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Comparison Of Isotonic Beverage And Mineral Water Consumption On Archery Score And Hydration Status Of Archery UKM Athletes At State University Of Surabaya

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Abstract

Archery is a precision sport that requires high concentration and postural stability, so hydration status may potentially affect athlete performance. This study aimed to compare the effects of isotonic drink and mineral water consumption on archery scores and hydration status, as measured by urine specific gravity (USG), among archery athletes of Universitas Negeri Surabaya. This quasi-experimental study used a crossover design involving 20 active athletes who received both interventions alternately. Fluid was administered at 150 mL every 10 minutes during the training and scoring sessions, with a total volume of 1,050 mL. Archery performance was assessed using the World Archery Federation scoring sheet, while hydration status was measured using USG reagent strips. Data were analyzed using the Wilcoxon Signed Rank Test. Results showed no significant difference in archery scores between mineral water and isotonic drink consumption (p=0.070). Isotonic drink significantly decreased USG (p=0.001), while mineral water did not (p=0.088). However, the change in USG between the two interventions also did not differ significantly (p=0.062). It is concluded that there were no significant differences in archery scores or in hydration status change between mineral water and isotonic drink consumption. Nevertheless, isotonic drink consumption showed a significant decrease in urine specific gravity within its own group.

Keywords: Isotonic Drink, Mineral Water, Archery Score, Urine Specific Gravity, Athlete Hydration.

INTRODUCTION

Archery is a precision sport that requires muscle strength, balance, fine coordination of movements, and high concentration so that enabling arrows to hit the target with precision (Irfandi & Rahmat, 2020). Although it is classified as a light to moderate intensity exercise (3.5 MET) and dominated by isometric contractions in the shoulder, back, and arm muscles (Ainsworth et al., 2000), archery exercises and competitions generally take place for a long duration in outdoor venues. This condition increases the risk of losing body fluids that can interfere with thermoregulation and athlete performance (Kenney et al., 2012; Mora-Rodriguez & Ortega, 2016). Mild dehydration equivalent to 1–2% body mass loss has been shown to decrease concentration, cognitive function, and mood (Ganio et al., 2011) and potentially trigger hand tremors while maintaining arc pull due to metabolic shifts to anaerobic pathways (Barley et al., 2018; Savvides et al., 2020).

Fulfilling fluid needs during training and matches is one of the strategies to maintain the hydration status of athletes. Mineral water and isotonic drinks are two types of liquids that are commonly consumed by athletes, but they have different characteristics. Isotonic drinks contain carbohydrates and electrolytes that can support faster fluid absorption (Chatterjee & Abraham, 2019; Jeukendrup & Gleeson, 2010), while mineral water contains only natural minerals with no added carbohydrates or electrolytes. However, in light to moderate intensity exercise, the physiological advantage of isotonic drinks is not always a significant difference in performance compared to mineral water (Ainsworth et al., 2000; Casa et al., 2000; Demirhan et al., 2015).

Preliminary observations in Archery UKM athletes at the State University of Surabaya showed that most athletes only consumed about 750 mL of fluids during a 2-hour workout and about 1,500-2,000 mL in a match that lasted more than 5 hours. Fluid intake has not met the recommendations by the American College of Sports Medicine (ACSM) which recommends fluid consumption of 150-250 mL every 10-20 minutes during physical activity (Sawka et al., 2007; Maughan & Shirreffs, 2016). On the other hand, research that directly compares the consumption of isotonic drinks and mineral

water in precision sports, particularly archery, is still limited. Therefore, this study aims to compare the effect of isotonic drink consumption and mineral water on archery scores and hydration status in UNESA Archery UKM athletes, as the basis for the preparation of appropriate hydration strategies.

RESEARCH METHODS

Design, Location, and Time of Research

This study is a quasi-experimental study with a crossover design (within-subject design), where each subject receives two treatments alternately, namely the consumption of isotonic drinks and mineral water, so that each subject served as their own control (Rositas et al., 2009). The research was carried out on February 7-8, 2026 at the Marine Fly Navy X10 Archery Field, Surabaya.

Research Subject

The research population is 30 active athletes of the Archery UKM of the State University of Surabaya. Subjects were selected using purposive sampling techniques. A minimum sample count using G-Power 3.1 (effect size d = 0.80; $\alpha = 0.05$; power = 0.80) resulted in the need for a minimum of 12 respondents. Based on the inclusion and exclusion criteria, as many as 20 athletes met the criteria and were all included as research subjects.

Inclusion criteria include athletes in the recurve or standard bow division, aged 18–23 years, training regularly at least three times per week, having participated in regional or national championships in the past year, and willing to participate in all stages of research. Exclusion criteria include athletes experiencing an acute injury or medical impairment, a history of chronic illness or drug consumption that affects fluid balance, and absence from one of the study sessions.

Research Tools and Materials

The research material consists of the isotonic drink Pocari Sweat and Le Minerale mineral water. The research tools include a scoring sheet for assessing archery scores on targets with a diameter of 80 cm with a distance of 30 m, as well as a Verify strip reagent to measure urine specific gravity (USG) in mid-stream urine samples.

Research Procedure

Each subject participated in two research sessions which were held on two consecutive days. In one session the subjects consumed isotonic drinks and in the other sessions consumed mineral water, with the order of treatment determined based on odd and even absence numbers. Both drinks are served in dark-colored paper cups with the same volume to maintain a single blinding condition. Fluids were given as much as 150 mL every 10 minutes from warm-up to the end of the scoring session with a total of 1,050 mL per session according to the recommendations of the American College of Sports Medicine (ACSM).

Urine specific gravity (USG) measurements were carried out before (pre-test) and after (post-test) of each session using mid-stream urine samples. The archery score was measured using a scoring sheet on a target with a diameter of 80 cm with a distance of 30 meters, each subject participated in two scoring sessions which each consisted of six series with six arrows in each series, so that the total arrows for 2 series were 72 arrows with a maximum score of 720 points. The independent variable was the type of drink, while the dependent variables included archery score and hydration status based on USG. Controlled variables included duration and timing of exercise, environmental conditions, fluid intake outside of the intervention, food and caffeine intake, and strenuous physical activity 24 hours prior to the study.

Data Analysis

Data analysis was conducted using IBM SPSS Statistics for Windows version 22. The normality test was carried out using Shapiro–Wilk because the number of subjects < 50 people. All major variables are not normally distributed so that univariate analysis is presented in the form of median, interquartile range (IQR), and minimum–maximum values. Bivariate analysis used the Wilcoxon

Signed-Rank Test with a significance level of $p < 0.05$ to compare archery scores between the two treatments, changes in USG before and after treatment in each condition, and changes in USG between treatments.

RESULTS AND DISCUSSION

This study involved 20 Archery UKM athletes from the State University of Surabaya who met the research criteria. All respondents were active athletes who regularly participated in archery training. Respondents' characteristics include gender, archery division, age, anthropometry, and training activities presented in an integrated manner in Table 1.

Table 1. Respondent Characteristics

Features	Categories / Values	f (%)	$\bar{x}$ ± SD	Min	Max
Gender	Male	8 (40%)			
	Women	12 (60%)			
Archery Division	Recurve	10 (50%)			
	Standard Bow	10 (50%)			
Age (years)	—	—	20,4 ± 0,82	19	22
Body Weight (kg)	—	—	60,9 ± 7,40	51	71
Height (cm)	—	—	163,2 ± 5,75	156	171
IMT (kg/m²)	—	—	22,8 ± 1,72	21,0	26,4
Playing Time (years)	—	—	5,75 ± 2,93	3	12
Frequency of Exercise (times/week)	—	—	3,90 ± 0,64	3	5

Source: Primary data, 2026

Based on Table 1, most of the respondents were female (60%), with a balanced recurve and standard bow division of 10 people each (50%). The average age of the respondents was in the early adult group (20.4 ± 0.82 years) with normal nutritional status based on BMI (22.8 ± 1.72 kg/m²). The average length of time to play archery was 5.75 ± 2.93 years with a frequency of training of 3.90 ± 0.64 times per week, showing that all respondents were classified as experienced athletes with mature basic techniques.

In addition to general characteristics, this study also examined respondents' fluid consumption habits using the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). Fluid consumption patterns for seven days before the intervention are presented in Table 2.

Table 2. Types of Beverages Consumed by Archery UKM Athletes

Types of Drinks	f	%
Water	20	100
Milk	14	70
Tea (home, packaged)	13	65
Coffee (home, packaged)	9	45
Fruit Juice	7	35
Ice Cream	6	30
Fermented Milk Drink (Liquid)	5	25
Chocolate Drinks	5	25

Types of Drinks	f	%
Coconut Water	3	15
Isotonic Beverages	3	15
Spicy Drinks	3	15
Yoghurt Drink (Thick/Semisolid)	2	10
Soy Milk	2	10
Carbonated (hypertonic) drinks	2	10
Fruit Flavored Drink	2	10
Green Bean Juice Drink	1	5
Energy Drinks (Hypertonic)	1	5
Vitamin Isotonic Drink	1	5
Vitamin C Drink	1	5

Source: Primary data, 2026

Based on Table 2, all respondents (100%) consume water as the main source of daily fluids. Other beverage consumption that is quite high include milk (70%) and tea (65%). The consumption of isotonic drinks was relatively low, at 15%, indicating that before the intervention, most respondents were not used to consuming isotonic drinks regularly. The average daily fluid intake of respondents based on SQ-FFQ was 1,917.8 ± 525.8 mL/day (range 1,268–3,225 mL/day), which is still below the 2019 Nutritional Adequacy Rate (AKG) recommendation of 2,350–2,500 mL/day for the age group of 19–29 years, excluding additional needs due to physical activity.

Univariate analysis was conducted to describe the data distribution of each research variables, namely archery scores and hydration status based on urine specific gravity (USG). Results are presented in median, minimum, maximum value, and interquartile range (IQR).

Table 3. Archery Score on Consumption Conditions of Mineral Water and Isotonic Beverages

Variables	Median	Min	Max	IQR
Mineral Water Score	551,5	508	647	19
Isotonic Score	560,5	505	663	26

Source: Primary data, 2026

Based on Table 3, the median archery score in the mineral water consumption condition was 551.5 points (range 508–647 points, IQR = 19), while in the isotonic beverage consumption condition was 560.5 points (range 505–663 points, IQR = 26). Archery scores under isotonic conditions tended to be higher, although variation between respondents in isotonic conditions was greater than in mineral water.

Table 4. Description of Urine Specific Gravity (USG) Based on Treatment Conditions

Variables	Median	Min	Max	IQR
Mineral Water (Pre)	1.025,0	1.010	1.030	9
Mineral Water (Post)	1.020,0	1.010	1.030	5
Isotonic (Pre)	1.025,0	1.015	1.030	10
Isotonic (Post)	1.020,0	1.015	1.025	9
Mineral Water (Δ)	−5	−15	10	5
Isotonic (Δ)	−5	−10	5	9

Source: Primary data, 2026

Based on Table 4, the median USG before treatment in mineral and isotonic water conditions was both 1,025.0 g/dL, indicating relatively equivalent initial hydration conditions. After treatment, the median USG dropped to 1,020.0 g/dL in both conditions. The difference in change (ΔUSG) in the mineral water condition was −5.0 g/dL (IQR = 5), while in the isotonic condition it was −5.0 g/dL (IQR = 9). Although the median value of ΔUSG was the same, the variation in USG changes under isotonic conditions was greater, indicating that hydration responses between individuals were more diverse under isotonic conditions.

Before bivariate analysis, a Shapiro-Wilk normality test was performed because the number of subjects was less than 50 people. The results of the normality test are presented in Table 5.

Table 5. Results of the Research Data Normality Test (Shapiro-Wilk)

Variables	Mineral Water			Isotonic		
	Statistic	df	Sig.	Statistic	df	Sig.
Archery Score	0,865	20	0,010	0,803	20	0,001
USG pre	0,880	20	0,018	0,855	20	0,006
USG post	0,915	20	0,078	0,778	20	0,000
ΔUSG	0,859	20	0,008	0,850	20	0,005

Source: Primary data, 2026

Based on Table 5, almost all variables were not normally distributed ($p < 0.05$), except for USG post mineral water ($p = 0.078$). The data transformation has been carried out using a base logarithm of 10 ($\log_{10}$) still resulting in an abnormal distribution, so that bivariate analysis is performed using the non-parametric Wilcoxon Signed Rank Test.

Table 6. Results of Analysis of Differences in Archery Score and Hydration Status between Mineral Water Treatment and Isotonic Beverages

Variables	Sig. (2-tailed)	Remarks
Archery Score	0,070	Insignificant
USG Pre-Post Mineral Water	0,088	Insignificant
USG Pre-Post Isotonic	0,001	Significant
ΔUSG (Mineral Water vs Isotonic)	0,062	Insignificant

Source: Primary data, 2026

Based on Table 6, there was no significant difference in archery scores between mineral water consumption and isotonic beverages ($p = 0.070$). In mineral water consumption, there was no significant difference between USG before and after treatment ($p = 0.088$), as many as 11 out of 20 athletes experienced a decrease in USG, 7 athletes experienced no change, and 2 athletes experienced an increase in USG. In contrast, in isotonic drink consumption there was a significant difference between USG before and after treatment ($p = 0.001$), with 15 out of 20 athletes experiencing a decrease in USG. Direct comparison of USG changes between the two treatments showed no significant difference ($p = 0.062$).

Difference in Archery Score between Mineral Water Consumption and Isotonic Beverages

There was no significant difference in archery score between mineral water consumption and isotonic beverages ($p = 0.070$). Descriptively, the median score under isotonic conditions (560.5 points) was slightly higher than in mineral water (551.5 points), but the difference was not statistically significant. These results are in line with the research of Nugraha et al. (2016) in SSB Persisac Semarang football athletes who compared mineral water and isotonic drinks during 60–90 minute training and found no significant difference in physiological responses between the two groups ($p > 0.05$). These findings are also consistent with Márton et al. (2025) in 71 young basketball athletes showing that although the isotonic group had higher blood sugar levels and a lighter perceived exercise load, there was no significant difference in aerobic capacity (VO_2max) and cardiorespiratory endurance compared to the mineral water group.

The absence of significant differences in archery scores is closely related to the characteristics of archery sports that rely on concentration, technique stability, and fine motor coordination, rather

than cardiovascular capacity or large muscle strength. Esen et al. (2025) in world-class archery athletes The Turkish National Team found that all athletes were able to maintain sufficient hydration throughout the competition without significant differences between pre- and post-match conditions, indicating that archery does not cause a significant loss of fluids and electrolytes to create a difference between types of drinks. Technical and psychological factors also play a big role Wang et al. (2022) found that psychological factors such as confidence, concentration, and emotion regulation contributed 33.6% to variance in archery performance in Chinese National Team athletes. Considering that all respondents are experienced athletes with an average of 5.75 years of training and a frequency of 3-5 times per week, their technical abilities are relatively stable so that the type of drink consumed is not the dominant factor determining the archery score. Further research with larger sample counts is still needed to confirm these findings.

Difference in Hydration Status between Mineral Water Consumption and Isotonic Beverages

There was no significant difference between USG before and after mineral water consumption ($p = 0.088$). This can be explained by the difference in the composition of the two drinks in the fluid absorption process, mineral water only contains basic minerals without carbohydrates or additional electrolytes so that the absorption rate is slower and does not optimize fluid absorption in the small intestine. Maughan & Shirreffs (2010) affirm that effective rehydration requires adequate sodium levels because sodium plays a role in maintaining body fluid volume and promoting thirst. The median value of the initial USG in mineral water treatment was 1,025.0 g/dL which was included in the category of significant dehydration indicating that most of the respondents were already in a condition of severe dehydration before the intervention, so recovery from a large deficit requires a larger volume and time (Sawka et al., 2007).

In contrast to mineral water, there was a significant difference in USG before and after consumption of isotonic drinks ($p = 0.001$), with median USG decreasing from 1,025.0 g/dL to 1,020.0 g/dL and 15 out of 20 athletes experiencing a decrease in USG. This decrease can be explained by a more efficient fluid absorption mechanism, the sodium and glucose content in isotonic drinks activates the Sodium-Glucose Cotransporter 1 (SGLT1) in the small intestine which accelerates the absorption of fluids into the blood circulation (Maughan & Shirreffs, 2010), and sodium plays a role in suppressing urine production through hormonal mechanisms (Stachenfeld, 2008). These findings are in line with Geraldini et al. (2017) in karate athletes who showed significant differences in pre-post USG was only found in sessions with isotonic drink hydration protocols ($p = 0.047$).

Although isotonic drinks showed significant changes in their own groups, direct comparisons of ΔUSG between the two treatments showed no significant difference ($p = 0.062$). These results are consistent with Samudera & Ashadi (2019) who compared mineral, isotonic, and brown sugar water in 45 college students after running 5000 meters, although each group showed significant changes pre-post, there was no significant difference in hydration status between groups ($p > 0.05$). The insignificance of this direct comparison is likely influenced by several factors, namely the limited sample size ($n = 20$) which limits statistical power, the limited sensitivity of the strip reagent which produces many equal values (ties) thus weakening the strength of the Wilcoxon test. In addition, the median USG before intervention in both conditions was 1.025 g/dL, categorized as significant dehydration. These conditions suggest that rehydration needs may not have been fully met during the 90-minute intervention with a total of 1,050 mL of fluid, thus contributing to the insignificant difference in USG changes between the two treatments. (Shirreffs & Maughan, 2016). Final USG measurements performed immediately after the scoring session without adequate time lag also affected the accuracy of the actual rehydration readings (Oppliger et al., 2005; Capitán-Jiménez & Aragón-Vargas, 2022).

However, qualitatively isotonic drinks showed consistent advantages, with smaller variations in USG changes and no extreme increase in USG as in the mineral water group, indicating that isotonic drinks were more reliable in providing stable rehydration. This is supported by the meta-analysis of Rowlands et al. (2021) of 28 studies that found differences in plasma volume changes between isotonic

(−8.7%) and mineral water (−7.5%) were very small and not always clinically significant. Yusrowatin et al. (2026) also found no significant difference in increased VO_2max between the isotonic group and mineral water (p = 0.081) after a 30-minute run. The characteristics of archery with a MET 3.5 that is classified as moderate intensity (Ainsworth et al., 2000) do not cause massive electrolyte loss, so that mineral water is able to provide a rehydration effect that is relatively equivalent to that of isotonic drinks. This is also supported by Savvides et al. (2020) In 10 national archery athletes who found that archery scores did not differ significantly between normal and dehydrated conditions (p = 0.155), indicating that archery performance was relatively resistant to changes in hydration status within a certain range. Overall, the type of drink does not make a significant difference in the performance and hydration status of archery athletes as long as the volume of fluids consumed is sufficient for the body's needs. Nonetheless, isotonic drinks still have the potential to provide benefits in certain conditions such as when athletes start training in a state of lack of hydration or training lasts longer (Rowlands et al., 2021).

CONCLUSIONS

This study showed that there was no significant difference in archery scores between mineral water consumption and isotonic drinks in Archery UKM athletes at Surabaya State University. Consumption of mineral water showed no significant change in hydration status based on urine specific gravity (USG), whereas consumption of isotonic beverages showed a significant change in hydration status. However, there was no significant difference in hydration status change between the consumption of mineral water and isotonic beverages based on USG.

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