The Effects of a Fluid Intake Intervention for Elders in Long-term Care Hospitals

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Purpose: This study was done to evaluate the effects of a fluid intake intervention on increasing fluid intake and ameliorating dehydration status in elders admitted to long-term care hospitals. **Methods:** A nonequivalent control group, pretest and posttest design was used. The experimental group of 39 participants received the 4-week intervention while the control group of 38 participants received routine care. Outcome variables were daily fluid intake and physiological indexes such as blood urea nitrogen and creatinine ratio (BUN/Cr), urine specific gravity (USG), and urine color. **Results:** After the intervention to increase fluid intake, there were statistically significant increases in daily fluid intake, normal BUN/Cr, and USG in the experimental group. However, a statistically significant improvement in normal urine color was not found for either group. **Conclusion:** The findings of this study demonstrated that the fluid intake intervention improved hydration status of the experimental group participants. Consequently, it was confirmed that the intervention is considered to be effective in preventing dehydration which occurs frequently in older adults in long-term care facilities and, thus this intervention may contribute to preventing various health issues resulting from dehydration.

Key Words: *Aged; Dehydration; Urine specific gravity; Urine color; Oral rehydration*
국문주요어: 노인, 탈수, 요비중, 소변색, 구강수분섭취

INTRODUCTION

The population aged 65 or older is growing fast in South Korea and estimated to reach 20% of the total population by 2026 (Statistics Korea, 2010). Hence the need for long-term health care for this population is also increasing. Long-term care hospitals, one of the care facilities for elders, numbered 199 in 2005 and increased to 848 in 2010. The growth was accelerated after the long-term care insurance became effective in July, 2008 (Ministry of Health & Welfare, 2010). Long-term care hospitals, according to article 36 of the medical law, are to medically treat older adults who need long term care for health problems such as senile diseases, chronic diseases, and post-operative or post-traumatic states (Korea Law Information Center, 2010).

One of substantial health problems for elders who are hospitalized in long-term care facilities is dehydration (Mentes, 2006). Proper hydration

is a key to staying healthy and alive. Fluid is essential to maintain body temperature, to deliver nutrients and eliminate waste products, and to shape tissue constructs. Fluid is also essential for cell metabolism including brain cells (Choi, Kim, Park, Choi, & Lee, 2004). The proportion of water is high in body elements, but decreases as people age; the proportion is up to 65% in adults and then decreases to 46-52% in elders. Older adults are prone to fluid insufficiency for several reasons. They are already in short supply of body water as mentioned earlier, are likely to limit fluid intake due to mobility restraints or incontinence, or are ignorant of the importance of fluid intake. Moreover some adults are unable to perceive thirst because of a deteriorated cognitive states resulting from cerebrovascular diseases, paralytic diseases, or dementia (Lee, Kwon, & Kim, 2004).

In the United States, hydration status or dehydration in older adults is considered an important quality indicator of nursing care. Therefore a comprehensive evaluation of residents' hydration status is required within 14 days of admission (Popejoy et al., 2000). On the contrary, it is reported that fluid intake of elders residing in long-term care facilities in Korea is often inadequately managed (Oh, Hur, & Kim, 2006; Oh, Lee, Hur, & Kim, 2007; Shin, 2007). According to a previous study, daily fluid

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intake for older adults was often far less than the required amount and the proportion of elders without adequate fluid intake was over 50% (Oh et al., 2006).

Considering the high prevalence of dehydration or inadequate fluid intake and the severity of its ramifications, more studies evaluating the effects of fluid intake interventions for institutionalized elders are needed. But there are only a small number of intervention studies in literature from abroad (Culp, Mentes, & Wakefield, 2003; Mentes & Culp, 2003; Simmons, Alessi, & Schnelle, 2001), and very few in Korea (Oh et al., 2007). Moreover, many of these studies were conducted in nursing homes where the acuity and severity of the residents' health problems are less than for residents in long-term care hospitals. Therefore, in this study, effects of a fluid intake intervention for elders in a long-term care hospital were evaluated to provide evidence for caregivers in long-term care hospitals to utilize in improving the hydration status of their residents. Specifically, the purposes of this study were to assess the effects of a fluid intake intervention (1) on participants' daily fluid intake, and (2) on participants' physiological indexes related to dehydration such as blood urea nitrogen, creatinine, urine specific gravity, and urine color. Hypotheses tested in this study were as follows;

1. After the fluid intake intervention, the daily fluid intake in the experimental group will be greater than that in the control group.

2. After the fluid intake intervention, the physiological indexes in the experimental group will be better than that in the control group.

   1) After the fluid intake intervention, the percentage of participants with normal values for blood urea nitrogen/creatinine in the experimental group will be higher than that in the control group.

   2) After the fluid intake intervention, the percentage of participants with normal urine specific gravity in the experimental group will be higher than that in the control group.

   3) After the fluid intake intervention, the percentage of participants with normal urine color in the experimental group will be higher than that in the control group.

METHODS

1. Subjects and study design

A nonequivalent control group, pretest and posttest design was used. General and health-related characteristics of the participants were measured once, before the 4-week intervention. Outcome variables of daily fluid intake, blood urea nitrogen (BUN), creatinine (Cr), urine specific gravity (USG), and urine color were measured twice, before and after the intervention.

A convenience sample of 90 elders (45 each in the experimental and control groups) from one long-term care hospital in J city, Korea were included in this study. Sample size of 45 in each group was estimated based on the power analysis by Cohen (1988) using alpha .05, effect size .60, and power .80. Selection criteria were (1) 65 years old or older, (2) not on parenteral nutrition, (3) without fluid intake restriction for any purpose, and (4) provision of informed consent by the participants or their authorized guardians.

To prevent diffusion of the experimental effects, participants in each group were selected from different floors in the facility; 45 participants in the experimental group from the 2nd floor and the remaining 45 participants in the control group from the 3rd floor. Six participants in the experimental group (4 discharges, 2 deaths) and 7 participants in the control group (6 discharges, 1 death) were dropped from the study. Therefore 39 in experimental group and 38 in control group were included in the final data analysis. Participants' mortality rate was 14.4%.

2. Fluid intake intervention

The fluid intake intervention was to facilitate taking more than 1,100 mL of fluid daily from water and beverages for four weeks. The Korean Nutrition Society (2010) recommends that adequate fluid intake per day for an elderly person in Korea is 2,100 mL including 1,100 mL of fluid from water and beverages. The Korean Nutrition Society asserts that adequate fluid intake must be met for an elderly person to maintain optimal health and to prevent chronic debilitating diseases. The four-week intervention period was decided based on the study by Oh, Lee, Hur, and Kim (2007). The intervention consisted of 1) encouraging oral fluid intake at every meal and medication time, 2) providing tea time twice a day with the preferred beverage for each participant, 3) offering fluids between meals, and 4) placing an individual fluid bottle at the bedside of each participant, and encouraging oral fluid intake on all nursing rounds. The specific intervention activities and times are listed in Table 1.

Head nurses, staff nurses, and other caregivers who were educated by the primary researcher implemented the intervention. The staff education was comprised of raising perceptions of the importance of fluid intake, understanding ways of encouraging and offering fluids, and acknowledging motivations and roles. The staff nurses and other caregiv-

Table 1. Fluid Intake Intervention

Time	Activity	Intervention
07:30 - 08:00	Breakfast and medication	Encouraging intake of liquid foods and water
10:00 -	Tea time	Providing tea or preferred beverage
12:00 - 12:30	Lunch and medication	Encouraging intake of liquid foods and water
14:30 - 15:00	Tea time	Providing tea or preferred beverage
16:30 -	Between meal time	Providing water
17:30 - 18:00	Supper and medication	Encouraging intake of liquid foods and water
19:00 - 20:00	Between meals	Providing water
21:00 - 22:00	Bedtime medication	Encouraging intake of water

ers were mainly responsible for actually offering and encouraging fluids. Head nurses were responsible for reminding elders in the experimental group of the importance of fluid intake, and for supervising, guiding, or supporting, as necessary, staff nurses and other caregivers in providing intervention activities as scheduled.

3. Instruments

1) Cognitive function

The participants' cognitive function was measured with the Korean version of the Mini-Mental State Examination (MMSE-K) by Kwon and Park (1989). Scores range from 0 to 30; 24 or more indicating normal, 20-23 indicating suspicious, and 19 or less indicating deteriorated cognitive function.

2) Physical function

Physical function was measured with the Barthel Index (Shah, 1989) which is used to determine an individual's level of disability by the Ministry of Health and Welfare in Korea. It consists of 11 items assessing activities of daily living. Scores range from 0 to 100; the higher the scores are, the more independent the elders are. The Cronbach's alpha for this instrument with the current participants was .93.

3) Daily fluid intake

Daily fluid intake is the total amount of oral fluid taken by a participant in one day from water, soup, tea, beverages, etc. Daily fluid intake does not include fluids from solid foods such as rice, vegetables, fruits, etc. It was determined as the average of daily fluid intake measured in milliliters for three consecutive days. Daily fluid intake was recorded on the 'Intake Record Sheet', developed based on the fluid recording sheet

used in the facility. The sheet was validated by three nursing faculty and three other nurses who were specialized in gerontological nursing.

4) Physiological indexes related to dehydration

The physiological index determined from participants' blood was the ratio of blood urea nitrogen (BUN) to creatinine (Cr), and the physiological indexes determined from participants' urine included urine specific gravity (USG) and urine color.

(1) BUN/Cr

The ratio of BUN to Cr was determined by the facility's laboratory technician using the COVAS INTEGRA 400. Four milliliters of blood, which was drawn early in the morning while participants were in NPO state, were used to determine BUN/Cr. The normal value of BUN/Cr in this study was 20 or lower. A value of 20 or higher is considered an indication of dehydration (The Korean Urological Association, 2007).

(2) USG

USG represents the level of urine concentration, and was determined by the facility's laboratory technician using a handheld refractometer (Urometer 720). Participants' urine samples were collected through self-voiding or straight catheterization. A value of 1.020 or less indicates normal. Values ranging from 1.020 to 1.029 indicate risk of dehydration, and values of 1.029 or higher indicate dehydration (The Korean Urological Association, 2007).

(3) Urine color

Urine color was determined by the facility's laboratory technician using a urine color chart which uses numbers to code the color; ranging from "very pale yellow" (1) to "brownish green" (8). Higher numbers indicate darker urine due to dehydration. There are three levels of hydration status: normal for urine color of 1 to 3, risk of dehydration for urine color of 4 to 6, and dehydration for urine color of 7 to 8 (Armstrong, 2007; Armstrong et al., 1994, 1998).

4. Data collection

Data were collected between September 16 and November 4, 2010 by three research assistants who were head nurses in the facility and were trained by the researchers.

General characteristics of the participants and most health-related

characteristics were collected from the medical records. Of the health-related characteristics, cognitive function and physical function had been evaluated monthly; cognitive function was measured by the facility's physician and physical function was measured by the research assistants. The inter-rater reliability coefficient between the three research assistants was .90.

Daily fluid intake was measured mainly by the three research assistants with the help of other staffs. Measuring cups of 200 mL capacity were used to measure fluid intake amounts. Volumes of various containers such as bowls, dishes, cups, and commercial packages were measured. If a participant used one of the containers, the staff used 50 cc syringes to measure the amount of left over fluid and recorded the exact amount of fluid taken.

Researchers attached an 'Intake Record Sheet' to each participant's bedside to keep track of accurate fluid intake measurements. Research assistants regularly documented fluid intake after each intervention activity. To document amount of fluid taken by a participant privately in addition to the intervention activities, a wastebasket was placed next to each participant's bed and research assistants checked its content.

BUN, Cr, USG, and urine color were measured twice, specifically before and after the intervention. The measurement of physiological indexes for all participants took 3 days before the first day of intervention and again 3 days right after the intervention completion. Blood and urine samples were collected by staff nurses. Blood was drawn from peripheral route in the early morning while the participants were under NPO state. Urine was collected using bedpan with participants' cooperation or simple catheterization. Data collection from the control group was executed in the same manner used for the experimental group. Researchers provided small gifts to participants after each measurement.

5. Data analysis

Descriptive statistics were used to analyze general and health-related characteristics, daily fluid intake, and physiological indexes. Homogeneity tests between experimental and control groups for participants' characteristics and dependent variables were done with Chi-square test, Fisher's exact method, or t-test. Changes in daily fluid intake and physiological indexes between before and after the intervention were compared using Chi-square test, Fisher's exact method, or t-test. An alpha level of .05 was used in inferential tests. All analyses were conducted using the Statistical Package for Social Sciences version 17.0 (SPSS Inc., Chicago, IL, USA).

6. Ethical considerations

The research was approved by the Departmental Review Board at the College of Nursing at C National University. Research approval was also obtained from the ethical committee of the facility. Eligible participants signed consent forms to take part in the study after they listened to researchers' explanation of the purpose and procedure of the study, and harmlessness and privacy protection of being in the study. Eligible participants' family members signed the consent forms if participants' ability to give informed consent was in question.

Researchers ensured that the study did not incur any extra cost or physical harm to participants. Researchers covered the cost of tea, beverages, and extra diapers. The blood and urine testing for the study were executed simultaneously with the facility's basic routine tests, so it was not necessary to add extra charges for the testing, extra needle sticking for blood sampling, or extra straight catheterization for urine sampling. Staff nurses and other caregivers were trained to deal with increased frequency and amount of urination; providing skin care vigilantly, changing diapers more often, and helping and closely monitoring participants with high risk of falls getting to and from toilets. Participants in control group received the intervention after the study was completed.

RESULTS

1. Characteristics of participants and homogeneity tests

Seventy-seven elders participated in the study: experimental group (39) and control group (38). General characteristics of the participants are shown in Table 2. Participants were mostly women (experimental: 76.9%, control: 73.7%) with a mean age around 80 years (experimental: 78.9, control: 80.9). Almost half of the participants had no formal education (experimental: 48.7%, control: 42.1%) and did not have spouses (experimental: 87.2%, control: 86.8%). Homogeneity tests on general characteristics revealed that the two groups were not significantly different.

Health-related characteristics of the participants are shown in Table 3. Mean time from admission was 10.11 months (experimental group) and 15.07 months (control group). About 50% of the participants had bowel movements once every 4 or more days (experimental: 48.7%, control: 52.6%). About two-thirds of the participants in each group were not on diuretics. More than half of the participants in each group were taking 6 to 9 medications with a mean of 6.5 (experimental) and 6.8 (control). The mean score for participants' cognitive function was low at 13.2 (experi-

Table 2. General Characteristics and Homogeneity Tests (N = 77)

Characteristics Category	n (%) or Mean ± SD		X² or t	p
	Exp (n = 39)	Cont (n = 38)		
Gender				
M	9 (23.1)	10 (26.3)	0.11	.742
F	30 (76.9)	28 (73.7)		
Age (yr)	78.9 ± 7.7	80.9 ± 7.3	-1.19	.240
65 - 69	6 (15.4)	4 (10.5)	1.40	.731
70 - 79	14 (35.9)	11 (28.9)		
80 - 89	16 (41.0)	18 (47.4)		
90 - 95	3 (7.7)	5 (13.2)		
Education				
No formal education	19 (48.7)	16 (42.1)	-	.876*
Elementary school	11 (28.2)	14 (36.8)		
Middle school	4 (10.3)	3 (7.9)		
High school or more	5 (12.8)	5 (13.2)		
Spouse				
Yes	5 (12.8)	5 (13.2)	0.01	.965
No	34 (87.2)	33 (86.8)		

*Fisher's exact method.
Exp = experimental group; Cont = control group.

Table 3. Health-related Characteristics and Homogeneity Tests (N = 77)

Characteristics Category	n (%) or Mean ± SD		X² or t	p
	Exp (n = 39)	Cont (n = 38)		
Period of admission	10.1 ± 9.8	15.1 ± 12.4	-1.95	.055
6 months or less	19 (48.7)	10 (26.3)		
7-12 months	10 (25.7)	10 (26.3)		
13-24 months	5 (12.8)	9 (23.7)		
25 months or more	5 (12.8)	9 (23.7)		
Interval between bowel movements				
1 day	4 (10.3)	7 (18.5)	1.76	.415
2 or 3 days	16 (41.0)	11 (28.9)		
4 or more days	19 (48.7)	20 (52.6)		
Diuretics				
Yes	11 (28.2)	11 (28.9)	0.01	.943
No	28 (71.8)	27 (71.1)		
Number of medications	6.5 ± 2.6	6.8 ± 2.0	-0.52	.603
2-5	12 (30.8)	10 (26.3)		
6-9	21 (53.8)	24 (63.2)		
10 or more	6 (15.4)	4 (10.5)		
Cognitive function	13.2 ± 5.4	12.6 ± 5.8	0.45	.653
Normal or suspicious	3 (7.7)	2 (5.3)		
Deteriorated	36 (92.3)	36 (94.7)		
Physical function	53.6 ± 30.4	49.9 ± 31.1	0.53	.597
Completely dependent	13 (33.3)	15 (39.5)		
Highly dependent	4 (10.3)	4 (10.5)		
Moderately dependent	7 (17.9)	7 (18.4)		
Slightly dependent	15 (38.5)	8 (21.1)		
Rarely dependent	0 (0.0)	4 (10.5)		

Exp = experimental group; Cont = control group.

mental) and 12.6 (control) and therefore cognitive function of most participants had been deteriorated (experimental: 92.3%, control: 94.7%). Physical function of most of the participants was either completely dependent (experimental: 33.3%, control: 39.5%) or slightly dependent (experimental: 38.5%, control: 21.2%). Homogeneity tests on health-related characteristics revealed that the two groups were not significantly different.

2. Dependent variables and homogeneity tests

Participants in the experimental and control groups with normal values numbered 16 (41.0%) and 18 (47.4%) for BUN/Cr, 21 (53.8%) and 25 (65.8%) for USG, and 37 (94.9%) and 33 (86.8%) for urine color respectively. Before conducting homogeneity tests, Kolmogorov-Smirnov tests were done as the sample size was small, and the results indicated that the variables were normally distributed. The two groups were not significantly different on daily fluid intake (t = -1.35, p = .183), BUN (t = -1.27, p = .208), and Cr (t = -1.931, p = .059). The two groups were not significantly different on BUN/Cr (χ^2 = 0.31, p = .575), USG (χ^2 = .355, p = .202), or urine color (χ^2 = 0.14, p = .710) (Table 4).

3. Effects of the intervention

The results of hypotheses testing about daily fluid intake and physiological indexes are presented in the Table 5. The first hypothesis was this; 'the daily fluid intake in the experimental group after the intervention will be greater than that in the control group'. The amount of daily fluid

Table 4. Dependent Variables and Homogeneity Tests (N = 77)

Variable Category	n (%) or Mean ± SD		X² or t	p
	Exp (n = 39)	Cont (n = 38)		
Daily fluid intake (mL)	876.4 ± 292.9	990.7 ± 436.1	-1.35	.183
BUN (mg/dL)	12.9 ± 3.70	14.4 ± 6.50	-1.27	.208
Cr (mg/dL)	0.58 ± 0.22	0.73 ± 0.42	-1.93	.059
BUN/Cr				
Normal	16 (41.0)	18 (47.4)	0.31	.575
Dehydration	23 (59.0)	20 (52.6)		
USG				
Normal	21 (53.8)	25 (65.8)	0.355	.202
Risk of dehydration	18 (46.2)	13 (34.2)		
Dehydration	0 (0.0)	0 (0.0)		
Urine color				
Normal	34 (87.2)	32 (84.2)	0.14	.710
Abnormal	5 (12.8)	6 (15.8)		

BUN = blood urea nitrogen; Cr = creatinine; USG = urine specific gravity; Exp = experimental group; Cont = control group.

intake in the experimental group after the intervention increased more than that in the control group and the increase was statistically significant (t = 8.96, p < .001). Therefore the first hypothesis was supported.

The second hypothesis was this; 'the physiological indexes such as

Table 5. Comparisons of Dependent Variables between Groups (N = 77)

Variable Category	n (%) or Mean ± SD		X^2 or t	p
	Exp (n = 39)	Cont (n = 38)		
Daily fluid intake				
Before	876.4 ± 292.9	990.7 ± 436.1	8.96	< .001
After	1,474.5 ± 292.9	1,085.3 ± 399.1		
After-Before	598.1 ± 271.3	94.6 ± 217.9		
BUN/Cr				
Normal	29 (74.4)	20 (52.6)	3.97	.048
Dehydration	10 (25.6)	18 (47.4)		
USG				
Normal	34 (87.2)	21 (55.3)	9.61	.002
Risk of dehydration	5 (12.8)	17 (44.7)		
Urine color				
Normal	37 (94.9)	33 (86.8)	-	.263*
Abnormal	2 (5.1)	5 (13.2)		

*Fisher's exact method.
BUN = blood urea nitrogen; Cr = creatinine; USG = urine specific gravity; Exp = experimental group; Cont = control group.

BUN/Cr, USG, and urine color in the experimental group after the intervention will be better than that in the control group'. The number of participants in the experimental and control groups with normal values for BUN/Cr after the intervention was 29 (74.4%) and 20 (52.6%) respectively. The percentage of participants with normal BUN/Cr in experimental group was significantly higher than that in the control group (χ^2 = 3.97, p = .048). Therefore the hypothesis about BUN/Cr was supported.

The number of participants in the experimental and control groups with normal USG was 34 (87.2%) and 21 (55.3%) respectively. The percentage of participants with normal USG in the experimental group was significantly higher than that in the control group (χ^2 = 9.61, p = .002). Therefore the hypothesis about USG was supported.

The number of participants in the experimental and control groups with normal urine color was 37 (94.9%) and 33 (86.8%) respectively. The percentage of participants with normal urine color in the experimental group was slightly higher than that in the control group but the difference was not statistically significant (p = .263). Therefore the hypothesis about urine color was not supported. In summary, the hypothesis about physiological indexes was supported with the exception in urine color.

DISCUSSION

The participants' daily fluid intake before the intervention was far less than the recommended adequate intake of 1,100 mL. The problem of inadequate intake of fluid was also found in other elders residing in long-

term care facilities (Oh et al., 2006). Participants' characteristics and inadequate intake of fluid corroborates the common theme found in the literature that fluid intake insufficiency is induced partly from individual barriers such as long-term care patients' deteriorating cognitive or physical function (Kayser-Jones et al., 1999; Mentes, 2006; Mentes & Culp, 2003; Oh et al., 2006; Shin, 2007). In the literature, it is reported that fluid intake insufficiency is also induced by environmental barriers such as shortages in nursing care personnel, but the environmental barrier was not covered this study.

The daily fluid intake in the experimental group was significantly greater than that in the control group, and the experimental group consumed increased amount of daily fluid (about 600 mL more) after the intervention. These results clearly demonstrated that the reported activities of encouraging, providing, and prompting fluid intake in the literature are effective in improving hydration status in elders residing in long-care facilities (Culp et al., 2003; Mentes & Culp, 2003; Oh et al, 2007; Simmons et al., 2001). The improved hydration status, in turn, may be effective in preventing dehydration-related events. Mentes and Culp (2003) provided an 8-week hydration intervention to 49 elders with incontinence and found improvements in hydration-linked events such as infection or acute confusion.

The intervention also significantly increased the proportion of participants with a normal ratio of BUN/Cr in the experimental group compared to participants in the control group. In the current study, the proportion of dehydrated elders determined by the BUN/Cr was over 50% in both groups before the intervention which was almost twice of the 27% reported by Bennett, Thomas, and Riegel (2004). However, the current study used the ratio of higher than 20 to determine dehydration, while Bennett et al. (2004) used the ratio of higher than 25, which is more conservative. Therefore BUN/Cr when used alone may not be appropriate to determine hydration status.

The finding that the number of participants in the experimental group with USG in the normal range which was increased significantly after the intervention was contrary to the non-significant change reported by Oh and colleagues (2007). Oh et al. (2007) found that the mean USG changed significantly after their intervention but the proportion of participants with normal USG was not differ significantly in both groups. This result is possibly related to the increases in daily fluid intake of around 600 mL after the intervention in current study participants, which is larger than that in the study by Oh and colleagues (2007). The resear-

chers (Oh et al., 2007) speculated that the increase of 400-500 mL daily fluid intake might not be sufficient to change an abnormal USG to normal. Thus, replication studies in the future need to explore the interplay between magnitude of daily fluid intake increase and change in USG.

The intervention was not successful in affecting participants' urine color. The number of participants with normal urine color in each group was not significantly different after the intervention. This result was similar to what Mentes and Culp (2003) found in their experiment with 49 participants from four nursing homes. Mentes and Culp evaluated the effects of an 8-week hydration intervention but failed to find a significant change in urine color while they found improvements in other hydration-linked events. Oh and colleagues (2007) reported an unexpected finding about urine color, too. They assessed the urine color of their 39 participants once before their intervention and twice after the intervention, but found that all the assessment results were normal. There are several explanations for the discrepancy between urine color and other measures in representing elders' hydration state. Kolasa, Lackey and Grandjean (2009) asserted that the level of precision and accuracy of urine color is not the same as urine specific gravity. Mentes, Wakefield, and Culp (2006) also insisted that urine color may not be a valid measure to evaluate hydration state of elders in long-term care facilities as those elders are suffering from diverse medical conditions that might affect the ability of the kidneys to concentrate urine, and also are taking various medications that might change the color of urine. Nevertheless, Wakefield et al. (2002) asserted that urine color is still a useful, low-cost, and practical measure to monitor hydration state during everyday activities.

This experimental study contains some issues for researchers of future replication studies to consider. First, the fact that this study was conducted only in one long-term care facility contains both pros and cons. Since only one facility was the study site, it was practical to pull up all the possible resources for the study and to simplify executing the experiment. However the generalization of the study findings is limited since all the participants were recruited from one site. Secondly, although the best measure to determine hydration status in the elderly would be testing blood, authors of this study chose to use USG and urine color. While more studies are needed to clarity reliabilities of USG and urine color, these tests may still continue to be the choice for many reasons such as cost, easiness, non-invasiveness, etc.

In conclusion, this study demonstrates that it is possible to improve

hydration status in the long-term care hospital elders via the time and effort of nursing staff and using well designed hydration protocols. More replication studies are needed for the hydration intervention to become evidence-based routine care in properly staffed environments. Further, future studies should pay particular attention to selection of tools for assessing hydration status in elders. USG and urine color are low-cost, non-invasive, and simple ways to continuously monitor changes of hydration status in elders residing in long-term care facilities (Mentes, 2006; Mentes et al., 2006), but may not be as sensitive as other blood tests and are open to debate about validity in detecting dehydration. Future interventions may need to be applied for longer periods of time, for example, 8 weeks (Mentes & Culp, 2003) or 32 weeks (Simmons et al., 2001). Considering changes that follow aging such as slower response to altered homeostatis (Mentes & Culp, 2003), the intervention period of 4 weeks may not sufficient to correct various health issues, which have resulted from chronically inadequate hydrated status.

CONCLUSION

Majority of participants in the current study were taking much less oral fluid before the intervention than the recommended amount, but the issue in the experimental group improved significantly after the intervention. The improved hydration status was determined by supporting the hypotheses about daily fluid intake, BUN/Cr, and USG. The only hypothesis about urine color was not supported. Based on the study findings, the following recommendations can be made: 1) improve nursing care quality through prevention of dehydration in older adults, by regarding fluid intake intervention as one of the fundamental nursing care interventions, 2) make an effort to decrease barriers to adequate fluid intake, and 3) include fluid intake intervention protocols to the job descriptions of nurses in specialized hospitals for elders.

For research development, there are urgent needs for replication studies with expanded generalizability of the intervention and studies with expanded periods for the intervention as changes in homeostasis and physiological conditions in elders are slow. Finally studies to identify physiological measures that are more sensitive and specific than urine color to assess hydration status of the elders and that are preferably non-invasive. Since urine color may not be an accurate tool to assess hydration status of elders who usually are taking several medications that might alter urine color, and there are needs for utilizing various physiologic mea-

sures in studies conducted in Korea (Kim et al., 2006; Lee, Park, Cho, & Park, 2011).

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