

## ORIGINAL

# Diaper-zero program (prompted voiding care) improves diaper use in nursing home residents

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**Abstract :** With an aging population, the number of older adults admitted to nursing homes has increased. Diapers are often used to manage nursing home resident urinary incontinence, yet only one-third of these required assistance from caregivers to urinate. Unnecessary diaper use was reported in 23.9% of people, mostly for precautionary purposes. In this study, the Diaper-zero program caregivers asked residents regularly (every 2-3 h) whether they required voiding and prompted them to void. Over 11 months, the effects on 38 nursing home residents' diaper use, nursing care level, physical activity, daily energy, and water intake were measured. A higher rate of diaper wearing was initially observed with lower daily energy and water intakes at the beginning of the Diaper-zero program, but this association was not observed after 11 months of the program. The diaper usage rate decreased significantly from 71.1% to 47.4% after 11 months. During this period, for all subjects, nursing care level, physical activity, and total daily intakes of energy and water were unchanged. In conclusion, this program enhances the desire to void, minimizing diaper usage, thus protecting the human dignity of nursing home residents. *J. Med. Invest.* 70:221-225, February, 2023

**Keywords :** *diaper-zero program, urinary incontinence, nursing care, physical activity*

## INTRODUCTION

Aging populations in developed and developing countries increases the number of elderly individuals needing human and social support. The increase in admission of older adults to nursing homes, strains the aged care system. In nursing homes, care workers and other specialists provide integrated multidisciplinary care for older adults with frailty and sarcopenia, focused function recovery and participation (1). Older, frail individuals are at high risk of falls, disability, nursing home placement, and mortality (2). Weight loss also significantly impacts older adults, resulting in greater relative losses of lean mass and strength (3). Malnutrition and dehydration, also common in older people, are associated with frailty, sarcopenia, and poor health outcomes, often leading to increased diaper needs. Therefore, an adequate dietary intake meeting energy and protein requirements are essential in maintaining or increasing muscle mass and strength, which contributes significantly to the rehabilitations process. Older adults are also considered at risk of chronic dehydration due to reduced thirst sensitivity, lower urine concentrating ability, and lower fluid intake compared with young or middle-aged adults (4, 5). Furthermore, as lower fluid intake is commonly observed in older nursing home residents they may be at elevated risk of chronic dehydration (6, 7). Thus, nutrition and hydration are important in preserving physical function and continence in nursing home residents.

Within nursing home residents with urinary incontinence

(UI), the mean age was 79 years with 78% being women, and 48% of residents with UI requiring diapers (8). However, diaper use for UI is not normally indicated. Previously, the association between UI and mobility restriction among older people was described (9, 10). The Japanese Council of Senior Citizens Welfare Service in 2016 noted that the rate of elderly people managed by wearing diapers was reported to be 95% (11), 41.9% during daytime, and 65.7% at night. However, among diaper-wearing patients, one-third were able to urinate only with caregiver assistance (12). It was also reported that diapers were unnecessarily used in 23.9% of people, mainly for precautionary purposes (13).

When nursing home residents were prompted to void every 2-3 hours, while in the toilet, and provided requested assistance, 33% to 60% of them showed reduced incontinence event frequency to less than one episode per day, or became continent after participating in a prompted-voiding program (14-16). Although interest in patient welfare is growing in aging societies in terms of sarcopenia and frailty related quality of life in nursing homes, understanding of the association with UI is lacking. Therefore, we assessed relationships among diaper-usage rate, nursing care level, physical activity, and daily intakes of energy and water of nursing home residents before and after 11 months of the Diaper-zero program.

## MATERIALS AND METHODS

### Subjects

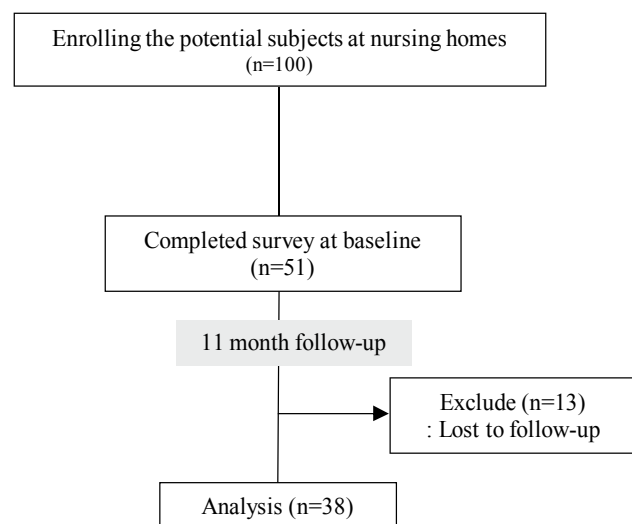
Participants were recruited in one nursing home, housing a total of 100 residents. Of the residents, 51 (10 male and 41 female : 86.0 ± 8.1 years old) agreed to participate in the baseline assessment and 38 (6 male and 32 female : 86.0 (80.8 - 90.3) years old) were followed up after 11 months of the Diaper-zero program (Fig. 1). Before and 11 months after the study, BMI,

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daily intake of energy and water, diaper-wearing status, nursing care level, and physical activity were assessed.

Height and weight measurements were performed with the participants wearing light clothing and no shoes. Body mass index (BMI) was calculated as weight (kg) divided by the square of height (m). Nursing care level (1 [mild] to 5 [severe]) was defined by care-needs level under the long-term care insurance, a public social service for elderly individuals in Japan (17).



During the study period, 51 elderly were recruited and 38 elderly were included in the final analysis.

Fig 1. Flow chart of participants

#### Daily energy and water intake

For two consecutive days, research staff directly observed periods during and between regularly scheduled meals. They recorded total food consumption and estimated the percent of each served food and fluid item consumed. Subjects and caregivers were instructed by registered dietitians on how to weigh each food and drink item, and to record consumption on recording days. Nursing home guidelines suggest residents receive an estimated total of 1600 kcal/day in standard meals, 1445 kcal/day in soft meals and 775 kcal/day in soup-like meals. Thus, an estimate of each participant's meal caloric intake was calculated based on average total percentages consumed for the six observed meals.

Total water intake corresponds to the sum of beverages (including tea, coffee, milk, and soup), water in food taken from the dietary record, and metabolic water on the day of urine collection. All foods and beverages consumed were recorded. Food scales were used for weighing, with standardized containers and templates used to estimate the amounts consumed. Dietary data were converted into water using the Standard Tables of Food Composition in Japan (18). Water is also produced by the oxidative metabolism of hydrogen-containing substrates in the body. Thus, total water intake was approximated by the addition of an assumed 200 ml of metabolic water.

#### Diaper usage

Diaper usage (daily percentage), evaluated by research staff at both start and after 11 months of the Diaper-zero program, was classified into 3 groups; non-diaper use, occasional diaper use, and all-day diaper use.

#### The physical activity

Research staff estimated the physical activity for all study participants. Physical activity was evaluated on a 4-point scale as able to walk independently, independent movement with wheelchair, movement in wheelchair by nursing home staff, and bed ridden, as 4, 3, 2 and 1 point, respectively.

#### Study design

This intervention study investigated the impact of 11 months of the Diaper-zero program by changes in BMI, daily intake of energy and water, diaper usage rate, nursing care level, and physical activity. In the interventional phase of the Diaper-zero program (prompted voiding), caregivers regularly asked the residents every 2-3 h whether they had a desire to void, prompting them to when the response was yes. Residents were also allowed to void whenever they desired. Individuals physically unable to visit the toilet were aided.

#### Statistical analysis

Continuous data are presented as mean (standard deviation [SD]) or median (interquartile range [IQR]). Comparisons were conducted using the Wilcoxon signed rank test and McNemar's test. The three groups, non-diaper wearing, occasional diaper wearing, and all-day diaper wearing were compared using the Kruskal Wallis test with a post hoc Steel Dwass test. All p-values were two tailed, and p-values < 0.05 considered significant. JMP version 13.1.0 (SAS Institute Inc., NC, USA) and R version 3.1.1 (R Foundation for Statistical Computing, Vienna, Austria) were used for statistical analysis.

#### Ethical considerations

Ethics approval was obtained from the clinical research ethics committee at Tokushima University Hospital (approval number 384). Informed consent to participate in the study was also obtained from participants or from an authorized surrogate.

## RESULTS

#### Association among diaper usage, nursing care level, physical activity rating, and daily intake of energy and water

At the beginning of the Diaper-zero program, participants were classified into 3 groups: non-diaper use, occasional diaper use, and all-day diaper use. As shown in Table 1, nursing care level, physical activity rating, and daily energy and water intake varied greatly between non-diaper use and all-day diaper use groups. Higher diaper wearing rates were associated with lower daily energy and water intakes, lower physical activity, and higher nursing care level (becoming severe). Analyses indicated the relationships among diaper wearing situation (Yes or No) and daily energy intake (Odds Ratio: 0.995, 95% CI: 0.990 – 0.999, p-value: 0.012), and daily water intake (Odds Ratio: 0.995, 95% CI: 0.992 – 0.999, p-value: 0.021) but was not related to age or BMI.

After 11 months of the Diaper-zero program, nursing care level and physical activity ratings showed no differences between non-diaper use and all-day diaper use groups (Table 2). Energy and water intakes did not vary among the 3 groups of diaper usage levels. Thus, diaper usage was not associated with energy

and water intake, nursing care level or physical activity rating.

*Changes in diaper usage after 11 months of the diaper-zero program*

As shown in Table 3, comparisons before and 11 months after the Diaper-zero program of nursing care level, physical activity,

and daily energy and water intake showed no significant differences. However, the rates of diaper use (occasionally and all-day) decreased significantly from 71.1% at program start to 47.5% after 11 months.

**Table 1.** Characteristic of Participants and association between diaper wearing status and daily energy and water intake at the start of diaper-zero program

	All (n = 38)	Non diasper wearing (n = 11) ①	Diasper wearing some time a day (n = 8) ②	Diasper wearing all day (n = 19) ③	P-value ① vs ②	P-value ① vs ③	P-value ② vs ③
Sex (male/female)	6/32	2/9	1/7	3/16			
Age (year)	86.0 (80.8-90.3)	84.0 (80.0-90.0)	87.5 (83-88.8)	86.0 (79.0-93.0)	0.892	0.757	0.998
BMI (kg/m <sup>2</sup> ) *n = 36	19.0 (17.1-20.3)	19.3 (17.6-22.2)	16.8 (15.6-19.0)	18.5 (17.2-20.2)	0.166	0.627	0.52
Nursing care level	4.0 (3.0-4.3)	3.0 (2.0-3.0)	3.5 (3.0-4.0)	4.0 (4.0-5.0)	0.135	0.001	0.067
Physical activity point	3.0 (2.0-3.3)	4.0 (3.0-4.0)	3.0 (3.0-3.5)	2.0 (1.6-3.0)	0.251	<0.001	0.031
Energy intake (kcal/day)	1172 (982-1336)	1342 (1189-1530)	1166 (1086-1295)	982 (982-1187)	0.066	0.007	0.33
(kcal/kg/day)	28.8 (25.7-31.4)	28.5 (26.7-31.1)	31.5 (26.2-43.0)	27.8 (24.8-30.3)	0.762	0.425	0.177
Total water intake (ml/day)	2344 (2171-2636)	2761 (2419-2971)	2324 (2182-2583)	2272 (2102-2371)	0.06	0.004	0.689
(ml/day/kg)	58.3 (52.8-66.5)	62 (55.0-67.1)	56.8 (53.3-84.2)	58.3 (50.7-63.6)	1	0.611	0.814

Steel dwass analysis

**Table 2.** Association between diaper usage and daily energy and water intake after 11 months of the Diaper-zero program

	All (n = 38)	Non-diaper use (n = 20) ①	Occasional diaper use (n = 6) ②	All-day diaper use (n = 12) ③	P-value ① vs ②	P-value ① vs ③	P-value ② vs ③
Nursing care level	4.0 (3.0-5.0)	3.0 (3.0-4.0)	5.0 (3.8-5.0)	4.5 (4.0-5.0)	0.01	0.001	0.886
Physical activity rating	3.0 (2.0-3.0)	3.0 (3.0-3.9)	2.5 (2.0-3.3)	2.0 (2.0-3.0)	0.272	0.002	0.611
Energy intake (kcal/day)	1166 (982-1290)	1177 (1085-1340)	1036 (943-1227)	1119 (982-1188)	0.405	0.48	0.884
(kcal/kg/day)	28.8 (25.7-31.4)	29.3 (26.0-31.5)	28.2 (24.4-34.7)	28 (23.3-30.4)	0.975	0.371	0.907
Total water intake (ml/day)	2312 (2172-2627)	2320 (2164-2940)	2310 (2168-2455)	2312 (2169-2391)	0.94	0.868	0.943
(ml/day/kg)	59.5 (52.9-66.1)	60.5 (54.1-65.3)	62.7 (50.8-76.8)	57.3 (50.3-64.3)	0.94	0.461	0.647

Table 3. Longitudinal research

	Pre	Post	Median (IQR)
BMI (kg/m <sup>2</sup> ) *n = 36	19.0 (17.1-20.3)	19.0 (17.1-20.3)	
Nursing care level	4.0 (3.0-4.3)	4.0 (3.0-5.0)	0.324
Physical activity point	3.0 (2.0-3.3)	3.0 (2.0-3.0)	0.089
Energy intake			
(kcal/day)	1172 (982-1336)	1166 (982-1290)	0.16
(kcal/kg/day)	28.8 (25.7-31.4)	28.8 (25.7-31.4)	0.083
Total water intake			
(ml/day)	2344 (2171-2636)	2312 (2172-2627)	0.939
(ml/day/kg)	58.3 (52.8-66.5)	59.5 (52.9-66.1)	0.829
Wearing diasper condition (n, %)			
Non	11	20	<0.001
Sometime a day or all day	27	18	

Wilcoxon signed rank test  
McNemar's test

## DISCUSSION

This study identified, at the start of this program, that higher daily energy and water intake was related with higher physical activity, lower nursing care level, and a lower diaper usage rate. Sarcopenia and frailty are associated with low energy intake in nursing home residents (19-21). Dehydration is also shown to negatively affect muscle endurance, power, and strength (22, 23). Older adults who are frail or experiencing sarcopenia were more likely to report UI than robust older adults. It is also known that nursing home residents with UI more often require a wheelchair (24) or walking aids (9). These findings suggest that either UI or diaper use can lead decreased physical activity, negatively impacting activities of daily living (ADL), or that ADL deterioration and compromised mobility affect UI due to the inability to reach the restroom in a timely manner, necessitating diaper use.

UI is common in community-dwelling and institutionalized elderly populations, with a prevalence ranging from 25% to 50% (25, 26). UI management in elderly individuals usually involves diaper use. Changing diapers is a stressful task for care workers (27). Prompted voiding is a toileting program that combines scheduled voiding with "prompting" from a caregiver and is appropriate for older adults with all types of UI. Between 25% and 33% of nursing home residents participating in previous prompted voiding trials have responded excellently, reducing UI frequency from an average of nearly four episodes per day to one or fewer per day (28, 29). In this study, the Diaper-zero program (prompted voiding care) decreased diaper usage rate from 71.1% at baseline to 47.4% after 11 months without changes in total daily energy and water intake.

The number of nursing home elderly managed by diapers was reported to be 56.0% (1,301 of 2322 people) (4). Diapers were used unnecessarily for 23.9% of people, mainly for precautionary purposes. Among the patients wearing diapers, one-third were capable of urinating only with the appropriate assistance of caregivers. Given this usage, nursing home residents may continue to have physical and mental disabilities to properly toilet

themselves, resulting in understaffed nursing homes unable to provide frequent assistance in toileting (prompted voiding) further increasing staff tendencies to rely on diapers. Thus, the Diaper-zero prompted voiding program, over 11 months, reduced diaper usage, without reducing nursing care level, physical activity point or energy and water intake (Table 3).

UI and diaper use are associated with reduced quality of life and human dignity (30). This Diaper-zero program may identify 30 - 40% of residents who are most responsive to prompted voiding, thus staff are able maintain consistent toileting assistance with this limited number of responsive residents. Therefore, the Diaper-zero program enhances the desire to void, protecting the dignity and pride of nursing home residents. In conclusion, the Diaper-zero program (prompted voiding care) improves diaper usage outcomes in nursing home residents.

## CONFLICT OF INTEREST AND ACKNOWLEDGEMENT

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