Original Article
ISSN (Online): 2582-7472

ShodhKosh: Journal of Visual and Performing Arts
July-December 2022 3(2), 1349–1353

COMPARATIVE ANALYSIS OF WATER CONTENT AND INORGANIC SALT LEVELS IN FEMALE ATHLETES AND NON-ATHLETE FEMALES: IMPLICATIONS FOR HYDRATION AND ELECTROLYTE BALANCE

Naseer Ud Din Waza [1], Naseer Mushtaq Rather [2]

[1] Research Scholar, Department of Physical Education Punjabi University Patiala, India
[2] Research Scholar, Department of Physical Education Punjabi University Patiala, India

Corresponding Author

Naseer Ud Din Waza,
naseerahmd14@gmail.com

DOI
10.29121/shodhkosh.v3.i2.2022.5819

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

Background: Maintaining hydration and balancing electrolytes are crucial for essential physiological functions, including muscle contraction, thermoregulation, and cellular activity. It is well established that physical activity influences body composition, encompassing total body water and mineral content. However, there has been little research that specifically compares hydration-related parameters such as water content and levels of inorganic salts between physically active and inactive female populations. Understanding these alterations can shed light on the physiological advantages of regular physical activity for females.

Objective: The objective of this study was to compare and analyze the water content and inorganic salt between female athletes and non-athletes.

Materials and Methods: A Total of 30 females N=30 were selected, using a convenience sampling technique. The participants were between 20-25 years old. To achieve the purpose of the study masters of physical education students (n=15) from Department of physical education Punjabi University Patiala, Punjab were selected, and the non-athlete female students of pharmacy department and computer science department (n=15) from Punjabi University Patiala Punjab were selected. To achieve the purpose of the study, Body composition analyser GS6.5B Body Building Weight Test System (Version 1.0) was used to measure the water content percentage and inorganic salt percentage of the subjects.

Results: The female athletes exhibited a significantly higher percentage of water content compared to non-athlete females, t-value= 6.81, p=0.0001, indicating a statistically significant difference ($p < 0.05$) and the percentage of inorganic salt content was also significantly higher in female athletes compared to non-athlete, t-value= 2.43, p=0.02, indicating a statistically significant difference ($p < 0.05$).

Conclusion: The present study concludes that female athletes possess significantly higher percentages of total body water and inorganic salt content compared to non-athlete females.

Keywords: Female Athletes, Non-Athlete Females, Body Composition, Water Content, Inorganic Salts, Hydration Status, Electrolyte Balance, Physical Activity

1. INTRODUCTION

Maintaining important physiological functions like nerve conduction, muscular contraction, thermoregulation, and cellular homeostasis depends critically on the balance of water and electrolytes (Metheny, 2012; Montain et al., 2006). Age, sex, degree of physical activity, and general body composition all affect total body water, which is primarily determined by lean body mass (Ritz et al., 2008; Watson et al., 1980). Athlete performance and overall health depend on the balance of electrolytes, especially sodium and potassium, which are essential for osmotic regulation, neuromuscular activity, and metabolic reactions (Epstein & Armstrong, 1999; Campbell, 2009).

It has been demonstrated that regular exercise causes adjustments in mineral balance and fluid management. Due to frequent exposure to fluid changes and sweat loss, athletes usually have higher plasma volume and total body water, which enhances their thermoregulatory effectiveness and endurance ability (Convertino, 2007; Cheuvront & Kenefick, 2014). Athletes' hydration state is further distinguished from that of sedentary populations by the fact that their increased muscle mass results in a higher percentage of intracellular water (Pilis et al., 2019; Keino et al., 2014).

Electrolyte balances are also impacted by physical training, because females may have varied thermoregulatory responses due to hormonal factors, effective salt conservation is necessary to compensate for sweat losses during exercise (Kaciuba-Uscilko & Grucza, 2001; Shirreffs, 1999). According to research, trained people have better fluid-electrolyte homeostasis because they can better retain and use electrolytes during physical exercise (Hamouti et al., 2011; Maughan et al., 2009). Additionally, especially in highly active females, electrolyte status is associated with bone mineralization and musculoskeletal development (Ilich et al., 1998).

Despite the well-established importance of electrolytes and hydration in exercise physiology, there is scarcity of studies that have evaluated the body water content and inorganic salt levels of physically active and inactive females. In order to determine the consequences for hydration status and electrolyte management in the setting of physical activity, the current study intends to measure and compare the percentage of water content and inorganic salt levels in female athletes and non-athletes.

2. MATERIALS AND METHODS

To achieve the objective of the study total 30 females were selected N=30. The age of the participants ranging from 20-25 years were selected using a convenience sampling technique. To achieve the purpose of the study masters of physical education students (n=15) from department of physical education Punjabi University Patiala Punjab were selected and the non-athlete female students of pharmacy department and computer science department (n=15) from Punjabi University Patiala Punjab were selected. All the subjects have been informed about the objective and protocol of the study, and after their consent they voluntarily participated in this study.

Body composition analyser GS6.5B Body Building Weight Test System (Version 1.0) was used to measure the water content percentage and inorganic salt percentage of the subjects. The test was conducted in physiology lab of department of physical education Punjabi university Patiala. The data was carefully recorded and descriptive statistical technique independent t test was employed to analyse the difference between the groups, the level of significance was set at .05.

2.1. OPERATIONAL DEFINITIONS

Athlete females: For the purpose of this study Female athletes are those who engage in regular, structured physical training and participate in competitive sports activities (Pilis et al., 2019).

Non-athlete females: Non-athlete females are defined as females who do not participate in organized sports or regular physical training programs, and their activity is often limited to daily living or recreational activities (Keino et al., 2014).

2.2. NCLUSION AND EXCLUSIVE CRITERIA

This study included female athletes enrolled in the Master of Physical Education program who were actively participating in structured sports training. Non-athlete females were selected from non-sports disciplines and had no history of regular physical training. Participants with any medical condition or on medications affecting hydration or electrolyte levels were excluded from the study.

3. ANALYSIS AND INTERPRETATION

Table 4.1: Comparison of the water content % between female athletes and non-athlete females using an independent samples t-test

Variable	Groups	N	Mean Scores	Standard Deviation	t-value	p-value
(Water Content)	Female athletes	15	56.17	2.20	6.81	0.0001

	Non-athlete females	15	51.74	1.22		

An independent sample t-test was conducted to compare the water content % between the female athletes and non-athlete females. The results revealed that the mean± SD for female athletes=56.17±2.20 and for the non-athlete females=51.74±1.22. The t-value= 6.81, p=0.0001, indicating a statistically significant difference ($p < 0.05$) between the two groups. The female athletes exhibited a significantly higher percentage of water content compared to non-athlete females.

Figure 4.1: Graphical presentation of mean and SD for water content % between female athletes and non-athlete females.

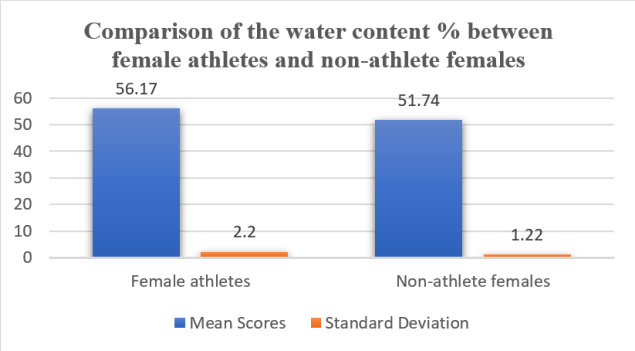
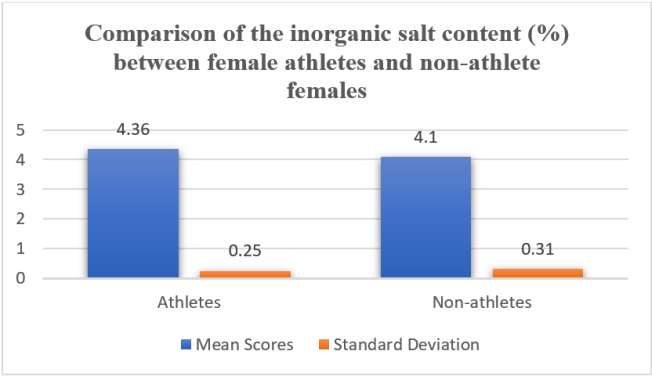


Table 4.2: Shows a comparison of the inorganic salt content (%) between female athletes and non-athlete females using an independent samples t-test

Variable	Groups	N	Mean Scores	Standard Deviation	t-value	p-value
(Inorganic Salt)	Athletes	15	4.36	0.25	2.43	0.02
	Non-athletes	15	4.10	0.31		

Table 4.2 shows the results for comparison of inorganic salt content (%) with mean ± SD for female athletes=4.36±0.25 and for the non-athlete females=4.10±0.31. The t-value= 2.43, p=0.02, indicating a statistically significant difference ($p < 0.05$) between the two groups. The percentage of inorganic salt content was significantly higher in female athletes compared to non-athlete females.

Figure 4.2: Graphical presentation of mean and SD for inorganic salt content (%) between female athletes and non-athlete females.



4. DISCUSSION OF THE FINDINGS

According to the current study, female athletes' body water percentages were noticeably higher than those of female non-athletes. This result is in line with earlier research showing how physical activity affects hydration and body

composition. Ritz et al. (2008) state that lean body mass, which is often higher in athletes because of frequent physical exercise, is directly related to body water distribution. Similarly, Pilis et al. (2019) highlighted that both exercise-induced muscle adaptations and dietary behaviors result in more favorable body composition profiles, including enhanced total body water, in physically active females.

According to Keino et al. (2014), physically active women had higher water turnover and hydration efficiency, supporting the notion that exercise encourages the management of fluid balance. Convertino (2007) further concluded that consistent exercise causes the plasma volume to increase, which improves thermoregulatory responses and encourages greater hydration during exercise. This could help to explain why female athletes in the current study had noticeably higher water content.

The study also found that female athletes had significantly greater levels of inorganic salt than female non-athletes. This is explained by training-induced increases in bone mineral density, mineral absorption, and electrolyte retention. According to Ilich et al. (1998), exercise improves skeletal development and mineral deposition, which benefits females and improve mineral status. According to McKenna (1992) and Allen (2004), inorganic salts, especially sodium, potassium, calcium, and magnesium, are essential for nerve conduction, cellular activity, and muscle contraction.

Athletes tend to develop more effective salt management systems with time, while exercise increases electrolyte losses through sweat (Hamouti et al., 2011). The elevated levels of inorganic salt seen in athletes in the current study were probably caused by this adaptive response. While Maughan et al. (2009) highlighted the significance of mineral balance in well-trained populations, Montain et al. (2006) and Kenefick et al. (2012) provide additional evidence of the impact of training in preserving fluid and electrolyte homeostasis during heat stress and exercise.

Thermoregulatory variations by gender may potentially affect these results. According to Shirreffs (1999) and Kaciuba-Uscilko & Grucza (2001), females are more likely to rely on fluid conservation strategies, which may further improve their electrolyte and hydration profiles when paired with training. These physiological changes support long-term health and metabolic management in addition to performance (Larsen, 2011; Logan-Sprenger et al., 2015). These findings corroborate other studies that highlighted the value of exercise in preserving internal physiological balance and general health (Rehrer, 2001; Cheuvront & Kenefick, 2014).

The study concludes that female athletes have higher percentages of inorganic salt content and total body water than female non-athletes. The findings highlight how crucial exercise is for preserving ideal internal fluid and mineral balance, which is necessary for metabolic and general health as well as athletic performance. To improve electrolyte balance and hydration, women should be encouraged to engage in regular physical activity. For females who are not participating in any sports activity, it is particularly crucial to pay attention to their mineral-rich diets and hydration intake. Future studies may explore related factors like diet and body composition.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCES

Allen, D. G. (2004). Skeletal muscle function: role of ionic changes in fatigue, damage and disease. Clinical and Experimental Pharmacology and Physiology, 31(8), 485–493.

Campbell, I. (2009). Physiology of fluid balance. Anaesthesia & Intensive Care Medicine, 10(12), 593–596. https://doi.org/10.1016/j.mpaic.2009.09.008

Cheuvront, S. N., & Kenefick, R. W. (2014). Dehydration: physiology, assessment, and performance effects. Comprehensive Physiology, 4(1), 257–285.

Convertino, V. A. (2007). Blood volume response to physical activity and inactivity. The American Journal of the Medical Sciences, 334(1), 72–79.

Epstein, Y., & Armstrong, L. E. (1999). Fluid-electrolyte balance during labor and exercise: Concepts and misconceptions. International Journal of Sport Nutrition and Exercise Metabolism, 9(1), 1–12.

Hamouti, N., Del Coso, J., Ortega, J. F., & Mora-Rodriguez, R. (2011). Sweat sodium concentration during exercise in the heat in aerobically trained and untrained humans. European Journal of Applied Physiology, 111(11), 2873–2881.

Ilich, J. Z., Skugor, M., Hangartner, T., Baosh, A., & Matkovic, V. (1998). Relation of nutrition, body composition and physical activity to skeletal development: a cross-sectional study in preadolescent females. Journal of the American College of Nutrition, 17(2), 136–147.

Kaciuba-Uscilko, H., & Grucza, R. (2001). Gender differences in thermoregulation. Current Opinion in Clinical Nutrition & Metabolic Care, 4(6), 533–536.

Keino, S., van den Borne, B., & Plasqui, G. (2014). Body composition, water turnover and physical activity among women in Narok County, Kenya. BMC Public Health, 14(1), 1212.

Larsen, F. (2011). Dietary inorganic nitrate: role in exercise physiology, cardiovascular and metabolic regulation. Karolinska Institutet (Sweden).

Logan-Sprenger, H. M., Heigenhauser, G. J., Jones, G. L., & Spriet, L. L. (2015). The effect of dehydration on muscle metabolism and time trial performance during prolonged cycling in males. Physiological Reports, 3(8), e12483.

Maughan, R. J., Dargavel, L. A., Hares, R., & Shirreffs, S. M. (2009). Water and salt balance of well-trained swimmers in training. International Journal of Sport Nutrition and Exercise Metabolism, 19(6), 598–606.

McKenna, M. J. (1992). The roles of ionic processes in muscular fatigue during intense exercise. Sports Medicine, 13(2), 134–145.

Metheny, N. (2012). Fluid and electrolyte balance (5th ed.). Jones & Bartlett Learning.

Montain, S. J., Cheuvront, S. N., Carter, R., & Sawka, M. N. (2006). Human water and electrolyte balance.

Pilis, K., Stec, K., Pilis, A., Mroczek, A., Michalski, C., & Pilis, W. (2019). Body composition and nutrition of female athletes. Roczniki Państwowego Zakładu Higieny, 70(3).

Rehrer, N. J. (2001). Fluid and electrolyte balance in ultra-endurance sport. Sports Medicine, 31(10), 701–715.

Ritz, P., Berrut, G., Tack, I., Arnaud, M. J., & Tichet, J. (2008). Influence of gender and body composition on hydration and body water spaces. Clinical Nutrition, 27(5), 740–746.

Shirreffs, S. M. (1999). Heat stress, thermoregulation, and fluid balance in women. British journal of sports medicine, 33(4), 225.

Watson, P. E., Watson, I. D., & Batt, R. D. (1980). Total body water volumes for adult males and females estimated from simple anthropometric measurements. The American journal of clinical nutrition, 33(1), 27-39.