintain performance and prevent the risk of dehydration during intensive training, especially in sports such as triathlons that involve long match durations and high intensity. Coaches and athletes are expected to increase attention to body fluid management, including making individual adjustments based on each athlete's body response.

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