Journal of **S**ports for **A**ll and **R**ecreation
Herkes için Spor ve Rekreasyon Dergisi

2024, 6(1)
Araştırma Makalesi / Research Article

e-ISSN: 2687-6027

Analysis of Long-Term Hydration Levels in Elite Football Players

Elit Futbolcuların Uzun Vadeli Hidrasyon Düzeylerinin Analizi

***Emre Altundağ[1], Mestan Hüseyin Çilekçi[2], Mert Kayhan[3]**

[1] Kütahya Dumlupınar Üniversitesi, Spor Bilimleri Fakültesi, emre.altundag@dpu.edu.tr, 0000-0002-7010-5065
[2] İstanbul Aydın Üniversitesi, Beslenme ve Diyetetik Bölümü, mestancilekci@gmail.com, 0000-0001-6593-0311
[3] Kütahya Dumlupınar Üniversitesi, Spor Bilimleri Fakültesi, mert.kayhan@dpu.edu.tr, 0000-0001-5850-3872

ABSTRACT

The aim of this study was to determine the hydration levels of 21 football players in a football team competing in the Turkish Super League before 34 official competitions in the 2022 - 2023 season. The sample group was selected by cluster sampling. The players were divided into 6 groups according to their positions. In addition, soccer matches were divided into home and away matches. Urine samples were collected immediately after waking up in the morning on an empty stomach. The densities of the collected urine were determined by refractometer (Loyka Atc 0-50 Brix Meter). In addition, Urine Color Chart was used to determine the hydration status of football players according to urine color. Normality tests were applied to check whether the data were normally distributed. Skewness and kurtosis values within the range of +2 to -2 were considered acceptable. Independent samples t test was used for comparison of independent variables, one-way anova was used for comparison of 3 or more variables and descriptive analysis was used for determination of mean and standard deviation. The mean number of matches of football players was 17.85±10.217 matches, mean urine density was 1012.61±4.601 g/ml and mean urine color was 3.05±0.94 point. There was no statistically significant difference between USG and UCL values according to the positions of the soccer players. In addition, there was no statistically significant difference between the USG and UCL values between home and away. The fact that the fluid status was hydrated for 34 weeks, there was no variability between the positions, and it was not affected by home and away situations may be that the soccer players were aware of the effects of hydration on their performance and were trained on this issue. Similarities in the facilities and equipment offered by the clubs to prepare for training and competitions under equal conditions may affect this situation. Clubs may use specific protocols and programs to monitor athletes' hydration levels and intervene if necessary.

Keywords: Dehydration, Hydration, Football.

ÖZET

Bu araştırmanın amacı, 2022 – 2023 sezonunda Türkiye Süper Ligi'nde mücadele eden bir futbol takımının 34 resmi müsabakası öncesinde, takımda yer alan 21 erkek profesyonel futbolcunun hidrasyon seviyelerini tespit etmektir. Örneklem grubu küme örnekleme yöntemi ile seçilerek belirlenmiştir. Oyuncular mevkilerine göre 6 gruba ayrılmıştır. Ayrıca futbol karşılaşmaları iç saha ve deplasman olarak da ayrılmıştır. İdrar örnekleri sabah uyandıktan hemen sonra aç karna olacak şekilde toplanmıştır. Toplanan idrarların refraktometre (Loyka Atc 0-50 Brix Ölçer) ile dansiteleri tespit edilmiştir. Ayrıca idrar rengine göre futbolcuların hidrasyon durumlarının tespit edilebilmesi için Urine Colour Chart kullanılmıştır. Verilerin normal dağılıp dağılmadığını kontrol etmek için normallik testleri uygulanmıştır. +2 ila -2 aralığındaki çarpıklık ve basıklık değerleri kabul edilebilir olarak kabul edilmiştir. Bağımsız değişkenin karşılaştırılması için independent samples t test, 3 ve üzeri değişkenin karşılaştırılması için one way anova ve ortalama ve standart sapma tespiti için de descriptive analiz kullanılmıştır. Futbolcuların maç sayıları ortalama 17,85±10.217 maç, idrar dansite ortalamaları 1012,61±4,601 g/ml ve urine colour ortalamaları ise 3,05±0,94 puan olarak tespit edilmiştir. Futbolcuların mevkilerine göre USG ve UCL değerleri arasında istatistiksel açıdan herhangi bir fark tespit edilmemiştir. Ek olarak futbolcuların iç saha ve deplasman değerleri arasında USG ve UCL istatistiksel açıdan herhangi bir fark tespit edilmemiştir. Sıvı durumlarının 34 hafta boyunca hidrate olması, mevkiler arasında değişkenlik olmaması ve iç saha deplasman durumlarından etkilenmemesi futbolcuların hidrasyonun performansları üzerinde etkilerini bilerek ve bu konuda eğitim alarak hareket ediyor olabilir. Eşit koşullarda antrenman ve müsabakalara hazırlanmaları için kulüplerin sunduğu tesis ve ekipmanlardaki benzerlikler bu durumu etkileyebilir. Kulüpler sporcuların hidrasyon seviyelerini izlemek ve gerekirse müdahalede bulunmak için belirli protokoller ve programlar kullanabilir.

Anahtar Kelimeler: Dehidrasyon, Hidrasyon, Futbol.

Citation: *Altundağ, E., Çilekçi, M.H. & Kayhan, M. (2024). Analysis of Long-Term Hydration Levels in Elite Football Players, Herkes için Spor ve Rekreasyon Dergisi , 6 (1), 81-85.*

Gönderme Tarihi/Received Date: 14.02.2024

Kabul Tarihi/Accepted Date: 28.03.2024

Yayımlanma Tarihi/Published Online: 30.03.2024

https://doi.org/10.56639/jsar.1437077

** Corresponding author:*
emre.altundag@dpu.edu.tr

INTRODUCTION

Football is an exciting sport that millions of people worldwide are passionate about, where competition and strategy come together (Yapici et al., 2016; Avcı & Kılınçarslan, 2023). In elite football matches, there has been an increase in physical performance in recent years. Nowadays, football involves more passing, ball possession, and off-the-ball running compared to the past, leading to a significant increase in the tempo of matches collectively. The number of competitive matches per season for elite clubs, often around 60, has also increased. Periods of fixture congestion in elite football (i.e., playing 1-3 matches per week) are common, and they can become even more complex due to travel issues during European/World competitions and/or national team matches, resulting in increased fatigue for players (Oliveira et al., 2017).

For athletes to perform dynamically and successfully in intensive match tempos, it is critical for players to be hydrated not only with skill and physical endurance but also with proper hydration. The link between football and hydration is an important factor affecting players' performance and health (Köse et al., 2021). The body loses water through sweating, and if this loss is not replenished by fluid intake, dehydration (body water deficit) occurs (Nuccio et al., 2017). The rate of sweat loss is directly related to exercise intensity, i.e., metabolic heat production (Baker et al., 2016). Team sports characterized by prolonged (30-120 minutes), intermittent, and high-intensity exercises can lead to high sweating and, consequently, water loss (Gagnon et al., 2013). Dehydration in football significantly increases heart rate, perceived exertion, blood lactate levels, and body temperature. Furthermore, dehydration is reported to cause a significant decrease in aerobic performance, dribbling skills, sprint performance, and cognitive abilities related to performance (Chapelle et al., 2020).

While fluid intake during training and competition is essential, the hydration status of athletes between matches (Bayrakdar & Zorba, 2020), maintaining fluid intake between training sessions, and hydration on match days are of critical importance. Ensuring adequate

hydration at the beginning of training and matches, for example, having a Urine Specific Gravity value of ≤ 1.020 g/ml before exercise, is a clearly recommended hydration target for athletes (Dean et al., 2023).

In this study, it was aimed to determine the hydration status of athletes before the competition. In addition, the hydration status of the athletes was analyzed according to their positions and according to the matches played at home and away. Determining athletes' hydration levels before competition can help them optimize their performance and reduce the risk of injury. Therefore, it is considered important for athletes to adopt good hydration habits and monitor their hydration levels before competition. The data of the study can be used as a basis in the literature to develop research, training methods and strategies to improve the performance of professional soccer players.

METHODS

Research Model: This research was conducted on the players of a professional football team competing in the Turkish Football Federation Super League. The sample group was selected using cluster sampling method for the 2022-2023 football season.

Participants: The study covers 34 matches. Data were collected from 21 male professional soccer players before each match. The players' age mean was 28.46±4,255 years, height mean was 180.21±6.396 cm and weight mean was 72.92±7.096 kg. The players were divided into 6 groups according to their positions: goalkeeper, center defender, wide defender center midfielder, winger, and striker. Additionally, football matches were categorized as home and away games.

Data Collection Tools: To determine the hydration levels of the athletes, they were asked to collect their urine in a sterile urine container before the matches. Urine samples were collected immediately after waking up in the morning on an empty stomach. The densities of the collected urine samples were determined using a refractometer (Loyka Atc 0-50 Brix Meter). Urine density above 1020 g/ml indicates mild dehydration, while exceeding 1025 g/ml indicates moderate to severe dehydration (Popowski et al., 2001). Additionally, the Urine Colour Chart was used to determine the hydration status of the footballers based on urine color. Samples with a color rating of 4 or higher were considered indicative of dehydration (Casa et al., 2000).

Statistical analysis: In our study, the statistical analysis of the findings was conducted using the Statistical Package for the Social Sciences (SPSS) 23, developed by International Business Machines (IBM). Normality tests were applied to check whether the data were normally distributed. Skewness and kurtosis values within the range of +2 to -2 were considered acceptable (George & Mallery, 2016). The arithmetic means and standard error values of the parameters were calculated. It was found that the data were normally distributed. Independent samples t-test was used for comparing two independent variables, one-way ANOVA was used for comparing three or more variables, and descriptive analysis was used to determine the mean and standard deviation. Microsoft Excel 2016 was used for generating graphs. The significance level was taken as .05.

Ethical principles of the study: The study was conducted in accordance with the Declaration of Helsinki. Before the study began, the players signed informed consent to participate in this study, which was approved by the Kütahya Dumlupinar University Review Board (Approval Number: 2023 − 256).

RESULTS

The descriptive statistics of the data collected from the football players participating in this study are presented in Table 1.

Table 1. Descriptive statistics of number of matches and urine samples of soccer players

	N	Minimum	Maximum	Mean	Standard Deviation
Number of Matches		1	34	17,85	10,217
Urine Density	714	1004	1022	1012,61	4,601
Urine Colour Chart		1	5	3,05	,940

In Table 1, the mean number of matches of football players was 17.85±10.217 matches, the mean urine density was 1012.61±4.601 g/ml and the mean urine color was 3.05±0.94. Urine density and color data of the football players indicate hydration status.

Figure 1 Urine specific gravity means in weeks

According to Figure 1, all the 34-week urine results were below the dehydration limit of 1020 g/ml. Above 1020 g/ml is indicated in red as dehydration area.

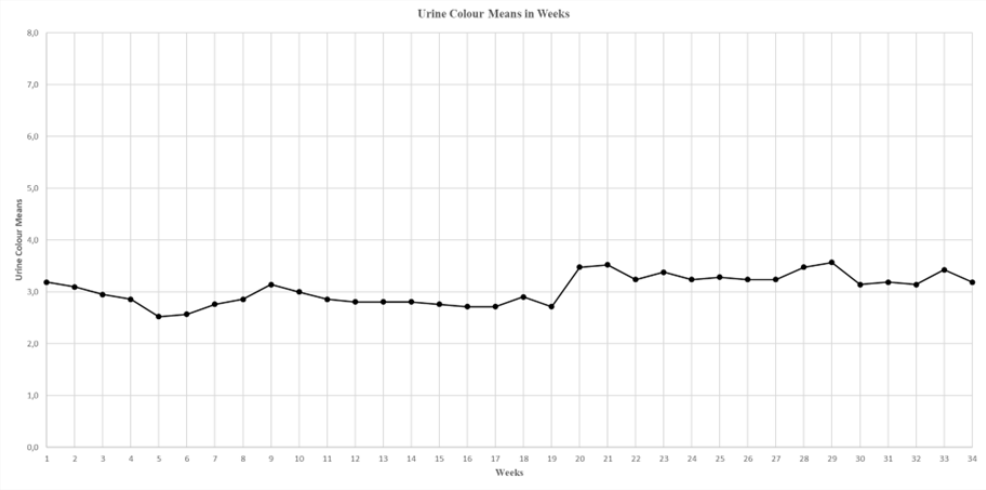

Figure 2 Urine colour means in weeks

When Figure 2 is examined, it is seen that the urine samples of the football players are at the hydration level according to the urine color chart. According to the urine color chart, all the data are below level 4.

Table 2. Urine Specific Gravity at Positions

	Positions	**N**	$\overline{X}$	**SS**	**F**	**p**
Urine Specific Gravity	Goalkeeper	68	1013.29	4.798	.890	.487
	Center defender	110	1012.88	4.304		
	Wide defender	120	1012.85	4.722		
	Center Midfielder	157	1012.27	4.641		
	Winger	123	1012.15	4.626		
	Striker	136	1012.15	4.565		
	Total	**714**	**1012.61**	**4.601**		

**p<0,05*

Table 2 presents the comparison of football players' urine specific gravity (USG) values according to their positions. According to the one-way ANOVA analysis conducted, no statistically significant difference was found among the USG values of football players based on their positions (F (5–714) = ,890; p>0.05).

Table 3. Urine Colour at Positions

	Position	**N**	$\overline{X}$	**SS**	**F**	**p**
Urine Colour	Goalkeeper	68	3.13	.991	.550	.739
	Center defender	110	2.97	.893		
	Wide defender	120	3.03	.948		
	Center Midfielder	157	3.02	.930		
	Winger	123	3.06	.926		
	Striker	136	3.13	.975		
	Total	**714**	**13.05**	**.940**		

**p<0,05*

Table 3 shows the comparison of urine color values of soccer players according to their positions. According to the one-way anova analysis, there was no statistical difference between the UCL values of the soccer players according to their positions (F (5-714) = ,550; p>0.05).

Table 4. Urine Home-Away Comparison

	Game	**N**	**X**	**Ss**	**t**	**p**
Urine Specific Gravity	Home	378	1012,80	4,538	1,193	,233
	Away	336	1012,39	4,668		
Urine Colour	Home	378	3,05	,948	-,009	,993
	Away	336	3,05	,932		

Table 4 shows the comparison of USG and urine color values of soccer players according to home and away variables. According to the independent samples t test analysis, there was no statistical difference between the USG (t (1,193) = ,233; p>0.05). and UCL (t (-.009) = ,993; p>0.05). No statistically significant difference was detected.

DISCUSSION AND CONCLUSION

Football is a sport that requires special attention to hydration because athletes cannot regularly consume fluids during matches. Therefore, the hydration status of athletes before matches is crucial (Soares Fernandes, 2020). The aim of this study is to determine the hydration levels of 21 football players from a team competing in the Turkish Super League in the 2022-2023 season, prior to 34 official matches.

In our research, the mean urine density of the football players was found to be 1012.61±4.601 g/ml, and the mean urine color scale value was 3.05±0.94. Urine density above 1020 g/ml indicates mild dehydration, while exceeding 1025 g/ml indicates moderate to severe dehydration (Armstrong et al., 2009). Our findings indicate that the football players had good hydration levels. Additionally, when examining urine densities according to the players' positions, no statistically significant difference was found among positions. This suggests that the hydration levels of football players are similar regardless of their positions. Similarly, no statistical difference was found in urine color values among positions. Finally, analyses based on whether matches were home or away showed that hydration status was not affected by these variables.

In the existing literature, there is a lack of research specifically focusing on long-term assessment of athletes' fluid status. However, there are studies that have investigated short-term fluid status. Köse et al. (2021) examined the body composition, nutrition, and hydration status of football players in different leagues throughout the season. They found that the average urine specific gravity of Super League players was 1021.1±2.15 g/ml, for Second League players it was 1024.4±3.57 g/ml, and for Third League players it was 1024.6±5.21 g/ml (p<0.05) (Köse et al., 2021), indicating mild dehydration among the players.

Gordon et al. (2015) reported the urine specific gravity of football players aged 14-17 as 1023±0.005 g/ml (Gordon et al., 2015). In a study conducted on 16 football players before training, Güvenç (2011) found the urine specific gravity to be 1019.4±4.8 g/ml (Güvenç, 2011). Stella et al. (2009) investigated the pre-training hydration status of national university athletes, with 138 male and 125 female athletes participating in the study. The research found that 13% of the athletes were significantly hypohydrated with a mean urine specific gravity of 1.031±0.002 g/ml, 53% were hypohydrated with a mean urine specific gravity of 1.024±0.003 g/ml, and 34% were euhydrated with a mean urine specific gravity of 1.012±0.005 g/ml (Volpe et al., 2009). In another research report that during a football match played in warm (34.3 ± 0.6 °C), humid (64 ± 2% rh) conditions, 22 male players hydration status was 1.012 ± 0.006 g/ml before match (Kurdak et al., 2010). Moreover, in another study, 17 male players between stadium arrival and game end (3h), playing at 34.9°C and 35.4% relative humidity, for an average heat stress index of 31.9°C. Initial urine specific gravity was 1.018 ± 0.008 g/ml (Aragón-Vargas et al., 2005). In our study, it is thought that the continuous monitoring of fluid intake of professional soccer players by themselves and dietitians caused the athletes to be hydrated.

Dehydration of 2% or more of euhydrated body mass can negatively impact physical performance. Exercise performance is impaired when an athletes is dehydrated by as little as 2% of body weight. Losses more than 5% of body weight can decrease the capacity for work by about 30% (Nuccio et al., 2017). Determining the hydration status is effective in maintaining the athlete's euhydration and protecting them from dehydration. Dehydration is one of the main factors that impair an athlete's aerobic performance (Gordon et al., 2015). Football; It is a team sport that involves physical contact through repetitive high-intensity sprints, jogging and walking (Tumilty, 1993). Within the scope of this information, it seems very important to frequently control the hydration levels of football players in order to keep both training and match performance at optimum levels.

Football players may act knowingly and with training regarding the effects of hydration on their performances, aiming to maintain hydration over the course of 34 weeks, minimize variability between positions, and remain unaffected by home and away game situations. Similarities in facilities and equipment provided by clubs for training and matches under equal conditions may influence this approach. Clubs may employ specific protocols and programs to monitor players' hydration levels and intervene if necessary, contributing to maintaining similar hydration levels among players. Additionally, personalized training and nutrition plans may help balance individual differences among players, thereby preventing significant differences in hydration levels based on positions. This research would be limited to one football league season and one football team.

References

Aragón-Vargas, Luis & Solera, A. & Barrenechea, A. & Monge, M. (2005). Thermoregulation and Fluid Balance During Professional Soccer Competition in The Heat. Medicine and Science in Sports and Exercise, *Med Sci Sport Exercise*. 37. 29. 10.1097/00005768-200505001-00167.

Armstrong, L. E., Maresh, C. M., Castellani, J. W., Bergeron, M. F., Kenefick, R. W., LaGasse, K. E., & Riebe, D. (1994). Urinary indices of hydration status. *International Journal of Sport Nutrition and Exercise Metabolism*, *4*(3), 265-279.

Avcı, P., & Kılınçarslan, G. (2023). The Excitement of Football Kicks off in Qatar: A Sample of Twitter Data Analysis. *The Online Journal of Recreation and Sports*, *12*(4), 678-686.

Bayrakdar, A., & Zorba, E. (2020). *Egzersiz ve Beslenme*, 1.Baskı, Akademisyen Kitabevi.

Baker, L. B., Barnes, K. A., Anderson, M. L., Passe, D. H., & Stofan, J. R. (2016). Normative data for regional sweat sodium concentration and whole-body sweating rate in athletes. *Journal of Sports Sciences*, *34*(4), 358–368. https://doi.org/10.1080/02640414.2015.1055291

Casa, D. J., Armstrong, L. E., Hillman, S. K., Montain, S. J., Reiff, R. V, Rich, B. S., & Stone, J. A. (2000). National Athletic Trainers' Association Position Statement: Fluid Replacement for Athletes Volume 35 * Number 2 *. In *Journal of Athletic Training* (Vol. 35, Issue 2). Association, Inc. www.joumalofathletictraining.org

Chapelle, L., Tassignon, B., Rommers, N., Mertens, E., Mullie, P., & Clarys, P. (2020). Pre-exercise hypohydration prevalence in soccer players: A quantitative systematic review. In *European Journal of Sport Science* (Vol. 20, Issue 6, pp. 744–755). Taylor and Francis Ltd. https://doi.org/10.1080/17461391.2019.1669716

Dean, T. M., Knight, S. N., Robinson, M. J., Bowling, L. R., Russell, A. R., O'Neal, E. K., & Davis, B. A. (2023). 24 h Hydration profile of collegiate soccer players training once versus twice per day in the heat. *Physiology and Behavior*, *269*. https://doi.org/10.1016/j.physbeh.2023.114273

Gagnon, D., Jay, O., & Kenny, G. P. (2013). The evaporative requirement for heat balance determines whole-body sweat rate during exercise under conditions permitting full evaporation. *Journal of Physiology*, *591*(11), 2925–2935. https://doi.org/10.1113/jphysiol.2012.248823

George, D., & Mallery, P. (2016). *IBM SPSS Statistics 23 Step by Step*. Routledge. https://doi.org/10.4324/9781315545899

Gordon, R. E., Kassier, S. M., & Biggs, C. (2015). Hydration status and fluid intake of urban, underprivileged South African male adolescent soccer players during training. *Journal of the International Society of Sports Nutrition*, *12*(1). https://doi.org/10.1186/s12970-015-0080-0

Güvenç, A. (2011). Effects of ramadan fasting on body composition, aerobic performance and lactate, heart rate and perceptual responses in young soccer players. *Journal of Human Kinetics*, *29*(1), 79–91. https://doi.org/10.2478/v10078-011-0042-9

Köse, B., Kızıltan, G., & Turnagöl, H. (2021). Farklı Liglerdeki Futbolcuların Vücut Kompozisyonu, Beslenme ve Hidrasyon Durumlarının Sezon İçi Dönemde Değerlendirilmesi. *Spor Bilimleri Dergisi*, *32*(4), 183–196. https://doi.org/10.17644/sbd.817101

Kurdak SS, Shirreffs SM, Maughan RJ, Ozgünen KT, Zeren C, Korkmaz S, Yazici Z, Ersöz G, Binnet MS, Dvorak J. Hydration and sweating responses to hot-weather football competition. Scand J Med Sci Sports. 2010 Oct;20 Suppl 3:133-9. doi: 10.1111/j.1600-0838.2010.01218.x. PMID: 21029200.

Nuccio, R. P., Barnes, K. A., Carter, J. M., & Baker, L. B. (2017). Fluid Balance in Team Sport Athletes and the Effect of Hypohydration on Cognitive, Technical, and Physical Performance. In *Sports Medicine* (Vol. 47, Issue 10, pp. 1951–1982). Springer International Publishing. https://doi.org/10.1007/s40279-017-0738-7

Oliveira, C. C., Ferreira, D., Caetano, C., Granja, D., Pinto, R., Mendes, B., & Sousa, M. (2017). Nutrition and supplementation in soccer. In *Sports* (Vol. 5, Issue 2). MDPI. https://doi.org/10.3390/sports5020028

Popowski, L. A., Oppliger, R. A., Lambert, G. P., Johnson, R. F., Johnson, A. K., & Gisolfi, C. V. (2001). Blood and urinary measures of hydration status during progressive acute dehydration. In *Med. Sci. Sports Exerc* (Vol. 33, Issue 5). http://journals.lww.com/acsm-msse

Soares Fernandes, H. (2020). Hydration Strategies for Elite Soccer Players. *Scholarly Journal of Food and Nutrition*, *3*(4). https://doi.org/10.32474/sjfn.2020.03.000169

Tumilty, D. (1993). Physiological characteristics of elite soccer players. Sports Medicine, 16(2), 80-96

Volpe, S. L., Poule, K. A., & Bland, E. G. (2009). Estimation of Prepractice Hydration Status of National Collegiate Athletic Association Division I Athletes. In *Journal of Athletic Training* (Vol. 44, Issue 6). www.nata.org/jat

Yapici, A., Aydin, E., Çelik, E., & Başkaya, G. (2016). Genç futbolcularda mevkilere göre motorik özelliklerin karşılaştırılması. *Sportif Bakış: Spor ve Eğitim Bilimleri Dergisi*, *3*(1), 49-60.