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Water Consumption Reduces Energy Intake at a Breakfast Meal in Obese Older Adults

BRENDA M. DAVY, PhD, RD, **ELIZABETH A. DENNIS**, **A. LAURA DENGO, MS**, **KELLY L. WILSON**, and **KEVIN P. DAVY, PhD**

B. M. Davy is an assistant professor, E. A. Dennis and A. L. Dengo are graduate students, K. L. Wilson is an undergraduate research assistant, and K. P. Davy is an associate professor, all with the Department of Human Nutrition, Foods and Exercise, Virginia Tech, Blacks-burg

Abstract

Water consumed before a meal has been found to reduce energy intake among nonobese older adults. However, it is unknown whether this effect is evident among overweight and obese older adults, a population who would benefit from strategies to improve energy intake regulation. Our purpose was to determine whether premeal water consumption reduces meal energy intake in overweight and obese older adults. Twenty-four overweight and obese adults (body mass index=34.3±1.2), mean age 61.3±1.1 years, were given an ad libitum standardized breakfast meal on two randomly assigned occasions. Thirty minutes before the meal, subjects were given either a 500-mL water preload or no preload. Energy intake at each meal was covertly measured. Meal energy intake was significantly less in the water preload condition as compared with the no-preload condition (500±32 vs 574±38, respectively; P=0.004), representing an approximate 13% reduction in meal energy intake. The percentage reduction in meal energy intake following the water preload was not related to sex, age, body mass index, or habitual daily water consumption (all P>0.05). Given the high prevalence of overweight and obesity among older adults, future studies should determine whether premeal water consumption is an effective long-term weight control strategy for older adults.

Advancing age is associated with weight gain (1,2), and obesity is common in older adults (≥60 years of age) (3). Numerous factors likely contribute to age-related weight gain, including a reduction in energy expenditure, a reduction in energy requirements, and an increased susceptibility to energy overconsumption (4–8). Although it is often thought of as an inevitable consequence of the aging process, weight gain leading to overweight and obesity in older adults has serious consequences, including increased morbidity and mortality, decreased mobility, and increased health care utilization and costs (9–13).

A common belief is that water ingestion reduces energy intake, but there is surprisingly little data addressing this possibility. Among nonobese young and older adults, water consumed before a meal increases satiety (14). Water consumed with a meal reduces sensations of hunger and satiety among normal-weight young and middle-aged women (15). Popkin and colleagues (16) reported that daily energy consumption among habitual water drinkers in the general adult population was approximately 9% (194 kcal/day) less than those who do not drink water. We recently reported that premeal water consumption reduced energy intake at a meal in nonobese older adults, but not in younger adults (14). However, to our knowledge it is unknown whether such an effect is evident in overweight and obese older adults, a population who would benefit

Address correspondence to: Brenda M. Davy, PhD, RD, Department of Human Nutrition, Foods and Exercise, 221 Wallace Hall (0430), Virginia Tech, Blacks-burg, VA 24061. bdavy@vt.edu.

from a strategy designed to suppress hunger and reduce energy intake at meals. Thus, the purpose of the present investigation was to investigate this issue.

METHODS

Subjects

Twenty-four overweight and obese (body mass index=34.3±1.2) adults (seven men, 17 women) with a mean age of 61.3±1.1 years (range=55 to 75 years) were recruited from a local university community for this investigation. Subjects were weight-stable (±2 kg for more than 1 year, determined by self-report), nonsmokers, without major chronic disease (ie, diabetes, coronary heart disease), and not taking medications known to influence food intake or body weight. Participants had no food allergies or restrictions, did not consume alcohol in excess (≤2 drinks/day), and were screened to exclude individuals with depression or eating disorders (17,18). All subjects provided informed consent before participation in the investigation, but they were not aware of the specific purpose of the study; they were informed that the purpose of the research was to investigate eating habits among older adults. The Institutional Review Board at Virginia Tech approved the protocol and the consent form.

Laboratory Measurements

Height was measured in meters without shoes using a scale-mounted stadiometer (Scale-Tronix, Wheaton, IL). Body weight was measured to the nearest 0.1 kg using a digital scale (Scale-Tronix model 5002). Body mass index was calculated as weight (kg)/height $(m)^2$. Body weight was measured at the initial study visit, and again at each test meal session to ensure weight stability.

Laboratory Test Meal Procedures

The meal randomization scheme (ie, the ordering of meal sessions one and two) was generated for each subject at the initial screening visit. Each participant consumed two breakfast meals in a random order as follows: (a) 30-minute waiting period (no preload) followed by an ad libitum standardized meal, and (b) preload consisting of 500 mL of chilled (5° to 7°C) bottled water, given 30 minutes before an ad libitum standardized meal. Breakfast meals for each subject were separated by a minimum of two days. We studied the impact of premeal water consumption on energy intake at breakfast instead of lunch or dinner to avoid the potential confounding effect of differences in food intake earlier in the day on test meal energy intake.

Subjects were instructed to arrive for the test meals in the fasted state (no food/beverages for ≥12 hours), and to refrain from exercise on the day before and morning of the test meals. This was verified with subjects when they arrived at the laboratory for the test meals. The 30-minute waiting period between water preload and meal was chosen because individuals compensate most accurately for the energy content of a preload when the preload is given 30 minutes before the lunch meal (19). Subjects were instructed to consume the water preload as quickly as they comfortably could, within a maximum time period of 15 minutes. Reading was permitted during test meal sessions.

Test meal items were evaluated for palatability before initiation of the study. The breakfast meal consisted of a standardized individual buffet-style meal containing a variety of typical breakfast items (cinnamon raisin bagel, cream cheese, margarine, jelly, vanilla yogurt, cereal bar, bananas, mozzarella cheese stick, orange juice, coffee, cream, and sugar) in excess of what would normally be consumed, presented in the same manner on both testing days (ie, serving location and temperature), from which the subjects were allowed to self-select during a 20-minute period. Meals were served in individual cubicles, under standardized laboratory conditions (ie, quiet, temperature-controlled). Foods were covertly weighed (±0.1 g) before being served and again after the completion of the meal to determine the amount consumed. Meal energy intake was calculated using nutritional analysis software (NDS-R 2006, 2006, University of Minnesota, Minneapolis).

Habitual Beverage Consumption

In addition to completing the laboratory test meals, we investigated habitual water and total beverage consumption patterns in our study population to determine if this was associated with laboratory test meal findings. Subjects were instructed in methods to accurately record their food and beverage intake, including the use of two-dimensional food models for estimation of portion size. Subjects recorded their dietary intake for four consecutive days (three weekdays and one weekend day). Intake records were analyzed using nutritional analysis software (NDS-R 2006, University of Minnesota) to determine energy content of beverages consumed, and records were reviewed manually to calculate mean daily amounts (g, kcal) of water and total beverages consumed.

Statistical Analysis

Statistical analyses were done using SPSS statistical analysis software (version 12.0 for Windows, SPSS Inc, 2004, Chicago, IL). Descriptive statistics (mean±standard error of the mean and frequencies) are reported for subject demographic characteristics and habitual mean water and total beverage consumption. Paired sample *t* tests were used to compare energy intake, gram weight of food consumed, and energy density (kcal/gram weight of food) at the two breakfast meals. Independent sample *t* tests were used to assess potential sex differences in absolute and relative change in meal energy intake, as well as possible differences between water consumers and nonconsumers (defined as those above and below the mean grams of water consumed in this sample). Associations among variables were assessed by simple correlational analyses (Pearson *r*). The *α* level was set a priori at $P<0.05$.

RESULTS AND DISCUSSION

Energy intake consumed during the two test meals is shown in the Figure. As with meal energy intake, the gram weight of food consumed at the test meals was also less in the water preload condition as compared with the no-preload condition (611±31 vs 663±36 g, respectively; $P=0.023$). Dietary energy density did not differ between the two test meals (water preload: 0.83±0.03; no water preload: 0.87±0.04, $P=0.13$). Participants consumed significantly less energy at the test meal after the water preload as compared with the no-preload condition (74 ±23 kcal difference in energy intake between the two conditions), which represented an approximate 13% reduction in meal energy intake. Energy intake and grams of food consumed at breakfast among male and female participants are provided in the Table. The relative reduction in meal energy intake following the water preload did not differ significantly between male and female participants (8%±5% vs 11%±5%, respectively; $P=0.70$), nor did it differ between those categorized as overweight vs obese (9%±6% vs 11%±5%, respectively; $P=0.77$) or between water consumers (mean daily water intake >304 g/day; 8%±5% reduction) vs non-water consumers (mean daily water intake <304 g/day; 12%±5% reduction, $P=0.54$). The percentage reduction in meal energy intake was not significantly associated with age ($r=-0.10$, $P=0.64$), body mass index ($r=0.15$, $P=0.48$), mean habitual water intake ($r=0.23$, $P=0.32$), or mean habitual total beverage consumption ($r=0.04$, $P=0.88$).

Habitual daily water consumption in this sample (304±121 g; approximately 10.6 fl oz) was less than the recently proposed guidelines of 20 to 50 fl oz/day for adults (20). In addition, total daily beverage consumption was 1,553±143 g/day (approximately 54 fl oz), which represents approximately 50% of recommended total fluid intake (20,21). Mean total energy content of beverages consumed was 313±36 kcal/day.

We observed that premeal water consumption reduces meal energy intake (74 kcal) among overweight and obese older adults, which is consistent with our previous work demonstrating that consuming approximately 2 cups of water before a meal reduced meal energy intake by approximately 60 kcal in nonobese older adults (14). The mechanism(s) responsible for reduced meal energy intake following water consumption in older adults are unclear, but delayed gastric emptying (22) may contribute by reducing hunger and promoting fullness (6, 14,23). Inasmuch as gastric emptying is a time-dependent phenomenon, it is unknown how the timing of premeal water consumption might modulate subsequent meal energy intake. Future studies are needed to address this important issue.

Our findings should not be extrapolated beyond an acute meal setting and the population studied. To obtain objective measures of food/energy intake, the breakfast meals were conducted in a laboratory setting; thus, it is possible that this setting may have influenced participant's food intake. Finally, it is unknown whether the significant reduction in meal energy intake after water consumption would be sustained with increased habitual water consumption, and whether premeal water consumption would facilitate weight loss and maintenance. However, these preliminary findings may serve as the basis for justifying future larger-scale intervention studies in this area.

CONCLUSIONS

Premeal water consumption reduced meal energy intake in overweight and obese older adults, suggesting that this may be an effective weight-control strategy for this segment of the population, particularly because habitual water consumption seems to be substantially less than recommended levels. The latter issues seem to be important areas for future investigation considering recent data indicating that adults 60 years of age and older have a higher prevalence of overweight and obesity (71%) than the general population (24).

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References

1. Lissner L, Andres R, Muller DC, Shimokata H. Body weight variability in men: Metabolic rate, health and longevity. Int J Obes 1990;14:373–383. [PubMed: 2361814]
2. Littman AJ, Kristal AR, White E. Effects of physical activity intensity, frequency, and activity type on 10-y weight change in middle-aged men and women. Int J Obes (Lond) 2005;29:524–533. [PubMed: 15672107]
3. Flegal KM, Carroll MD, Ogden CL, Johnson CL. Prevalence and trends in obesity among US adults, 1999–2000. JAMA 2002;288:1723–1727. [PubMed: 12365955]
4. Roberts SB, Dallal GE. Energy requirements and aging. Public Health Nutr 2005;8:1028–1036. [PubMed: 16277818]
5. Boudville A, Bruce DG. Lack of meal intake compensation following nutritional supplements in hospitalised elderly women. Br J Nutr 2005;93:879–884. [PubMed: 16022757]
6. Rolls BJ, Dimeo KA, Shide DJ. Age-related impairments in the regulation of food intake. Am J Clin Nutr 1995;62:923–931. [PubMed: 7572737]
7. Roberts SB, Fuss P, Heyman MB, Evans WJ, Tsay R, Rasmussen H, Fiatarone M, Cortiella J, Dallal GE, Young VR. Control of food intake in older men. JAMA 1994;272:1601–1606. [PubMed: 7966871]
8. Van Walleghen EL, Orr JS, Gentile CL, Davy KP, Davy BM. Habitual physical activity differentially affects acute and short-term energy intake regulation in young and older adults. Int J Obes (Lond) 2007;31:1277–1285. [PubMed: 17342074]

9. Villareal DT, Apovian CM, Kushner RF, Klein S. Obesity in older adults: Technical review and position statement of the American Society for Nutrition and NAASO, The Obesity Society. Obes Res 2005;13:1849–1863. [PubMed: 16339115]

10. Stevens J, Cai J, Pamuk ER, Williamson DF, Thun MJ, Wood JL. The effect of age on the association between body-mass index and mortality. N Engl J Med 1998;338:1–7. [PubMed: 9414324]

11. Harris TB, Launer LJ, Madans J, Feldman JJ. Cohort study of effect of being overweight and change in weight on risk of coronary heart disease in old age. BMJ 1997;314:1791–1794. [PubMed: 9224080]

12. Lee JS, Kritchevsky SB, Tylavsky F, Harris T, Simonsick EM, Rubin SM, Newman AB. Health ABC Study. Weight change, weight change intention, and the incidence of mobility limitation in well-functioning community-dwelling older adults . J Gerontol A Biol Sci Med Sci 2005;60:1007–1012. [PubMed: 16127104]

13. Leigh JP, Hubert HB, Romano PS. Lifestyle risk factors predict healthcare costs in an aging cohort. Am J Prev Med 2005;29:379–387. [PubMed: 16376700]

14. Van Walleghen EL, Orr JS, Gentile CL, Davy BM. Pre-meal water consumption reduces meal energy intake in older but not younger subjects. Obesity (Silver Spring) 2007;15:93–99. [PubMed: 17228036]

15. Lappalainen R, Mennen L, van Weert L, Mykkanen H. Drinking water with a meal: A simple method of coping with feelings of hunger, satiety and desire to eat. Eur J Clin Nutr 1993;47:815–819. [PubMed: 8287852]

16. Popkin BM, Barclay DV, Nielsen SJ. Water and food consumption patterns of U.S. adults from 1999 to 2001. Obes Res 2005;13:2146–2152. [PubMed: 16421349]

17. Radloff L. The CES-D scale: A self-report depression scale for research in the general population. Appl Psychol Meas 1977;1:385–401.

18. Garner DM, Olmsted MP, Bohr Y, Garfinkel PE. The eating attitudes test: Psychometric features and clinical correlates. Psychol Med 1982;12:871–878. [PubMed: 6961471]

19. Rolls BJ, McDermott TM. Effects of age on sensory-specific satiety. Am J Clin Nutr 1991;54:988–996. [PubMed: 1957832]

20. Popkin BM, Armstrong LE, Bray GM, Caballero B, Frei B, Willett WC. A new proposed guidance system for beverage consumption in the United States. Am J Clin Nutr 2006;83:529–542. [PubMed: 16522898]

21. Institute of Medicine. Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate. Washington, DC: The National Academies Press; 2005.

22. Clarkston WK, Pantano MM, Morley JE, Horowitz M, Littlefield JM, Burton FR. Evidence for the anorexia of aging: Gastrointestinal transit and hunger in healthy elderly vs. young adults. Am J Physiol 1997;272:R243–R248. [PubMed: 9039015]

23. Sturm K, Parker B, Wishart J, Feinle-Bisset C, Jones KL, Chapman I, Horowitz M. Energy intake and appetite are related to antral area in healthy young and older subjects. Am J Clin Nutr 2004;80:656–667. [PubMed: 15321806]

24. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999–2004. JAMA 2006;295:1549–1555. [PubMed: 16595758]

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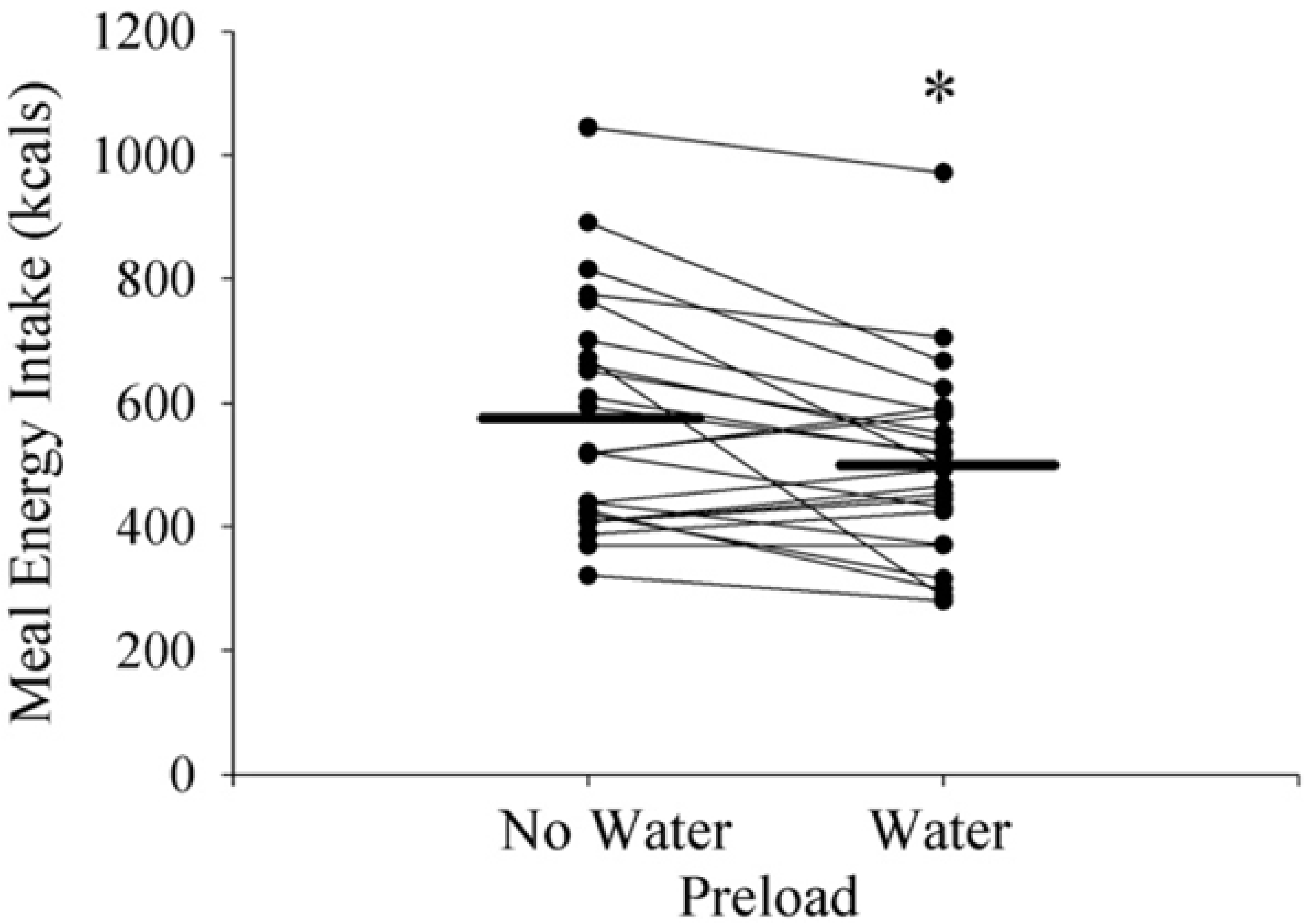

Figure.
Energy intake at ad libitum test meals: after a water preload and without a water preload condition. * P=0.004 vs no water preload.

Table

Energy intake at ad libitum breakfast meals after a water preload and without a water preload among male (n=7) and female (n=17) older adults

	No Water Preload			Water Preload		
	Men	**Women**	***P* value[a]**	**Men**	**Women**	***P* value[a]**
	←*mean±standard error* →			←*mean±standard error*→		
Energy intake (kcal)	588±86	567±43	0.49	535±79	485±32	0.81
Weight of food consumed (g)	674±53	659±47	0.85	611±56	611±38	0.99

[a] *P* value based on sex difference.