原著

A study to determine the optimal strategy—how to drink and kind of beverage—for appropriate urine sample collection from female athletes undergoing doping tests

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〔Abstract〕 In-competition doping testing can a long time due to dehydration and mental stress of the athletes. In this study, we focused on how to drink and the kind of beverage taken to collect proper urine samples as fast as possible. A comparative intergroup study was performed on female college athletes. Blood and urine samples were examined before and after exercise that caused a 1% decrease in body weight. To evaluate how to drink the beverage for proper sample collection, subjects were divided into groups taking mineral water at amounts of 800mL at once, 400mL twice, and 200mL 4 times, respectively. In the at once group, the time to reach an accumulated urine volume of 90mL was shorter, but more samples had lower urine specific gravity. To evaluate the kind of beverage to drink, subjects were divided into groups taking mineral water, oral rehydration solution, and orange juice, respectively. The entire 800mL of each beverage was consumed at once in all groups. The time to reach an accumulated urine volume of 90mL was similar in the oral rehydration solution and mineral water groups, but the decrease in urine specific gravity was smaller in the oral rehydration solution than the mineral water group. We demonstrated that proper samples can be collected in the shortest period of time by drinking oral rehydration solution at once.

INTRODUCTION

To athletes participating in competitive sports, doping testing is important not only for keeping sports clean and fair but also "for protecting athletes' right to participate in clean sports." Therefore, athletes are obligated to take doping control tests. However, some of the authors, who served as team doctors for the Japanese Olympic delegation, understand that doping testing after matches places a burden on athletes. For example, it takes several hours to complete doping testing; proper cooling down, recovery, and treatment of injury for athletes may be limited or delayed; and the diuretic effect of excessive beverage intake to provide a sufficient volume of urine causes pollakiuria and diarrhea and disturbs sleep. According to the results of a questionnaire survey of athletes conducted by the Japan Institute of Sports Sciences (JISS), which supports

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Olympic athletes medically[1], many athletes felt that doping testing was a physical and psychological burden, and more female athletes felt this way than did male athletes. A doping control officer monitors the athlete during the waiting period and a doping control officer of the same gender as the athlete checks that the sample actually comes from the athlete being tested. When taking a doping test, athletes drink beverages such as mineral water and juice and wait until they can urinate. Moreover, the volume of the collected urine sample needs to be at least 90mL and the urine specific gravity needs to be at least 1.005[2] according to the World Anti-Doping Agency's regulations in 2019. On site during competitions, decisions about what and how much to drink for sample collection are mostly based on athletes' and their coaches' experience. If we can find out what beverage athletes should drink and how they should drink it after matches in order to efficiently collect a urine sample that meets the current criteria, we can reduce the physical and psychological burden on athletes and keep them in good condition. At present, there is not much scientific information about optimization of fluid intake for sample collection.

Oral rehydration solution (ORS) was originally developed to supply water and electrolytes to patients with cholera diarrhea in developing countries. In recent years, it has been used to ameliorate mild to moderate dehydration due to gastroenteritis, heat stroke, etc.[3,4]. The combination ratio of sugars and electrolytes in ORS was determined by taking into account the intestinal absorption of water and electrolytes, which has been demonstrated to be rapid[3]. OS-1, the ORS used in the present study, is approved by the Japan Consumer Affairs Agency as a food to supply and maintain water and electrolytes in mildly to moderately dehydrated persons with medical conditions. We think that consuming this beverage after exercise, when dehydration is presumed to be mild, can correct dehydration quickly, increase urine volume, and prevent decrease in the urine specific gravity by supplying electrolytes. If we could take advantage of these characteristics of ORS, we would not only quickly collect a urine sample of the appropriate volume and specific gravity but also improve dehydration in athletes after matches, making ORS an ideal beverage for athletes.

It has been previously reported that beverages containing sodium and carbohydrate had a stronger rehydrating effect than mineral water, water/apple juice mixture, rooibos tea, etc.[5,6]. These prior studies, however, did not investigate urine volume or specific gravity from the perspective of doping testing.

Therefore, the present study mimicked doping testing events in female athletes who felt stressed by the procedure according to questionnaire survey results[1], and compared beverages to determine the most appropriate kind of beverage and the most appropriate way of drinking it during on-site control.

MATERIALS AND METHODS

This comparative intergroup study included 16 healthy, female college athletes who participated in both examination I and examination II. It was previously approved by the Research Ethics Committee at the JISS. Before conducting this study, we provided subjects with a sufficient explanation of the study purpose and then obtained their informed consent to participate.

All experimental trials started in the morning or the afternoon around 2 hours after a light meal and last fluid intake, which was not controlled.

The subjects exercised indoors by freely selecting to use a treadmill (Woodway, SAKAI Medical, Japan), exercise bike (Cycle Ergometer, PowerMaxV II, COMBI, Japan), and rowing ergometer (Concept2, Concept Inc., USA) until their body weight had decreased approximately by 1%, while maintaining heart rate (HR), which was monitored (RS-800CX monitor, Polar, Finland), at more than 150bpm.

Body temperature (℃), blood pressure (mmHg), and heart rate (bpm) were measured before exercise (Pre), and at 0 (before hydration), 30, 60, 90,

Table 1 Nutritional components per 100 mL.

Drink	Osmolarity (mOsm/L)	Carbohydrate (g)	Na (mg)	K (mg)	Cl (mg)
MW	＜10	0	1.13	0.18	3
ORS	270	2.5	292	78	117
OJ	650	10.4	0	192	0

120, 150, and 180 min after exercise. From an indwelling needle, venous blood samples were collected at the same time points to measure serum urea nitrogen (BUN, mg/dL, Urease-GLDH method, LST008α), serum sodium (Na, mEq/L, ion selective electrode method, LST008α), serum potassium (K, mEq/L, ion selective electrode method, LST008α), serum chloride (Cl, mEq/L, ion selective electrode method, LST008α), and serum osmolarity (mOsm/L, cryoscopic method, OM6060). Urine samples were obtained at the same time points, with the participants' emptying their bladders as completely as possible to measure urine volume (mL) and urine specific gravity (Refractometry, US-3500MS). The entire urine volume was measured.

The climate chamber was set at around 25°C and 45% relative humidity during the period of rehydration.

Examination I

We examined ways to drink a total of 800mL of water to determine which one would best enable the fastest collection of a sufficient volume of urine. The water was a commercially available mineral water (Crystal Geyser® Alpine Spring Water, 500mL PET bottle, Otsuka Foods Co., Ltd., Japan). Three groups were given the same total volume of water to drink: (1) The Once Group drank 800mL all at once, (2) the Twice Group drank 400mL twice 60 min apart, and (3) the 4-time Group drank 200mL on 4 occasions separated by 30-minute intervals. At each time point, water intake was completed within 5 min.

Their physical characteristics (mean ± standard deviation) were age 23 ± 2y and body mass 56.27 ± 4.81kg for the Once Group, 55.94 ± 5.05kg for the Twice Group, 56.76 ± 4.82kg for the 4-time Group. All exercise was conducted in a room maintained at around 29°C and 50% relative humidity.

Examination II

The beverage enabling collection of a sufficient volume of urine in the shortest possible time was examined by having subjects drink 800mL of various beverages all at once. Beverages were a commercially available mineral water (Crystal Geyser® Alpine Spring Water, 500mL PET bottle, Otsuka Foods Co., Ltd., Japan: MW Group), an oral rehydration solution OS-1 (Otsuka Pharmaceutical Factory, Inc., Japan: ORS Group), and 100% pure orange juice (Ehime Beverage Inc., Japan: OJ Group) (**Table 1**).

Their physical characteristics (mean ± standard deviation) were age 21.0 ± 0.8y and body mass 56.41 ± 7.82kg for the MW Group, 56.52 ± 7.98kg for the ORS Group, 56.51 ± 7.79kg for the OJ Group.

All exercise was conducted in a room maintained at around 24°C and 30% relative humidity.

The interval between experiments I and II was 4 months or more, and therefore there was no carry-over effect.

STATISTICAL ANALYSIS

Data are expressed as mean ± SD. Statistical analyses were carried out using JMP10.0.2 software (SAS Institute Inc. USA). We tested the normality of our data and the homogeneity of the variance and judged that parametric tests were appropriate. We did not perform sample size estimation because there were no reference data available, and therefore we enrolled as many subjects as possible. The data in urine specific gravity were compared using the Pearson's chi-square test, and the other data were compared using the Tukey's HSD test after repeated meas-

Table 2　Electrolyte levels over the course of Examination I, mean ± standard deviation.

	(MIN)	Once	Twice	4-time
		mean ± SD	mean ± SD	mean ± SD
Na (mEq/L)	Pre	139.6 ± 1.3	139.1 ± 1.5	139.5 ± 1.5
	0	141.8 ± 1.8	141.7 ± 1.3	141.5 ± 1.5
	30	139.6 ± 1.6	139.9 ± 1.9	140.1 ± 1.5
	60	138.9 ± 1.6	140.3 ± 1.5*	138.9 ± 1.5
	90	139.3 ± 1.5	139.1 ± 1.8	138.4 ± 1.9
	120	139.5 ± 1.2	139.3 ± 1.8	138.3 ± 1.4
	150	139.3 ± 1.3	139.0 ± 1.7	138.4 ± 1.2
	180	139.5 ± 1.1	139.0 ± 1.5	138.9 ± 1.6
K (mEq/L)	Pre	4.3 ± 0.3	4.3 ± 0.3	4.3 ± 0.2
	0	4.3 ± 0.4	4.2 ± 0.3	4.3 ± 0.3
	30	4.2 ± 0.4	4.1 ± 0.3	4.3 ± 0.2
	60	4.1 ± 0.3	4.1 ± 0.2	4.2 ± 0.3
	90	4.1 ± 0.3	4.1 ± 0.3	4.1 ± 0.3
	120	4.1 ± 0.3	4.1 ± 0.3	4.1 ± 0.2
	150	4.0 ± 0.2	4.1 ± 0.3	4.0 ± 0.2
	180	4.0 ± 0.4	4.1 ± 0.3	4.0 ± 0.2
Cl (mEq/L)	Pre	103.4 ± 1.5	104.3 ± 1.7	104.5 ± 1.3
	0	105.0 ± 1.6	105.5 ± 2.1	104.9 ± 1.8
	30	102.7 ± 1.6*	105.8 ± 2.5	105.4 ± 1.3
	60	102.3 ± 1.6*	105.3 ± 1.8	104.1 ± 1.9
	90	102.7 ± 1.5	103.9 ± 2.0	103.3 ± 1.3
	120	102.5 ± 1.4#	103.9 ± 1.6	103.5 ± 1.1
	150	102.8 ± 1.6	103.9 ± 1.6	103.5 ± 1.3
	180	102.9 ± 1.8	103.9 ± 1.4	103.7 ± 1.4
BUN (mg/dL)	Pre	14.7 ± 3.8	14.5 ± 3.0	13.8 ± 3.5
	0	15.2 ± 3.7	15.1 ± 2.8	14.6 ± 4.1
	30	14.9 ± 3.3	15.2 ± 2.7	15.0 ± 4.5
	60	14.7 ± 3.5	15.2 ± 2.5	14.6 ± 4.2
	90	14.8 ± 3.3	14.9 ± 2.7	14.5 ± 4.1
	120	14.6 ± 3.2	14.7 ± 2.6	14.2 ± 3.9
	150	14.3 ± 3.1	14.6 ± 2.6	14.1 ± 3.9
	180	14.3 ± 3.1	14.5 ± 2.6	13.8 ± 3.9

Tukey's HSD test *: $P<0.05$ vs other 2groups. #: $P<0.05$ Once vs Twice

ures ANOVA. Statistical significance was accepted at $p<0.05$.

RESULTS

Examination I

No significant intergroup difference was observed in mean body temperature, mean systolic blood pressure, or mean heart rate at baseline. Diastolic blood pressure before exercise was significantly different between the Once Group and the 4-time Group. However, there was no significant intergroup difference in BUN or K level, and change in BUN or K level was within the reference range. Na level was significantly higher in the Twice Group than in the Once Group or the 4-time Group at 60 min, but the changes were within the reference range. Cl level was significantly lower in the 4-time Group than in the Once Group or the Twice Group at 30min and 60min, and significantly lower than in the Twice Group at 120min, but the changes were within the reference range (**Table 2**). There was interaction between Group and time for Cl level but not other levels. Serum osmolarity was decreased in pro-

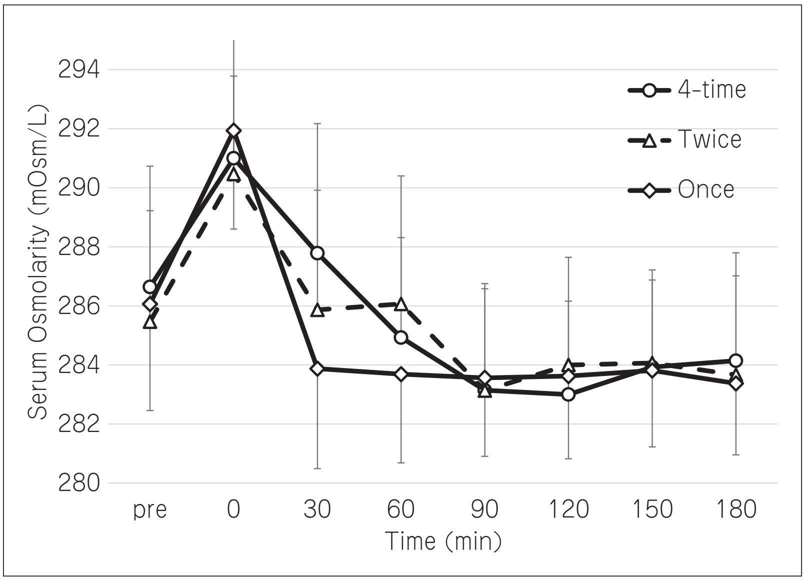

Figure 1 Changes in serum osmolarity over the course of Examination I. Values are mean±standard deviation.

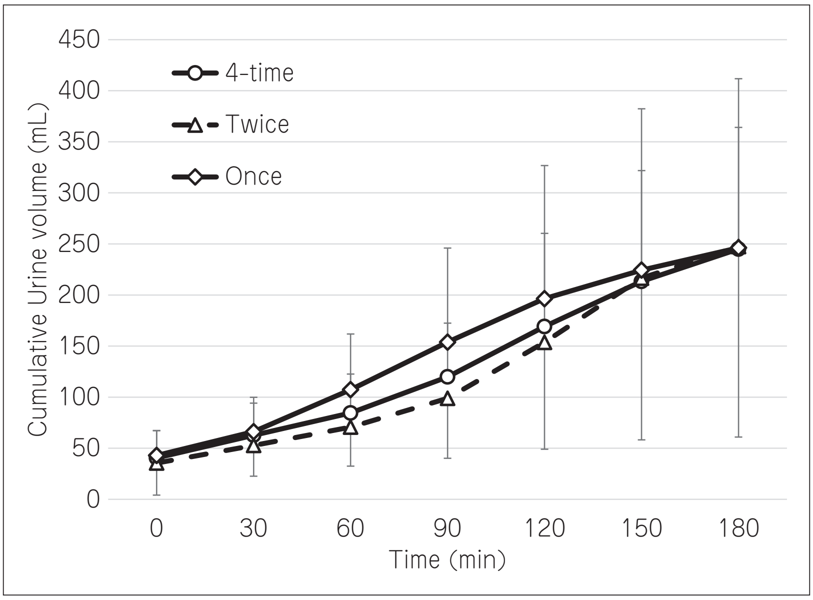

Figure 2 Cumulative urine volume over the course of Examination I. Values are mean±standard deviation.

portion to volume of water intake at 30min (**Figure 1**). The urine volume at each time point was significantly increased at 60 min in the Once Group. Although the accumulated urine volume tended to be lower in the Twice Group, no significant intergroup difference was observed (**Figure 2**). However, the subjects in the Once Group were the fastest to reach and provide the required 90-mL of urine for doping testing. There was no interaction between Group and time for urine specific gravity, which was significantly decreased in the Once Group at 60min and was the lowest among the groups until 90min (**Figure 3**). At 90 min, the accumulated urine volume was the highest in the Once Group.

Examination II

No significant intergroup difference was observed in the mean body temperature, mean blood pressure, or mean heart rate. Intergroup differences in BUN were not significant and

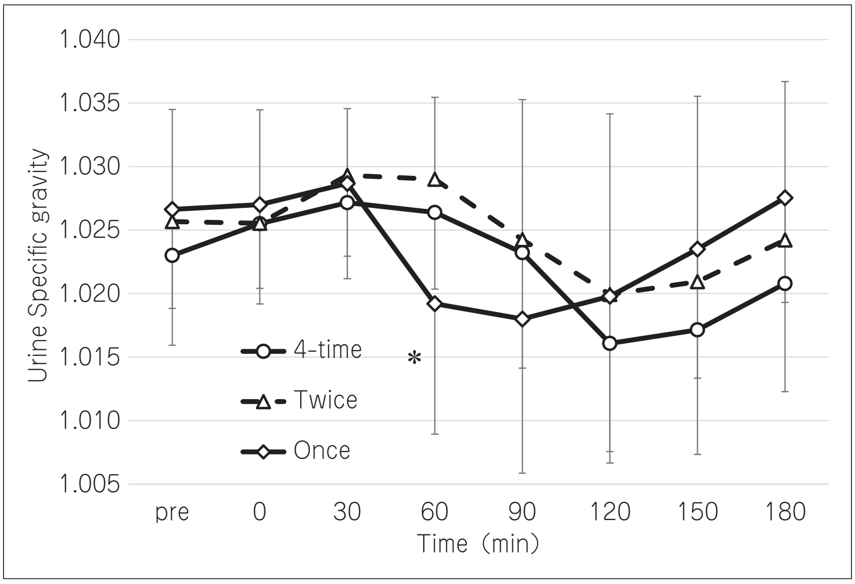

Figure 3　Changes in urine specific gravity over the course of Examination I. Values are mean±standard deviation. *$p < 0.05$ Tukey's HSD test Once vs Twice.

change in BUN was within the reference range. Na level was significantly lower in the MW Group than in the OJ Group at 30min, 60min, 90min, and 120min. K level was significantly lower in the MW Group than in the OJ Group at 60min, 90min, and 120min and significantly lower in the ORS Group than in the OJ Group at 90min and 120min. Cl level was significantly lower in the MW Group than in the ORS Group and the OJ Group at 30 min and 60min. However, changes in Na, K, and Cl levels were within the reference range (**Table 3**). There was interaction between beverage and time for serum osmolarity and the Na and K levels but not other levels. Serum osmolarity was significantly less in the MW Group than in the ORS Group and the OJ Group at 30min, 60min, and 120min and was also significantly less in the MW Group than in the OJ Group at 90min (**Figure 4**).

When urine volume was compared among groups at each time point, urine volume per void was significantly higher in the MW Group than in other groups at 90min. Intergroup differences in accumulated urine volume first appeared at 90 min and later, when it tended to be higher in the MW Group, followed by the OJ Group, and then by the ORS Group. However, the differences were not significant (**Figure 5**). There was interaction between beverage and time for urine specific gravity, which was significantly lower in the MW Group than in the ORS Group and the OJ Group at 60min, 90min, and 120min (**Figure 6**), significantly higher in the OJ Group than in the ORS Group at 60min, and significantly higher in the ORS Group than in the MW Group at 150min. In the MW Group, the proportion of urine samples with specific gravity below 1.005 was significantly higher at 60min and 90min.

Urine specific gravity of 90-mL samples, which is the required sample volume for doping testing, was significantly different between the MW Group and the ORS Group and between the OJ Group and the ORS Group. In the MW Group, 5 of the 16 subjects provided urine samples with a specific gravity lower than 1.005, while in the ORS Group, none of the subjects provided low specific gravity samples. This difference between the groups was statistically significant (**Table 4**).

DISCUSSION

The purpose of this study was to determine how and what kind of beverage to drink in order to collect samples as fast as possible. Our study performed experiments in women because more

Table 3 Electrolyte levels over the course of Examination II, mean±standard deviation.

	(MIN)	MW	ORS	OJ
		mean ± SD	mean ± SD	mean ± SD
Na (mEq/L)	Pre	139.8 ± 2.1	139.0 ± 1.3	139.9 ± 1.3
	0	140.7 ± 1.9	140.4 ± 1.3	140.9 ± 1.5
	30	137.9 ± 2.3*	139.4 ± 1.7	140.8 ± 1.5
	60	138.3 ± 2.0*	139.6 ± 1.5	140.7 ± 1.0
	90	138.1 ± 1.7*	139.0 ± 1.5	139.6 ± 1.2
	120	138.4 ± 1.4*	139.2 ± 1.3	139.6 ± 1.0
	150	138.4 ± 2.1	139.1 ± 1.5	138.9 ± 1.1
	180	138.9 ± 1.7	138.8 ± 1.2	139.3 ± 1.2
K (mEq/L)	Pre	4.2 ± 0.2	4.2 ± 0.3	4.2 ± 0.3
	0	4.2 ± 0.2	4.2 ± 0.3	4.2 ± 0.2
	30	4.2 ± 0.2	4.3 ± 0.3	4.4 ± 0.4
	60	4.1 ± 0.2*	4.4 ± 0.4	4.6 ± 0.3
	90	4.1 ± 0.3*	4.3 ± 0.4*	4.7 ± 0.5
	120	4.1 ± 0.2*	4.2 ± 0.4*	4.6 ± 0.3
	150	4.0 ± 0.2*, #	4.3 ± 0.3	4.4 ± 0.2
	180	4.0 ± 0.3	4.1 ± 0.4	4.3 ± 0.2
Cl (mEq/L)	Pre	103.6 ± 2.0	103.6 ± 2.3	104.4 ± 1.5
	0	104.0 ± 1.9	103.8 ± 2.0	104.9 ± 1.9
	30	102.5 ± 2.4*, #	104.6 ± 1.6	104.6 ± 1.9
	60	102.2 ± 1.7*, #	104.8 ± 1.4	103.9 ± 2.0
	90	102.6 ± 2.3	104.2 ± 1.5	103.3 ± 1.8
	120	102.9 ± 2.0	103.7 ± 1.3	103.7 ± 1.4
	150	102.4 ± 1.9	103.5 ± 1.9	103.4 ± 1.5
	180	102.7 ± 2.0	103.2 ± 1.8	103.3 ± 1.3
BUN (mg/dL)	Pre	13.5 ± 4.2	15.4 ± 5.1	14.4 ± 3.2
	0	14.2 ± 4.5	16.1 ± 5.4	15.2 ± 3.3
	30	14.0 ± 4.5	15.9 ± 5.4	15.0 ± 3.3
	60	13.9 ± 4.4	15.5 ± 5.2	14.6 ± 3.2
	90	13.7 ± 4.2	15.1 ± 5.1	14.3 ± 2.9
	120	13.5 ± 4.3	14.9 ± 4.9	13.9 ± 3.0
	150	13.2 ± 4.2	14.6 ± 4.8	13.6 ± 2.8
	180	13.0 ± 4.1	14.4 ± 4.8	13.3 ± 2.8

Tukey's HSD test *: P＜0.05 vs OJ, #: P＜0.05 vs ORS

female athletes than male athletes responding to our questionnaire survey felt physical and psychological stress during doping testing[1]. A previous study demonstrated that the normal menstrual cycle had no effect on acute replacement of exercise-induced fluid loss, up to six hours after rehydration[7], so we conducted this study in female athletes to simulate doping testing under actual conditions as much as possible.

As of 2019, the sample collection criteria for doping testing are urine volume of at least 90mL and urine specific gravity of at least 1.005[2]. Although rehydrating athletes as fast as possible to protect their health is an important task of sports doctors, the present study investigates not only the correction of dehydration but also the urine volume and specific gravity needed for doping testing in order to obtain more practical results.

First, the results of Examination I have demonstrated that drinking the entire volume of a beverage all at once, instead of dividing it, is the best way of obtaining a sufficient volume of urine in the shortest possible time. Decreased plasma osmolarity increases urine volume[8, 9]. In our results, the Once Group had the lowest serum osmolarity at 30min, which was consistent with the observa-

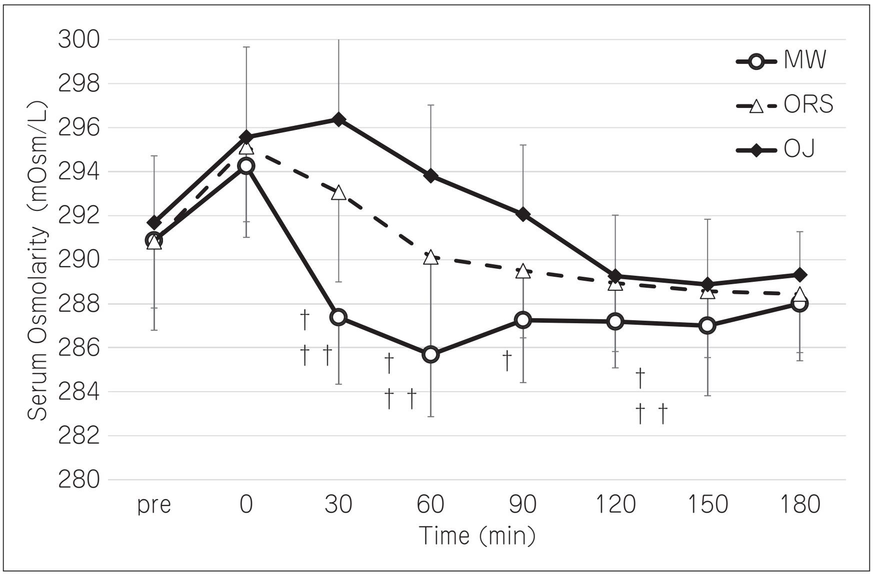

Figure 4　Changes in serum osmolarity over the course of Examination II. Values are mean±standard deviation. p＜0.05 Tukey's HSD test † indicates MW significantly different from OJ. † † MW, significantly different from ORS

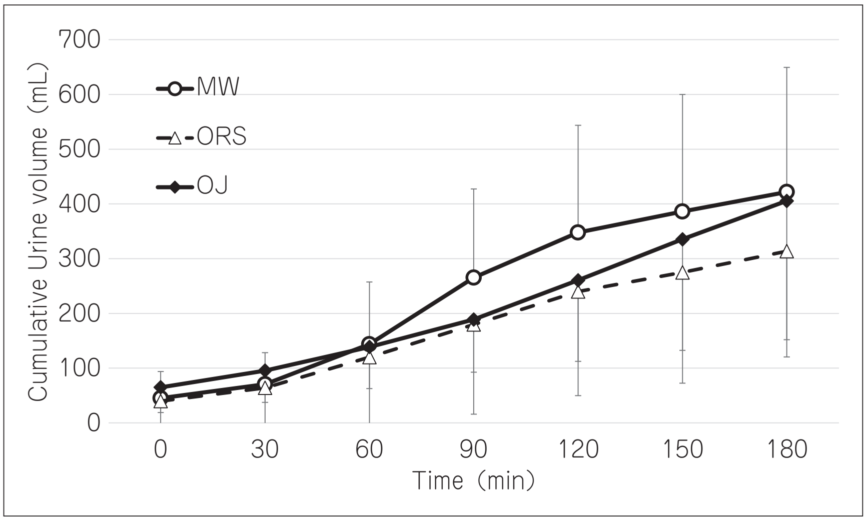

Figure 5　Cumulative urine volume over the course of Examination II. Values are mean±standard deviation.

tion that a sufficient urine volume was collected fastest in the Once Group. However, it should be noted that urine specific gravity tends to be lower in such circumstances.

In short, MW alone dilutes body fluid, which was confirmed by the decreased serum osmolarity observed in Examinations I and II, because it has little electrolyte content and is absorbed very fast, and because only water is absorbed[3, 5, 9].

Next, methods to ensure sufficient urine specific gravity need to be sought.

OJ has many components such as ingestible sugars, vitamins, and dietary fiber that raise its osmolarity to 500-700mOsm/L, which is very high. It is also known that high-calorie beverages move slowly from the stomach to the duodenum[10]. It has been demonstrated that the absorption of OJ into the body after ingestion takes time. In Examination II, urine volume was small early after ingestion of OJ, and the time to collec-

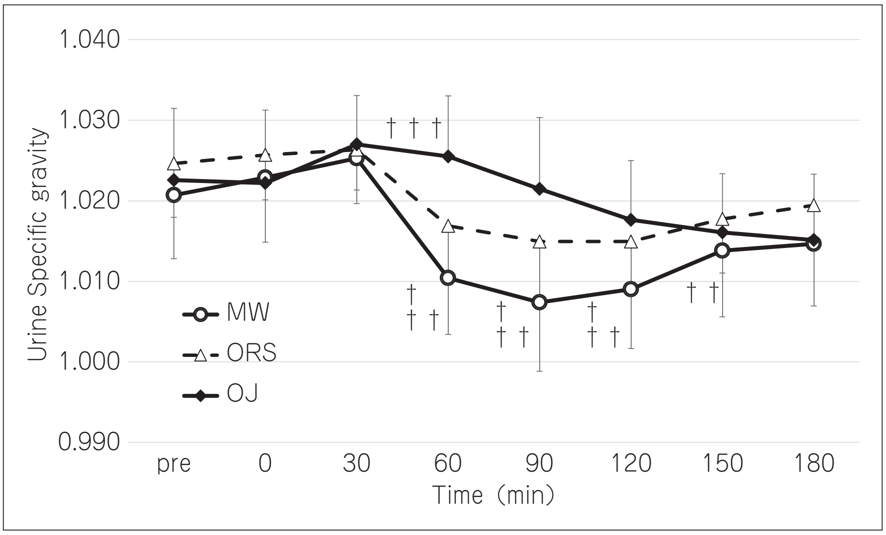

Figure 6 Changes in urine specific gravity over the course of Examination II. Values are mean±standard deviation. $p<0.05$ Tukey's HSD test † indicates MW significantly different from OJ. † † MW, significantly different from ORS and † † † OJ, significantly different from ORS.

Table 4 The number of subjects with low urine specific gravity in 90-mL urine samples.

Drink	<1.005	≥1.005
MW	5	11
ORS*	0	16
OJ*	0	16

Pearson's chi-square test *: $p<0.05$ vs MW

tion of the required urine volume was longer for OJ than for the other beverages studied. These results are understandable because serum osmolarity continued to increase until 90 min. Therefore, conceivably, OJ is suitable for the ingestion of sugars after exercise but not for improving dehydration or meeting the volume requirement.

On the other hand, ORS is designed to have close to body-fluid osmolarity and the balance of sugars and electrolytes needed for efficient water and electrolyte absorption in the intestines[11～14]. Therefore, dehydration is corrected rapidly, and the volume of excreted urine is also increased, conceivably hastening the collection of the required urine sample volume. Previous study showed that serum osmolarity accurately identifies a state of euhydration and is sensitive to changes in hydration status during acute dehydration and rehydration[15]. As seen in the present study in dehydrated subjects, serum osmolarity in the ORS Group returned to the previous level at 30min and then decreased slightly but was significantly higher than in the MW Group. Therefore, improving dehydration status by immediately supplying water and electrolytes can conceivably maintain normal hydration[16, 17]. A prior study obtained similar results[11]. Indeed, in the present study, the accumulated urine volume in the ORS Group was approximately that in the MW Group at 90min and later, and at the time 90 mL of urine was collected, 5 of the 16 subjects in the MW Group but no subject in the ORS group had urine samples with low specific gravity. In short, compared with MW and OJ, the ORS ensures rapid collection of the required urine volume without decreasing urine specific gravity.

Moreover, as for dehydration and hyponatremia, which affect the condition of the body, Na, BUN, K, and Cl values were within their normal ranges after ingestion of ORS. By 30 min, Na, BUN, K, and Cl had almost returned to their baseline values, demonstrating that both concentration and dilution of body fluid were quickly prevented.

LIMITATIONS

Several limitations to the present study must be acknowledged. We aimed to perform experiments under close to actual conditions simulating those of in-competition doping control. Unlike many prior studies, in which the goal of dehydration was 2% of body weight and amount of fluid intake depended on body weight loss, our goal of dehydration by exercise was 1% of body weight and fixation of the fluid intake amount at 800mL. We did not control meals on the day before the study or meals before exercise. The participants in the study had their usual meals and water intake. We also did not measure electrolytes lost in perspiration. Regarding influences on electrolytes, we only consulted prior studies. Moreover, we had the subjects exercise in a controlled environment. However, environments of actual competitions are not constant. Only female athletes were involved in this study according to our questionnaire survey and there was no objective evidence that female athletes felt more stressed than male athletes during urine sample collection. Differences in sport, gender, age, type of beverage, and the environment in which the competition is held can also influence results. To obtain more conclusive results, we think that further studies under various conditions are needed.

CONCLUSION

This study examined the most appropriate kind of beverage to use for collection of doping test urine samples and how to drink it during sample collection. We found that consuming as much as possible all at once is better than imbibing smaller amounts more than once, and that it is a more useful to ingest ORS than MW or OJ in terms of meeting urine volume, specific gravity, collection time requirements and improving dehydration.

Author Contributions

This study was conceived by DM. All authors contributed to implementation of the study. NE and TY interpreted the urine and blood data. KE, NM, and YS managed the conduct of exercise. All authors participated in the preparation of this manuscript, revised it critically for important intellectual content and approved the version submitted for publication.

Conflicts of Interest

This study was a collaborative effort between the Japan Institute of Sports Sciences and Otsuka Pharmaceutical Factory, Inc. The Japan Institute of Sports Sciences paid the costs of the study and Otsuka Pharmaceutical Factory, Inc. provided the beverages.

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原　著

女性アスリートにおけるドーピング検査時の適切な尿検体を採取するための最適な方法―どのように，何を飲むのか―に関する研究

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キー･ワード：水分補給，女性アスリート，ドーピング検査

〔要旨〕 目的:アスリートにとって競技会ドーピング検査は競技終了後に監視員のもとで採尿, 長時間の拘束や不十分なリカバリーによるコンディションの悪化により, 精神的, 肉体的に大きなストレスとなる. その傾向は女性アスリートにおいて強い. しかしドーピング検査のための最適な水分補給についての情報はほとんどない. 本試験では適切な尿検体を短時間で採取するための飲料の飲水方法と種類について検討した.

方法:女子学生アスリートで前向き群間比較試験を行った. 体重の1% 減少するまで運動を行い, その後, 800mL のミネラルウォーターを 1 回, 400mL ずつ 2 回, 200mL ずつ 4 回で飲む群に分けた. 運動前, 運動後 0, 30, 60, 90, 120, 150, 180 分で採血, 採尿を行い, 各種項目の測定･分析を行なった. 飲料の種類の検討では, 1 回で 800mL のミネラルウォーター, 経口補水液, オレンジジュースを飲む群に分けた.

結果:ミネラルウォーター 800mL を 1 回で飲む群で必要累積尿量に到達する時間が短かった. 種類では, 経口補水液群でミネラルウォーター群と比較して必要累積尿量に到達する時間が同程度, 尿比重の低下が軽度だった. オレンジジュース群は尿比重の低下はほとんどなかったが, 尿量の確保に時間を要した.

まとめ:ドーピング検査時の最適な飲料の飲水方法と種類の検討を行い, 経口補水液が最も短時間で適切な比重の尿を確保できることが示された.