하루 생수 2L섭취에 따른 타액 분비량과 타액 pH의 상관관계

김민지‡

동서대학교 치위생학과 조교수

The Relation of Amount of the Saliva Secretion Rate and Saliva pH on Taking 2 Liters of Water Per a Day

Min-Ji Kim‡

Assistant professor, Dept. of Dental Hygiene, Division of Health Sciences, Dongseo University

ABSTRACT Objectives: The purposes of this study were 1) to investigate how the saliva secretion rate and saliva pH affect the consumption of 2 L of bottled water per day and 2) to obtain basic data to suggest the proper contents and direction of water intake education to help prevent and treat dental caries.

Methods: The study participants were 20 women in their 20s in B area who did not drink 2 L of water per day. This work measured the amount of water consumed daily over five weeks, saliva secretion rate, and saliva pH and then examined the correlation between factors.

Results: Before the experiment, the water intake, saliva secretion rate, and pH were 793.63 mL, 2.97 mL, and 6.63, respectively. At the end of the experiment, the water intake, saliva secretion rate, and pH were 2,040.92 mL, 5.00 mL, and 7.43, respectively. The mean water intake, saliva secretion rate, and pH were 1,950.24 mL, 4.27 mL, and 7.18, respectively, and the pH increased significantly each week ($p < 0.05$). The saliva secretion rate and saliva pH were positively correlated with the increase in water intake, but the correlation was not significant. As the saliva secretion rate increased, the saliva pH increased, and it was statistically significant ($p < 0.01$).

Conclusions: The saliva secretion rate and saliva pH increased significantly with the water intake ($p < 0.05$), and the saliva secretion rate and saliva pH were positively correlated with water intake. Encouraging frequent and large amounts of water intake from adolescence through oral health education may help improve oral hygiene through the effect of increased saliva.

Keywords saliva secretion rate, saliva pH, 2 liters of water per a day

Ⅰ. Introduction

Health in modern society is recognized as one of the important factors that can improve the quality of life[1]. It was also recognized that the cost of prevention is much more effective than the treatment, and the focus of health improvement activities is shifting to prevention through lifestyle and dietary improvement rather than treatment after onset[2].

Recently, water consumption, which is known and recommended as a desirable health habit, began with Woongjin Coway's 'Clean Water Love Campaign[3]', Dongyang Magic's 'Healthy Drinking Water Campaign' in 2012[4], Nongshim's 'Good Drinking Water Campaign' in 2015[5], Lock & Lock's 'National Drinking Water Campaign' in 2017[6], Our Home's '2L Drinking Water Day Campaign[7]', Lotte Member's 'Healthy 42! Four times a day, 2L of Water Intake[8]' is leading to a drinking campaign led by various companies.

Water makes up 70% of the human body and plays an important part in maintaining the functioning of all living organs[9]. The proper intake of fluids plays a key role in maintaining blood

flow, nutrient supply and waste excretion, and is known to help maintain body homeostasis, improve immunity and prevent constipation[10, 11].

On the other hand, tissues in the oral cavity are always immersed in saliva. Saliva soaks the oral mucosa and maintains oral health, and pronunciation, food residue removal, acid neutralization, taste, lubrication, chewing, and swallowing function, digestive function, tissue growth and wounds. It is also related to functions such as healing, antibacterial, antifungal and enamel remineralization[12] and bad breath[13].

Saliva is not only necessary to maintain normal function of oral tissues, but also suppresses oral disease occurrence, and if salivary secretion decreases below normal, it can cause oral mucosal diseases and oral diseases[14]. Patients with dry mouth or burning sensation due to decreased salivation are increasing[15]. When salivation is lowered, salivary buffering capacity and saliva pH are lowered and this can cause and increase dental caries significantly[14].

Treatments to increase saliva secretion rate include hydration, drug control, mouthwash, artificial saliva, parasympathetic nerve stimulation[16] and stereopsis[17]. Recently, the used of pilocarpine, a parasympathetic nerve stimulant with few side effects, has been widely used, and studies on the effects of pilocarpine dentifrice have been reported steadily[16]. To investigate the effect of stereotactic exercise, one of the methods to increase saliva secretion rate, the study of the elderly with low saliva secretion rate showed that symptom relief increased oral dryness symptoms by increasing saliva secretion[17].

Although it is a desirable health habit and there is water supply as a way to increase saliva secretion rate, the study of water intake is mostly studied in the elderly, and as the water intake increases, cardiovascular effects[18]. The better the physical health of the elderly, the lower the water intake[19], research on oral health due to fluid intake is still insufficient.

Recently, as the prevalence of chronic diseases and the number of drug users have increased, the number of studies that have expanded the subjects to younger people is increasing[20]. Dry mouth is reported in older people, but the main cause is chronic disease and drug use[21], and the prevalence and treatment rate of chronic disease is increasing in people aged 30 and older[22]. It is necessary to study saliva secretion according to the amount of water and the amount of water intake.

The purpose of this study is to examine the intake of water in 20s and to examine the effects of saliva secretion rate and saliva pH on the intake of 2L of water per day to help prevent and treat dry mouth and dental caries associated with salivation.

II. Study Subjects and Research Methods

1. Study subjects

The subjects of this study were 20 females in their 20s in B area who did not consume less than 2L of water per day. Subjects were informed of the researcher's intention and purpose of the study, and educated them about the importance of water intake. Once a week(every Friday), 20 subjects (14 people with 21 years old (70%), 6 people with 22 years old (30%), with an average age of 21.3 years old) who measured for saliva secretion rate and saliva pH were selected.

2. Research Methods

The total amount of water consumed by the subjects was measured everyday over a total of five weeks, and the saliva secretion rate and saliva pH were measure once a week.

Water intake in this study means intake of water only without other additives. The water consumed during the day was recorded hourly. After checking the eco bottles and thermos used by students, the amount of each product was corrected and presented in ml using a measuring cup to improve the accuracy of the intake estimation and record convenience.

Saliva secretion rate was measured by spitting a non-irritating saliva that is secreted for 5 minutes at rest in a measuring cup. One hour before saliva collection, they were trained not to eat, not to brush teeth, not to smoke, not to chew gum, and etc. Five minutes before saliva collection, the subjects were allowed to rest in a relaxed state. Saliva collection was performed by spitting method that spits 1-2 times per minute when saliva accumulated naturally in the mouth. When the

sampling time was over, all remaining saliva in the mouth was spit into the measuring cup.

The pH of the saliva was checked by comparing the pH of the test paper with the pH indicator after wetting the non-irritating saliva taken out of the pH test paper for 10 seconds. The pH of the saliva was used Doosan's Universal Indicator paper(Korea).

3. Statistical analysis

Collected data were all computerized and analyzed using SPSS (Statistical Package for the Social Science) 24.0 (SPSS Inc, Chicago, IL, USA) program. Repeated Measure ANOVA was used to change the water intake, saliva secretion rate, and saliva pH weekly. The water intake of the study subjects was determined by descriptive statistics. The paired t-test was used for the change of saliva secretion and saliva pH before and after the experiment.

The correlation between water intake, saliva secretion rate, and saliva pH was used for the Pearson correlation coefficient.

Ⅲ. Results

1. Changes in salinity and saliva pH of water intake by week basis

The amount of water intake by week was 793.63ml before the start of the experiment, but significantly increased 1,850ml on first week, 1,939ml on second week, 1,970ml on third week, 2,040ml on fourth week (p<0.05), and the mean water intake

for four weeks was 1,950ml.

Salivary secretion rate by week was 2.97ml before the start of the experiment, but it increased significantly with each week to 3.64ml on first week, 4.04ml on second week, 4.43ml on third week, and 5.00ml on fourth week (p<0.05), and salivary secretion rate average over four weeks was 4.28ml.

The saliva pH according to each week was 6.63 before the start of the experiment. However, the saliva pH increased significantly with each week to 6.95 on first week, 7.17 on second week, 7.20 on third week, and 7.43 on fourth week (p<0.05), and saliva pH for four week average was 7.18<Table 1>.

2. Minimum, maximum and mean water intake of subjects

The minimum water intake was 1,473ml and the maximum was 2,322ml during the experiment. The average daily water intake was 1,950ml<Table 2>.

3. Comparison of saliva secretion rate and pH average before and after experiment

The saliva secretion rate before the start of the experiment was 2.97ml, but after the experiment was 4.28ml (p<0.001). The saliva pH before the experiment was 6.63, but after the experiment, it was 7.18 and there was a significant difference (p<0.001)<Table 3>.

4. Correlation of subject's water intake, saliva secretion rate, and saliva pH

Water intake was positively correlated with saliva secretion

<Table 1> Change in salinity and saliva pH of water intake by week basis

Variables	M±SD		
	Water intake(ml)	Saliva secretion rate (ml)	Saliva pH
Base line	793.63±364.80[*]	2.97±1.39[*]	6.63±0.56[*]
First week after water intake	1850.15±281.36[*]	3.64±1.27[*]	6.95±0.42[*]
Second week after water intake	1939.16±272.25[*]	4.04±1.47[*]	7.17±0.50[*]
Third week after water intake	1970.71±318.29[*]	4.43±1.55[*]	7.20±0.41[*]
Fourth week after water intake	2040.92±133.62[*]	5.00±1.63[*]	7.43±0.41[*]
Four week average water intake	1950.24±197.29[*]	4.28±1.38[*]	7.18±0.32[*]

[*]p<0.05 by repeated measure anova

<Table 2> Minimum, maximum and mean water intake of subjects

Variables	Minimum (ml)	Maximum (ml)	M±SD (ml)
Average daily water intake	1473.22	2322.83	1950.24±197.29

By Descriptive Statistics

<Table 3> Comparison of saliva secretion rate and pH average before and after experiment

Variables	Before (M±SD)	Afte(M±SD)	p^*
Saliva secretion rate(ml)	2.97±1.39	4.28±1.38	**<0.001**
Saliva pH	6.63±0.56	7.18±0.32	**<0.001**

$^*p<0.001$ by Paired t-test

<Table 4> Correlation of subject's water intake, saliva secretion rate, and saliva pH

Variables	Water intake(ml)	Saliva secretion rate(ml)	Saliva pH
Water intake	1	0.205	0.248
Saliva secretion rate		1	0.550**
Saliva pH			1

$^*p<0.001$ by Pearson correlation coefficient

rate and saliva pH, but was not significant. Saliva secretion and saliva pH showed a significant positive correlation(p<0.001) <Table 4>.

Ⅳ. Consideration

The purpose of this study was to identify the amount of water intake in women in their 20s and to determine the saliva secretion and the pH change of saliva according to 2L daily water intake. The subjects were 21-22-year-old females who consumed less than 2L of water daily. After educating about the importance of water intake, the correlation was measured by measuring the amount of water consumed daily by the subject over a total of five weeks, and by re-measuring saliva secretion rate and saliva pH

The subject's water intake was 793.63ml before the start of the experiment. In the study on the water intake of Korean college students, the water intake of female college students was higher than 583.5ml [23], and lower than the sufficient amount of water intake of women 19-29 years of age according to the Korean Nutrition Society [24]..

In the study of LIuis et al. [25], the water intake was smaller and the beverage intake was higher in the total water intake. In addition, although several countries and institutions around the world have suggested an adequate range of water intake, Korean adults have reported that water intake is less than the recommended intake [26]. In the study on the liquid intake of Korean university students, the daily liquid intake of female university students was 1,151.5ml [23], and the total water intake of female aged 19-29 was 2,100ml [24] according to Korean Nutrition Institute. Therefore, according to the campaign to consume 2L of water per day, which is known as a desirable health habit, it was measured over 5 weeks by encouraging the subjects to drink 2,000ml of water per day after teaching about the importance of water intake. 1,850ml on first week, 1,939ml on second week, 1,970ml on third week, 2,040ml on fourth week which was increased significantly (p<0.05), and the mean water intake for four weeks was 1,950ml. In this study, only water was consumed as the water intake. Considering solid foods and medicines containing water, the intake of water is thought to be higher. The proper habit of drinking water at this time not only affects the health of adulthood, but it is also a necessary part of proper awareness and practice of

drinking water because it is responsible for self-care by practicing good health behaviors. Based on the above results, it would be helpful to face the facts about their diet and to provide nutrition education to correct them. There was a study that nutrition education was effective when subjects of similar age were educated online [27] and offline [28]. Based on this, nutrition education about water intake needs to be done more systematically and regularly.

Salivary secretion rate by week was 2.97ml before the start of the experiment, but it increased significantly with each week to 3.64ml on first week, 4.04ml on second week, 4.43ml on third week, and 5.00ml on fourth week (p<0.05), and salivary secretion rate averaged over 4 weeks was 4.28ml. In the study of women in their twenties, Yoon et al. [29] showed 3.89ml of non-irritating saliva and Yang et al. [30] showed 3.68ml which the results were similar to salivary secretion rate at first week from this study. In this study, as the water intake increased, the saliva secretion rate also increased significantly (p<0.05).

It is known that the higher the amount of saliva secretion, the lower the likelihood of dental caries. It has been proved that the effect of improving oral function on saliva secretion rate is effective regardless of age, drug use and denture wearing [31]. However, salivary secretion rate varies depending on physical and mental conditions and may be temporarily reduced [32].

Saliva pH by week was 6.63 before the start of the experiment, but significantly increased with each week to 6.95 on first week, 7.17 on second week, 7.20 on third week, and 7.43 on fourth week respectively (p<0.05), and saliva pH's average over four weeks was 7.18. Low pH of saliva indicates acidity and is known to have a high risk of dental caries [33].

In this study, water intake was positively correlated with saliva secretion rate and saliva pH, but it was not significant. However, saliva secretion rate and saliva pH were positively correlated.

In this study, 2,000ml of water per day was recommended, and after 5 weeks of measurement, the changes in saliva secretion rate and the changes in saliva pH were shown. Although there was a significant result for each week, there was no significant difference in correlation due to the small sample size, the accuracy

of the statistical test appeared to be inferior. In addition, it was recognized that about 2L of daily water intake per day was recommended, and a larger amount was set. However, there were many cases in which taking water regularly was recommended but rather a large amount of water consumption at a time. The limit of this study was that drinking 2L of water was rarely done during the five weeks of the experiment and the intake of water in the diet could not be controlled. Therefore, it was considered that a study was needed to increase the number of samples not only female but also with various ages and genders, as well as to adjust the diet of all subjects equally to reflect the water intake included in the diet.

Nevertheless, this study can be used as basic data that it may be helpful to improve oral hygiene status through the effect of increased saliva, if the frequency of water intake and the amount of water intake are habitual from the beginning and the middle age.

Further research is needed to further investigate the intake of water, proper oral health behavior, and general health and oral health according to water intake so that in-depth study of water intake, correct oral health behavior, systemic health and oral health according to water intake is necessary.

V. Conclusions

In this study, 20 women in their 20s in B area who did not have 2L of water in one day (14 people with 21 years old (70%), 6 people with 22 years old (30%), with an average age of 21.3 years old) who have been measured each day of the water intake amount, saliva secretion rate, saliva pH was measured once a week over 5 weeks, and examined the correlation between factors. The results were as follows:

1. The water intake before the experiment was 793.63ml, the saliva secretion rate was 2.97ml, the saliva pH was 6.63. At the end of the experiment, water intake was 2,040.92ml, saliva secretion rate was 5.00ml, saliva pH was 7.43, mean water intake was 1,950.24ml, saliva secretion rate was 4.27ml, and saliva pH was 7.18 which shows an significant increase with each week (p<0.05).

2. The average water intake of the subjects was 1,950.24ml per day.

3. The correlation between water intake, saliva secretion rate, and saliva pH was positively correlated with the increase of water intake, but it was not significant. As saliva secretion rate increased, the pH of saliva increased and it was statistically significant ($p < 0.01$).

The results show that the amount of water intake, saliva secretion rate, and pH of saliva were related. If oral health education allows the habit of frequent water intake and a large amount of water intake from adolescence, it may be helpful to improve oral hygiene through the effect of increased saliva.

Therefore, in-depth study on the intake of water, proper oral health behavior, systemic health and oral health according to water intake is necessary which can be used as a basic data for saliva increase in dental clinic patients with dry mouth.

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