Providing Water With Meals is Not a Concern for Young Children

Summary of the Literature & Best Practice Recommendations

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To promote good health and to establish positive life-long nutrition habits, it is recommended that water be provided to young children both between and during meals and snacks as there is no evidence to support the concern that water might interfere with the intake of milk and other healthy foods.

Executive Summary

A commissioned analysis was undertaken to synthesize findings from recent and ongoing research, together with experts' science-based opinions, to: 1) determine how to reconcile new federal and California laws requiring water availability in childcare with concerns of some practitioners that water might displace valuable milk and food consumption; and 2) develop recommendations on best practices for promoting water intake to children in child-care settings to alleviate those concerns. The goals of promoting water in childcare are to enable children at an early age to become accustomed to drinking water as the beverage of choice for quenching thirst, and to develop a life-long habit of consuming non-caloric water instead of sugar-sweetened beverages – without unintended nutritional consequences.

While acknowledging that conclusions would be strengthened by additional empirical research on the interactions between water consumption and consumption of other beverages and foods among young children, we were able to come to consensus on five best practices:

1) **Offer plain water (preferably tap water without any additions) to children throughout the day, both indoors and outside, either in age-appropriate-sized cups or by self-serve.**
2) **Provide water along with other healthy beverages (milk or 100% juice in age-appropriate portions) and foods at meals and snacks.**
3) **Do not allow sugar-sweetened beverages or diet drinks at any time.**
4) **Child care providers should also follow, and therefore model, these healthy beverage practices when with children.**
5) **Information on the health and nutrition benefits of water should be provided to childcare providers, parents and children.**

Childcare providers should use this guidance to promote children's health by ensuring adequate hydration and promoting obesity prevention. Based on the evidence currently available and with expert panel input, **it is recommended that childcare providers provide water both between and during meals and snacks as there is no evidence to support the concern that water might interfere with the intake of milk and other healthy foods.**

Why the Concern?

California recently passed legislation requiring that all licensed childcare facilities provide drinking water to children at all times during the day, including during meals and snack-times.[1] With the passage of the Healthy, Hunger-Free Kids Act of 2010, this requirement now applies nationwide to childcare facilities that participate in the Child and Adult Care Food Program (CACFP), a federal United States Department of Agriculture (USDA) program that reimburses providers for nutritious meals to low-income children in childcare centers and family childcare homes.[2] The intent of this legislation was to ensure that children have access to a calorie-free healthy beverage - water. As obesity rates, even among our nation's youngest children, have risen at unprecedented rates, beverage intakes have become a focal point. Both statutes are critical pieces of the obesity-prevention strategy to eliminate sugar-sweetened beverages and to substitute calorie-free water as the beverage of choice for the millions of youngsters who spend much of their day and receive much of their nutrition in childcare. Demonstration of an effective public health approach to obesity prevention for very young children has the potential for wide dissemination for policy and practice and positive influence on the prevention of childhood obesity.

A preponderance of evidence points to sugar-sweetened beverages as a leading culprit in the obesity epidemic. These beverages provide ample calories in the absence of other essential nutrients and have grown in popularity over the same time period that obesity rates have risen.[3] According to national data, on any given day 44% of children 2-5 years of age consume fruit drinks while nearly 40% consume soda.[4] Early intervention among preschoolers at risk for poor nutrition and obesity, prior to the onset and consolidation of unhealthy eating habits and sedentary patterns, is critical to obesity prevention. Preschool aged children are more likely to modify their lifestyle behaviors than older children, as behaviors are less ingrained.[5] Further, parents and other caregivers play a more central role in guiding younger children's behaviors.[6]

Promoting water intake has been proposed in order to displace the intake of sugar-sweetened beverages. Providing water during meals and other times during the day in childcare has been endorsed by the Let's Move[7] campaign and is included in the National Health and Safety Performance Standards for Early Care and Education Programs.[8] These provisions are also

[1] AB 2084 (Brownley) – Healthy Beverage in Childcare. Available at: http://totalcapitol.com/?bill_id=200920100AB2084/.
[2] Healthy, Hunger-Free Kids Act of 2010, Pub. L. No. 111-296, 124 Stat 3183. Available at: www.fns.usda.gov/cnd/governance/legislation/CNR_2010.htm.
[3] Woodward-Lopez G, Kao J, Ritchie L. To what extent have sweetened beverages contributed to the obesity epidemic? Public Health Nutr. 2010;Sep 23:1-11.
[4] O'Conner TM, Yang S-J, Nicklas TA. Beverage intake among preschool children and it effect on weight status. *Pediatrics* 2006;118;e1010-e1018
[5] Patrick H, Nicklas TA. A review of family and social determinants of children's eating patterns and diet quality. J Am Coll Nutr. 2005;24:83–92.
[6] Ontai L, Ritchie L, Williams ST, Young T, Townsend MS. Guiding family-based obesity prevention efforts in children, Part 1: What determinants do we target? Int J Child Adolesc Health. 2009;2:19-30.
[7] Let's Move Child Care. What are the Main Goals? Available at: www.healthykidshealthyfuture.org/content/hkhf/home/startearly/thegoal.html.
[8] American Academy of Pediatrics, American Public Health Association, National Resource Center for Health and Safety in Child Care and Early Education. 2011. *Caring for our children: National health and safety performance standards; Guidelines for early care and education programs*. 3rd Edition. Elk Grove Village, IL: American Academy of Pediatrics; Washington, DC: American Public Health Association.

strongly supported by recommendations recently released by the Institute of Medicine and the 2010 Dietary Guidelines.

However, some childcare staff have voiced concerns that if young children are provided water with meals, they will fill up on the water and not consume enough milk or other healthy foods. Although childcare facilities that participate in the CACFP program offer healthier foods and beverages,[9] as compared to what is offered by childcare facilities not participating in the program or compared to what parents provide from home,[10] CACFP providers may be particularly concerned that serving water with meals may displace nutritive food and beverage intake. The USDA has taken the concern about water very seriously, encouraging CACFP providers to offer water at snack-time when milk is not served rather than with meals:

> "...caregivers should not serve young children ***too much*** water ***before and during meal times***; excess water may lead to ***meal displacement***, reducing the amount of ***food and milk*** consumed by children. States and sponsors should encourage facilities to ***serve water with snacks when no other beverage is being served***, and in lieu of other high calorie, sweetened beverages (juice drinks, soda, sports drinks, etc.) that are served outside of meal times."[11]

The purpose of this review was to identify the current state of the evidence with respect to the displacement of other beverages and foods by drinking water and to provide science-based information for the development of sound and practical recommendations to childcare providers on the provision of water to young children. Details on the studies and syntheses examined follow a brief summary of the literature and the resultant recommendations for providers. While it is acknowledged that more research is needed (in particular, there is a paucity of studies on the relative short-term satiety of foods and beverages in children), it is imperative to take action now to prevent obesity and to follow best practices that have the greatest likelihood of providing benefits while minimizing potential harms.

What Did We Do?

The development of best practices for promoting water consumption for childhood obesity prevention while minimizing potential unintended nutritional consequences involved a 3-step process. First, in recognition of the limited number of studies on water intake, we undertook a comprehensive search for research in order to fill the gap to the extent possible. Second, we critically reviewed the evidence to develop a draft of best practices. Third, these best practices were reviewed and modified by an expert panel on water convened by the Centers for Disease Control and Prevention.

The identification of relevant studies (both published and emergent) involved the following:

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[9] Ritchie LD, Boyle M, Chandran K, Spector P, Whaley SE, James P, Samuels S, Hecht K, Crawford P. Participation in the Child and Adult Care Food Program is associated with better nutrition offerings in childcare. Child Obes 2012;8:236-41.

[10] Briley ME, Jastrow S, Vickers J, Roberts-Gray C. Dietary intake at child-care center and way: Are parent and care providers working as partners or at cross-purposes? J Am Diet Assoc 1999;99:250-4.

[11] USDA. Child Nutrition Reauthorization 2010: Water Availability in the Child and Adult Care Food Program. CACFP Memo 20-2011. May 11, 2011. Available at: www.education.nh.gov/program/nutrition/cacfp_memos/2011/documents/20_2011.pdf. Words were italicized and in bold for emphasis in this review.

1) PubMed was searched twice by a single reviewer using the following terms: 1) “water AND diet AND obesity NOT gene NOT cells NOT microbiota NOT immunohistochemistry” (English) and 2) “water AND satiety AND beverage” (Humans, English). ‘NOT’ terms were added to reduce the hits to articles of interest. Academic Search Complete was searched by a second reviewer using the following terms: “water AND health” and “water AND intervention.” If water wasn’t mentioned in the abstract, it was not considered.

2) Research websites (e.g., USDA Current Research Information System, NIH Research Portfolio Online Reporting Tools, RWJF Healthy Eating Research) and scientific conference proceedings/abstracts (e.g., American Public Health Association Conference, Food and Nutrition Conference and Expo, Federation of American Societies for Experimental Biology, Obesity, Childhood Obesity, Weight of the Nation, American Academy of Pediatrics National Conference and Exhibition, Pediatric Academic Societies) were searched by the second reviewer.

3) A snowball sampling approach was used to identify additional unidentified or emergent studies by examining reference lists of review articles and primary research articles.

A single reviewer examined all studies or reports identified for relevance to the topic of interest. Relevant studies were then abstracted using a uniform format which included documenting the study design, sample population, intervention method, data collection method, outcomes measured, effect size, and conclusions relative to our topic of interest (Appendix A). To aid in interpretation of findings, studies were grouped as follows: shorter-term satiety tests – over a period of hours to a day; obesity prevention/longer-term intervention trials – studies over a period of months to years; obesity treatment/longer-term intervention trials; observational and epidemiological studies; and other reports/articles of interest.

The day and a half long CDC convening took place May 17-18, 2012 in Atlanta, GA and included input from nearly 30 attendees (see Appendix B for complete list of attendees). At the convening, a brief presentation on the findings of the commissioned analysis was presented. Attendees were then asked to comment on the best practices and recommendations, and to suggest revisions. The focus of the discussion was on the following questions:

1) Will providing water to young children (1-5 years of age) with or before meals and snacks compete with:
    a. intake of milk?
    b. intake of healthy foods?

2) What are strategies to help mitigate these potential problems/barriers?

Attendees were also asked to refer us to any additional studies we may have overlooked in our initial review that would help inform the analysis.

What is the Rationale for Change in Policy?

1) **Children may not be consuming adequate amounts of water.**[12,13,14]

    - Dehydration can result in impaired cognition, altered mood, poor regulation of body heat, and reduced ability to be physically active.[15]

2) **Increasing access to water, coupled with promotion of water through education, can increase water intake in children.**[16,17,18,19,20,21,22]

    - School-based studies suggest that education plus environmental change combined have the best chance of success in changing children's dietary behavior – more so than environmental or educational approaches in isolation.

3) **Increasing water intake alone may not prevent obesity; however water consumption when accompanied by lower intake of sugar-sweetened beverages is associated with improved nutrition.**

    - Observational studies have shown that habitual water drinkers eat a better quality diet (including a lower intake of sugar-sweetened beverages) than non-water drinkers.[23,24,25]

4) **Thirst is a stronger signal for drinking than hunger is for eating.**[26]

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[12] Kaushik A, Mullee MA, Bryant TN, Hill CM. A study of the association between children's access to drinking water in primary schools and their fluid intake: Can water be 'cool' in school? Child: Care Health Dev. 2007;33(4):409-15.
[13] Kant AK, Graubard BI. Contributors of water intake in US children and adolescents: associations with dietary and meal characteristics--National Health and Nutrition Examination Survey 2005-2006. Am J ClinNutr. 2010 Oct;92(4):887-96.
[14] Stookey JD, Brass B, Holliday A, Arieff A. What is the cell hydration status of healthy children in the USA? Preliminary data on urine osmolality and water intake. Public Health Nutr. 2012;Jan 27:1-9.
[15] Manz F. Hydration and disease. J Am Coll Nutr. 2007:26(5 Suppl):535S-541S; Manz F. Hydration and children. J Am Coll Nutr 2007;26(5Suppl):562S-569S.
[16] McGarvey E, Keller A, Forrester M, Williams E, Seward D, Suttle DE. Feasibility and benefits of a parent-focused preschool child obesity intervention. Am J Public Health. 2004 Sep;94(9):1490-5.
[17] Loughridge JL, Barratt J. Does the provision of cooled filtered water in secondary school cafeterias increase water drinking and decrease the purchase of soft drinks? J Hum Nutr Diet. 2005 Aug;18(4):281-6.
[18] Kaushik A, Mullee MA, Bryant TN, Hill CM. A study of the association between children's access to drinking water in primary schools and their fluid intake: Can water be 'cool' in school? Child: Care Health Dev. 2007;33(4):409-15.
[19] Laurence S, Peterken R, Burns C. Fresh Kids: the efficacy of health promoting schools approach to increasing consumption of fruit and water in Australia. Health Promot Int. 2007 Sep;22(3):218-26.
[20] Muckelbauer R, Libuda L, Clausen K, Toschke AM, Reinehr T, Kersting M. Promotion and provision of drinking water in schools for overweight prevention: randomized, controlled cluster trial. Pediatrics. 2009 Apr;123(4):e661-7.
[21] Siega-Riz AM, El Ghormli L, Mobley C, Gillis B, Stadler D, Hartstein J, Volpe SL, Virus A, Bridgman J; HEALTHY Study Group. The effects of the HEALTHY study intervention on middle school student dietary intakes. Int J Behav Nutr Phys Act. 2011 Feb 4;8:7.
[22] Patel AI, Bogart LM, Elliott MN, Lamb S, Uyeda KE, Hawes-Dawson J, Klein DJ, Schuster MA. Increasing the availability and consumption of drinking water in middle schools: a pilot study. Prev Chronic Dis. 2011 May;8(3):A60.
[23] Popkin BM, Barclay DV, Nielsen SJ. Water and food consumption patterns of U.S. adults from 1999 to 2001. Obes Res. 2005;13:2146-52.
[24] Stahl A, Kroke A, Bolzenius K, Manz F. Relation between hydration status in children and their dietary profile – results from the DONALD study. Eur J Clin Nutr. 2007;61:1386-92.
[25] Kant AK, Graubard BI, Atchison EA. Intakes of plain water, moisture in foods and beverages, and total water in the adult US population--nutritional, meal pattern, and body weight correlates: National Health and Nutrition Examination Surveys 1999-2006. Am J ClinNutr. 2009 Sep;90(3):655-63.
[26] McKiernan F, Houchins JA, Mattes RD. Relationships between human thirst, hunger, drinking, and feeding. Physiol Behav. 2008;94(5):700-8.

- Humans can survive without food for weeks to months; whereas for water, the time frame is only a few days.
- Most water comes from drinking beverages (plain water or water in other drinks); only 20% comes from the moisture in foods.[27]

5) **Healthy individuals have the ability to excrete excess water over a large range of intakes.**[28]
6) **Water is better at quenching thirst than other beverages.**[29]
7) **Beverages are less filling than solid foods.**[30,31]
    - The body's 'thermostat' (involving a combination of sensory, cognitive and physiological mechanisms) for energy appears to be substantially more responsive to calories from solids than from liquids.
    - Persons are less likely to 'feel full' and stop consumption when drinking beverages than when consuming solid foods.
8) **The increased availability, palatability and use of calorie-containing beverages, coupled with their low satiety properties, can lead to positive energy balance and over time, obesity.**[32]
9) **Water is less filling than calorie-containing beverages, such as milk.**
10) **Water intake prior to a meal is more filling than water intake with a meal, but this has been observed primarily in older adults.**[33]
11) **Only with the consumption of a very large amount of water immediately prior to a meal can a small decrease in energy intake at the meal be observed.**[34]

What Best Practices Should Childcare Providers Follow For Preschool Age Children? [35]

Based on the best evidence to date on water and its role in obesity prevention, the following five best practices are recommended:

[27] Institute of Medicine. Food and Nutrition Board. Dietary Reference Intake for Water, Potassium, Sodium, Chloride, and Sulfate. Washington, DC: National Academies Press. 2004.
[28] Institute of Medicine, Food and Nutrition Board, Panel on Dietary Reference Intakes for Electrolytes and Water, Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. *Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate.* Washington, DC: The National Academies Press. 2005.
[29] Flood JE, Roe LS, Rolls BJ. The effect of increased beverage portion size on energy intake at a meal. J Am Diet Assoc. 2006 Dec;106(12):1984-90.
[30] Mattes RD. Dietary compensation by humans for supplemental energy provided as ethanol or carbohydrate in fluids. Physiol Behav. 1996; 59, 179–87.
[31] Mattes R. Fluid calories and energy balance: the good, the bad, and the uncertain. Physiol Behav. 2006;89(1):66-70.
[32] Wolf A, Bray GA, Popkin BM. A short history of beverages and how our body treats them. Obes Rev. 2008;9(2):151-64.
[33] Welch RW. Satiety: have we neglected dietary non-nutrients? Proc Nutr Soc. 2011;70(2):145-54.
[34] Daniels MC, Popkin BM. Impact of water intake on energy intake and weight status: a systematic review. Nutr Rev. 2010;68(9):505-21.
[35] For children 0-6 months of age, all hydration requirements should be achieved with breastmilk or formula (per IOM DRIs).

1) **Offer plain water (preferably tap water without any additions) to children throughout the day, both indoors and outside, either in age appropriate sized cups of by self-serve.**
2) **Provide water along with other healthy beverages (milk or 100% juice in age-appropriate portions) and foods at meals and snacks.**
3) **Do not allow sugar-sweetened beverages (including flavored milk) or diet drinks at any time.**
4) **Child care providers should also follow, and therefore model, these healthy beverage practices when with children.**
5) **Information on the health importance of water should be provided to childcare providers, parents and children.**

What Did We Conclude?

In order to inform practice in implementing policy on water in childcare, we reviewed the evidence available and consulted with a panel of experts to identify recommendations on the provision of water to young children in childcare. Beyond the immediate healthy goals of promoting water at a young age is the long-term goal of drinking water rather than sugar-sweetened beverages as the beverage of choice for quenching thirst. While acknowledging more empirical research would be beneficial on the role of water in maximizing a healthful diet and reducing the likelihood of obesity, we were able to identify sufficient research to support five best practices. It is recommended that care providers follow these practices to promote child health.

Child care providers should provide water between and during meals and snacks as there is no evidence to support the concern that water might interfere with the intake of milk and other healthy foods.

Appendix A. Selected Literature Review on Water – Summary Table

Key: ORANGE shading signifies child study; NO SHADING signifies adult study
EI = energy intake
ED = education
ENV = environment
PA = physical activity
NUTR = nutrition
SSB = sugar-sweetened beverages
hrs = hours
yrs = years
w/ = with
VAS = visual analog scale; VAS is a measurement method to assess attitudes/perceptions (such as satiety) on a subjective scale.

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Shorter-term satiety tests						
Hägg, A., et al. Effects of milk or water on lunch intake in preschool children. *Appetite*, 1998, Vol.31:83-92	Prospective, Pre-/Post- 4-6 yrs	3 day care centers N=36 Sweden	Series of 12, where milk and water was served alternatively with a preferred/neutral/less-liked dish; each dish served twice Preload of 0.5dL (~1.8 fl oz) of milk or water. Consumption ad libitum	Mean EI. Body weight.	Meals w/ milk had a mean additional EI of 17% ($P<0.001$) irrespective of the meal. But when water was served, kids consumed 12% more food but total EI was still less than for meals w/ milk. "The mean intake of food only, when EI from milk was excluded, was 307+/-111kcal, significantly lower ($P<0.002$) than when food was eaten w water." Energy distribution of protein, fat, and carbs were very similar between milk/water. Meal duration did not differ w/ meals or between milk/water	MILK WITH MEALS (~1.8 fl oz) INCREASES ENERGY INTAKE COMPARED TO WATER WITH MEALS (in young children) MILK DISPLACES SOLID FOODS MORE THAN WATER

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Dubnov-Raz, G., et al. Influence of water drinking on resting energy expenditure in overweight children. *International Journal of Obesity*, 2011, Vol.35:1295-1300	Prospective, Pre-/Post-	N=21 overweight kids; 11 males Mean=9.9 yrs BMI > 85th percentile for age & sex From a pediatric obesity treatment program Israel	10 ml/kg cold water, given after 12 hours of physical inactivity and overnight fasting Resting Energy Expenditure (REE) measured pre-/post-, for 66 min.	Change in mean REE from baseline values BMI REE measured via portable metabolic cart Body fat percentage measured after metabolic measurements complete	Maximum REE values seen at 57 minutes after water consumption (P=0.004), 25% greater than baseline ("water induced- thermogenesis) Suggests effect due to rehydration of muscles via water after the overnight fasting. "We presume that this decrease occurred due to the rapid cooling of the upper gastrointestinal tract, which perhaps resulted in an adrenergic-related or other neural response." Previous studies didn't report on this initial reduction in REE	COLD WATER INTAKE (~14 fl oz) INCREASED ENERGY EXPENDITURE in children (water induced REE elevation also shown in adult studies)
Flood, J.E., et al. The effect of increased beverage portion size on energy intake at a meal *J Am Diet Assoc.*, 2006, Vol.106:1984-90	Crossover design. Randomized to experimental conditions Blinded to beverage type and portion	N=33 (of 40), 18-45 yrs; 18 women Subjects self-reported an affinity for both regular and diet soda	Pre-screened with the Eating Inventory, Zung Questionnaire, & Eating Attitudes Test Consumed lunch in the lab 1/wk for 6 wks. Same food served, but drink varied by type (cola, diet cola, & water) and portion size (12 fl oz or 18 fl oz). Could eat or drink however much they wanted. No beverage preload; water consumed as a beverage type during test or allowed to consume water between meals up to 1 hour before test	Food & activity diary the day before session Beverage intake (g) Energy intake from foods and beverages (kcal) Pre-/Post-scale (hunger, thirst, fullness, prospective consumption, and nausea). Food characteristics scale	Increasing drink portion size increases the weight of beverage consumed, regardless of type (P<0.05). But w/ water didn't lead to increased EI. EI only differed with beverage size if it was a caloric beverage. Total energy intake increased when a caloric beverage was served vs. non-caloric. No significant difference in food intake based on beverage type or size; no compensation of food intake based on drink type Ratings of thirst post-lunch were significantly reduced after large amount of water served vs. all others (P<0.05)	AMOUNT OF WATER WITH MEAL (12 or 18 fl oz) HAD NO IMPACT ON ENERGY INTAKE WATER BETTER AT QUENCHING THIRST THAN SUGAR or ARTIFICIALLY SWEETENED DRINKS

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Maersk, M., et al. Satiety scores and satiety hormone response after sucrose-sweetened soft drink compared with isocaloric semi-skimmed milk and with non-caloric soft drink: a controlled trial. *European Journal of Clinical Nutrition*, 2012, doi:10.1038/ejcn.2011.223	Crossover trial	N=24 obese individuals BMI 28-36, 20-50 yrs	Compared 2 isocaloric/macronutrient different beverages (SSB vs. semi-skimmed milk) and 2 non-energy containing beverages (aspartame-sweetened beverage (ASSD) and water) Each subject served 500 mL (16 fl oz) of one of the test drinks on 4 separate test days; order of test drinks randomized Ad libitum test meal served 4 hrs post test-drink Minimum 2 wk washout period between test days	Subjective appetite scores completed (Visual Analog Scale; satiety, hunger, fullness, prospective food intake) Anthropometric measures Biomarkers (of appetite regulating hormones) measured at baseline and continuously 4hr post-intake Plate weight; pre-/post-consumption	Milk induced greater subjective fullness and less hunger than regular cola (P<0.05) Total energy intake higher after the energy-containing drinks, compared with diet cola and water (P<0.01) Regular cola (P=0.04) and milk (P<0.001) induced a higher glucagon-like peptide -1 (GLP-1) response vs. water Self-reported satiety higher after milk compared with water (P<0.01). No differences reported between diet drink and water on EI or satiety. No significant difference between the 4 groups from the post-meal; energy from intake of caloric beverages aren't compensated for in following meal.	SUGAR SWEETENED DRINKS OR MILK BEFORE MEALS (16 fl oz, 4 hrs) INCREASED ENERGY INTAKE COMPARED TO WATER WATER BEFORE MEAL (16 fl oz, 4 hrs) HAD LESS SATIETY THAN MILK
Davy, B.M. et al. Water consumption reduces energy intake at a breakfast meal in obese older adults. *Journal of the American Dietetic Association*, 2008, Vol.108:1236-1239	Random crossover design of preload/no-preload Blinded participants	N=24 (7 men, 17 women) overweight and obese Mean age 61.3 yrs, nonsmokers, no chronic disease, and not taking meds that infl. weight	Adults given two standardized breakfast buffet meals on two randomly assigned locations; meals minimum 2 days apart 30 minutes pre-meal, given 500 mL (16 fl oz) water preload or no preload Meals served in individual cubicles	Self-report 4 consecutive days (Wed.-Sat.) of food/beverage intake BMI measurements via stadiometer and digital scale. Food weighed before and after served	Meal energy intake and gram weight of food less in the water preload condition vs. the no-preload; 13% reduction in meal energy intake (P=.004) (p>.05) Reduction unrelated to sex, age, BMI, or habitual daily water consumption.	WATER BEFORE MEALS (16 fl oz, 30 min) DECREASED ENERGY INTAKE IN OLDER ADULTS

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Abid, S., et al. Satiety drinking tests: Effects of caloric content, drinking rate, gender, age, and body mass index. *Scandinavian Journal of Gastroenterology*, 2009, Vol.44: 551-56	Randomized crossover design, uncontrolled	N=42, 22 female; 21-51 yrs	Pre-intervention fast, and required to complete a dyspepsia questionnaire Height, weight, and BMI recorded at baseline Participants drank on 3 separate occasions 1 of the following: -water at a rate of 100 mL/min. (RWD) or -nutrient liquid drink (Ensure) at 100 mL/min (RND) or -nutrient liquid drink at 20 mL/min (SND)	Using VAS, measured every 5 min until they scored 5 on satiety level. Then, post-30 min after drink cessation, VAS for: bloating, nausea, and abdominal pain Compared the Maximum Tolerated Volumes (MTVs) of the aforementioned conditions	Drinking capacity influenced by gender, age, and BMI in RWD and by gender in RND MTV_{males} for water>rapid nutrient>slow nutrient. Same order for females. -for water & rapid nutrient ($P<0.05$), for slow nutrient ($P=0.051$). Drinking a nutrient drink at a slower rate induces satiety earlier vs. RND. Only males showed high correlations for a linear relationship among MTVs and the different drinking tests.	WATER HAS LESS SATIETY THAN CALORIC BEVERAGES
Almiron-Roig, E., et al. No difference in satiety or in subsequent energy intakes between a beverage and a solid food. *Physiology & Behavior*, 2004, Vol.82: 671-77	Non-randomized crossover design, controlled	N=32, 16 women 18-35 yrs BMI = 20-27	Eating Disorder Inventory used as screening tool Participants consumed equal energy preloads (300 kcal) of regular cola (24 fl oz) or fat-free raspberry cookies (3 fl oz) on 2 occasions each Preloads issued 2 h or 20 min before test meal, but only plain water served during identical test meals	Measured food consumption Participants rated motivational states prior to ingestion and at 30 min intervals: hunger, thirst, nausea, fullness, and desire to eat	Cola, but not cookies, reduced water intakes at lunch ($P<0.001$), however final EIs after equal-energy amounts of preloads not significant Gender-by-time interaction observed ($P<0.05$) where initially males were thirstier, but reversed just before lunch Water intakes at lunch also lower in the late, vs. early, preload ($P<0.01$)	CALORIC BEVERAGE BEFORE MEAL (24 fl oz, 2 h or 20 min) BUT NOT SOLID FOOD REDUCED WATER INTAKE AT MEAL; MORE REDUCTION IN WATER INTAKE IF CALORIC BEVERAGE GIVEN CLOSER TO MEAL

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Almiron-Roig, E., et al Impact of some isoenergetic snacks on satiety and next meal intake in healthy adults. *Journal of Human Nutrition and Dietetics*, 2009, Vol.22: 469-74	Randomized, cross-over trial	N=30, 9 men Mean age = 36.6 years, and mean BMI = 22.1	Three-Factor Eating Questionnaire used as a screening tool Participants consumed isoenergetic (111kcal) preloads of: fiber-enriched drinking yogurt, regular drinking yogurt, plain crackers, fresh banana or an isovolumetric serving of plain water (160g) All subjects underwent all five testing conditions. All preloads served with 100 mL plain water	VAS scale post-consumption of test food, and leading up to the next meal (every 15min)	No significant differences between the food's satiating capacity, but found the following trend: fiber enriched yogurt > regular yogurt > banana > crackers > water Yogurts and banana more satiating than water and crackers ($P<0.001$) Mean energy intake at next meal greatest for the water preload compared to others; ($P<0.001$ for the yogurts vs water) and ($P<0.05$ for banana vs water)	WATER BEFORE MEAL (~5.5 fl oz) DID NOT REDUCE ENERGY INTAKE LIKE SAME VOLUME OF FOOD OR CALORIC BEVERAGE
Cuomo, R., et al The role of a pre-load beverage on gastric volume and food intake: comparison between non-caloric carbonated and non-carbonated beverage. *Nutrition Journal*, 2011, Vol.10: 114- 25	Randomized crossover design, controlled Blinded participants	N=10, 4 women 22-30 yrs BMI 23 +/-1	6 times, 3 w/ solid meal (SM) and 3 w/ liquid meal (LM) Preload of 300 mL non-caloric flavored carbonated beverage vs. water or an uncarbonated (non-caloric de-gassed) flavored beverage -beverages at 10-12˚C -drank it in 3 minutes Then consume a SM and LM at a constant rate of 110 kcal/5 min until Maximum Satiety (MS) reached	-Total Gastric volume (TGV) measured via MRI at MS -caloric intake at MS measured -ghrelin and cholecystokinin release) via biomarkers until 120 min post-meal VAS questionnaire	TGV w/ carbonated flavored drink higher than noncarbonated or water ($P<0.05$), but no influence on food intake Total EI (including beverage) didn't differ at MS after any of the treatments, with either SM or LM ($P<0.05$) Note: first author received a grant from Coca-Cola; last author employed by Coca-Cola.	CARBONATION (~10 fl oz) DID NOT INFLUENCE ENERGY INTAKE COMPARED TO NONCARBONATED DRINK or PLAIN WATER

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
DellaValle, D.M., et al Does the consumption of caloric and non-caloric beverages with a meal affect energy intake? *Appetite*, 2005, Vol.44: 187-93	Crossover design	N=44 women (of 45) 18-60 yrs BMI 20-40 kg/m^2	Ate a standardized lunch once a week for 6 weeks Lunch served w/ 1 of 5 beverages that were consumed in full (intermittently), or no beverage: -360g of water, diet cola, regular cola, OJ, and 1% milk	Height and weight Eating Inventory (dietary restraint, disinhibition, and perceived hunger) Eating Attitudes Test (short); aberrant attitudes to food & eating Zung Self-Rating Depression Scale VAS (fullness, hunger, prospective consumption, thirst, and nausea)	When beverage energy included, meal intake increased by a mean of 104 kcal when a caloric beverage was consumed vs. noncaloric/no beverage (P<0.0001) Energy intake didn't differ among non-caloric and no-beverage conditions (P<0.0001) Subject's ratings of fullness after lunch only significantly different compared to the no-beverage condition, which was lower (P<0.001)	WATER WITH MEAL (~11 fl oz) HAD NO EFFECT ON ENERGY INTAKE COMPARED TO NO BEVERAGE CONDITION
Van Walleghen, E.L., et al. pre-meal water consumption reduces meal energy intake in older but not younger subjects. *Obesity*, 2007, Vol.15, No.1:93-99	Prospective, controlled study	N=29 (of 40); 21-35yrs (BMI<30) N=21 (of 34); 60-80yrs	Participants prescreened with the Eating Inventory Cognitive Restraint Score, Centers for Epidemiological Studies Depression Scale Score, and Eating Attitudes Test Issued an ad libitum lunch meal on 2 occasions, after a 30 minute water preload [375mL for women or 500 mL for men] (WP) or no preload (NP)	Measured energy intake at the 2 lunch meals by weighing plates Anthropometric measurements VAS used to assess changes in hunger, fullness, and thirst; 6 times at a meal	No significant difference in meal energy intake between conditions in young subjects (P=0.65) WP significantly reduced meal energy intake relative to NP in older subjects (P=0.02), due to reduction in meal energy intake Fullness ratings higher in WP vs. NP for all subjects (P=0.01) Difference in energy intake between the 2 meal conditions not associated w/ habitual water (P=0.11) or beverage (P=0.10) consumption	WATER BFORE MEAL(~13-17 fl oz, 30 min) DID NOT REDUCE ENERGY INTAKE in younger adults WATER BEFORE MEAL DID REDUCE ENERGY INTAKE in older adults; ~60kcal

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Obesity PREVENTION /Longer-term intervention trials						
Haerens, L., et al. The effects of a middle-school healthy eating intervention on adolescents' fat and fruit intake and soft drinks consumption. *Public Health Nutrition*, 2007, Vol.10, No.5:443-49	Clustered RCT 1 school year	15 schools with a high prevalence of overweight & obese N=2,840 (of 2991) students in 7th& 8th grades Belgium	5 intervention groups w/ parental support, 5 intervention groups w/o parental support, and 5 control groups Education to promote healthy food choices and physical activity Increase in the availability of healthier food and decreasing the availability of unhealthier items: -reducing soft-drink consumption -increasing water consumption	Food-frequency questionnaires to measure fat & fruit intake, water & soda consumption	No intervention effects on fruit, soda, or water consumption	ED + ENV SCHOOL-BASED NUTR + PA INTERVENTION DID NOT CHANGE WATER INTAKE
Siega-Riz, A.M., et al. The effects of the HEALTHY study intervention on middle school student dietary intakes. *International Journal of Behavioral Nutrition and Physical Activity*, 2011, Vol.8, No.7:1-8	Cluster-randomized study	N=42 public middle schools N=3,908 (of 4,603) students Each school required to be >50% minority students	Longitudinal; followed students from 6th to 8th grade = 5 semesters Integrated nutrition, physical education, behavior change, and social marketing Each semester's activities focused on a specific theme, ranging from foods, physical activity, to beverages Environmental changes of the intervention included offering more healthy foods (i.e. fruits, veggies, legumes) and limiting unhealthy (i.e. smaller servings of high-fat foods, no SSBs [except flavored milk] in vending) Note: school policies changed during the intervention; USDA '04 required schools to develop wellness policies	Student self-reported dietary intakes (energy, macronutrients, and grams consumed of selected food groups) via Block Kids Questionnaire (FFQ) -5 questions added Anthropometrics, blood pressure, biometrics	Reported water intake about 2 fl. oz. higher in intervention schools vs. control (P=0.008) No significant differences between intervention and control for mean intakes of energy, macronutrients, fiber, grains, vegetables, legumes, sweets, SSBs, and high/low-fat milk consumption Intake of fruits & veggies decreased in both intervention and control schools, but meta-analysis of 7 schools showed intervention arm reported 19% more consumption on average.	ED + ENV SCHOOL-BASED NUTR + PA INTERVENTION INCREASED WATER INTAKE

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Laurence, S., et al. Fresh Kids: the efficacy of a Health Promoting Schools approach to increasing consumption of fruit and water in Australia. *Health Promotion International*, 2007, Vol.22, No.3: 218-26	Interrupted time-series. No control group	N=39 primary schools using Health Promoting Schools framework of the Fresh Kids Program Australia No age listed; but average age of entry into primary school is 5 yrs	2 years of intervention (organizational change through policy and nutrition education) Based on Health Promoting Schools (HPSs) framework: -school-home-community interaction (community RD, Seasonal "Fresh Fruit Weeks," intervention incorporated into municipal Public Health plan, newsletters) -school organization, ethos & environment (lead teacher to develop annual plans, scheduling "fruit breaks," develop school fruit/water policies & prohibiting sweet drinks) -school curriculum/teaching/learning (curriculum resources linked w/ "Fresh Fruit Weeks," and water bottles w/ student designed logos)	Baseline collected via "lunch box audit" assessing frequency of fresh fruit, water and sweet drinks	15-60% in the proportion of students bringing filled water bottles to school; sustained for up to 2 years post-intervention ($P<0.0010$) Water displaced sweet drinks (their conclusion), but at best it's a correlation; relative changes in consumption: -Fruit increase 25-50%, $P<0.001$ -Water increase 15-60%, $P<0.001$ -Sweet drink decrease 11% ($P<0.01$) and 27-38% ($P<0.001$) Note: The sweet drinks had a range (and the other schools didn't) because of the difference in statistical significance in one of the schools vs. the others in sweet drink category.	ED + ENV SCHOOL-BASED NUTR INTERVENTION INCREASED WATER INTAKE
Loughridge, J.L. & Barratt, J. Does the provision of cooled filtered water in secondary school cafeterias increase water drinking and decrease the purchase of soft drinks? *J Hum Nutr Diet*, 2005, Vol.18:281-86	Randomized, prospective trial 1 month intervention, 2 months follow-up	N=3 secondary schools 11-18 yrs United Kingdom	3 months Health promotion Free provision of cooled/filter water & active promotion (W&P), water only (W), and control school	Volume of water drank by students via flow meters attached to water coolers and also sales School attendance records to approximate cafeteria use Focus group interviews	Average volume of water drank by W&P (165mL/school day) greater than W (60 mL/school day) and control (5mL/school day) [$P=0.05$] -approximate volumes because they're from a figure; no table included Soft drinks sales remained constant	ED + ENV SCHOOL-BASED WATER INTERVENTION INCREASED WATER INTAKE INCREASED WATER INTAKE DID NOT DECREASE SSB SALES

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Muckelbauer, R., et al.[36] Promotion and provision of drinking water in schools for overweight prevention: randomized, controlled cluster trial. *Pediatrics*, 2009, Vol.123:e661-67	Randomized, controlled cluster trial 1 intervention, and 1 control arm 1 school year	N=32 elementary schools; 17 in intervention group N=1641 intervention, n= 1309 2nd and 3rd graders Germany	Water fountains installed, and teachers gave 4 lessons in intervention group Followed by a motivation unit, and at month 5, intervention group students got a new water bottle	Height/weight measures to determine overweight 24-hour recall questionnaires pre-/post- Water flow measured from the fountain during the intervention NOTE: Program fidelity not that high Reported limitations: small sample size, and possible selection bias	Risk of overweight reduced by 31% in intervention group (OR=0.69, 95%CI 0.48-0.98) No change in BMI scores between groups (no general weight reducing effect), or effect on juice/soft-drink consumption Intervention group consumed 1.1 more glasses of water/day at the end "The reduction in consumption of sugar-containing beverages did not reach significance, probably b/c our prevention program did not actively discourage drinking of those beverages but only promoted water consumption."	ED + ENV SCHOOL-BASED WATER INTERVENTION INCREASED WATER INTAKE WATER MAY HELP DECREASE OVERWEIGHT
Visscher, T.L.S., et al. Feasibility and impact of placing water coolers on sales of sugar-sweetened beverages in Dutch secondary school canteens. *Obes Facts*, 2010, Vol.3:109-15	Prospective, controlled study	N=6 schools N=5,866 students Average age 14 yrs (12-19 age range) Netherlands	Intervention schools had water coolers Hidden observations performed in one school, w/ accompanying interviews	Monitored beverage sales Post-intervention self-report student questionnaires about drinking habits	Water coolers didn't affect SSB sales Water consumed at school is mainly taken from home or from the tap in the bathroom	ENV SCHOOL-BASED WATER INTERVENTION DID NOT IMPACT WATER INTAKE

[36] Results on this study were also reported in: Muckelbauer et al. Approaches for the prevention of overweight through modified beverage consumption in the elementary school setting. The "trinkfit" study. Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz 2011 Mar;54(3):339-48; Muckelbauer et al. A simple dietary intervention in the school setting decreased incidence of overweight in children. Obesity Facts. 2009;2:282-5.

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
McGarvey, E., et al. Feasibility and benefits of a parent-focused preschool child obesity intervention. *American Journal of Public Health*, 2004, Vol.94, No.9:1490-95	Non-randomized, controlled 1-year prospective study Pre-/post-	N=2 WIC clinics 1 intervention (n=121), 1 control (n=65) WIC Parents with 2- to 4-yr old kids Hispanic participants over-represented in intervention group	"Fit WIC" comprised of: an educational group once every 2 months, and an individual session w/ a WIC nutritionist every 6 months for participants Issued cards containing 6 key messages i.e. (2) monitor mealtime behavior (4) drink water instead of SSBs Also had education classes and/or materials for WIC staff and local community service agencies	Quality assurance review to assess program fidelity Self-report 6-point scale to assess the frequency of offering the child water vs. SSB Questionnaires administered at baseline/enrollment, and at 12 months at conclusion	Intervention increased the frequency of offering the child water ($P<0.001$)	ED NUTR INTERVENTION (with parents of preschool-age children) INCREASED WATER INTAKE
Patel, A.I., et al. Increasing the availability and consumption of drinking water in middle schools: a pilot study. *Prev Chronic Dis*ease, 2011,Vol.8, Issue.3:A60	Quasi-experimental	N=876 students Mean age 13 yrs 5 wk pilot intervention 1 intervention & 1 comparison school	Schools at least 60% FRP -Provision of cold, filtered drinking water in cafeterias -Distribution of reusable water bottles to students & staff -School promotional activities i.e. raffles, art contests -Education i.e. posters, bookmarks, flyers, lead-testing class Self-report surveys (of only 7th graders) at pre-intervention, week 1, and 2 months post-intervention	Self-report surveys of students' consumption of water, non-diet soda, sports drinks, and 100% fruit juice AND whether they drank water from a fountain, sink or faucet, bottle, reusable bottle from home, or another source Measured daily water (in gallons) distributed in the cafeteria during the intervention	Intervention schools consumed more water from school drinking fountains, and reusable water bottles vs. the comparison school ($P=0.02$ and $P = 0.005$ respectively) Effect size decreased over length of the program. For water bottles, it may be due to no on-campus bottle storage space. These effects based on 2-month post-intervention results b/c they're "most indicative of intervention sustainability"	ED + ENV SCHOOL-BASED WATER INTERVENTION INCREASED WATER INTAKE& SALES NO IMPACT ON MILK SALES& MILK INTAKE

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Veitch, et al. Reduction in sugar-sweetened beverages is not associated with more water or diet drinks. *Public Health Nutrition*, 2011, Vol.14, No.8:1388-93	Nested study within a clustered RCT	N=18 secondary schools N=747 adolescents, 50% boys Mean age 12.7 yrs 8 month intervention The Netherlands	Data from the Dutch Obesity Intervention in Teenagers (DOiT) Students filled a questionnaire at baseline and at 8 months (post-intervention) Primary focus of the intervention was aimed at reducing SSB consumption -raising awareness of energy balance-related behaviors -behavior change facilitation i.e. worksheets	Beverage intake questionnaire measuring consumption of SSBs, diet drinks, and water -frequency and quantity -filled out at 0, 8, 12, and 20 months	SSB consumption significantly reduced 284mL/day at 8 months and 260 mL/day at 12 mos. Diet drinks significantly reduced 52 mL/d at 8 mos. No significant difference in water consumption at any follow-up No significant association between the decrease in SSB and increase No significant differences in consumption any of the beverages at 20 months	ED SCHOOL-BASED SSB INTERVENTION DID NOT IMPACT WATER INTAKE
Muckelbauer, R., et al. Immigrational background affects the effectiveness of a school-based overweight prevention program promoting water consumption. *Obesity*, 2010, Vol.18, No.3:528-34	Secondary analysis (of a controlled cluster trial)	N= 32 elementary schools N=1,306 "immi-grational background" (MIG) (of 2,950) -2nd-3rd graders 1 school yr Low SES districts in 2 German cities	Schools either in intervention (IG) or control (CG) group -Intervention schools had water fountains installed and teachers promoted water consumption via lessons	Pre-post body weight and height measured Beverage consumption assessed through 24-hr recall questionnaires (1 glass = 200mL) Retention rates not significantly similar among the non-MIG and MIG (P=0.59)	MIG status modified the intervention effect on prevalence (P=0.03) and remission of overweight (P=0.02), but not incidence Post-intervention the risk of overweight was reduced in IG vs. CG among non-MIG (OR=0.51, 0.31,0.83 C.I.), but not in MIG group (0.63,1.65 C.I.) Post-intervention, water consumption increased in non-MIG/MIG groups in the IG by ~1glass/day -No effect on SSB consumption -Post-intervention, juice consumption in non-MIG reduced in IG vs. CG by 0.4glasses/day (-0.7,-0.1), but no difference in MIG	CULTURE/IMMIGRATION STATUS MAY AFFECT IMPACT OF A WATER INTERVENTION

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Muckelbauer, R., et al. Long-term process evaluation of a school-based programme for overweight prevention. *Childcare, health and development*, 2009, Vol.35, No.6:851-57	Secondary analysis of a randomized controlled cluster trial (process evaluation of their intervention)	N=11 (of 17) elementary schools (2nd and 3rd graders) Germany	School-based environmental and educational intervention promoting water consumption -environmental: installing 1 or 2 fountains/school and each child got a plastic water bottle. Teachers encouraged to organize their classes to fill bottles each morning -education: four 45-min class lessons 1 school yr intervention period and a 19 month follow-up Note: fountains "provided cooled and filtered plain or carbonated water"	Data collection methods: -Measuring the water flow of school water fountains, -Teacher & headmaster questionnaires and interviews (from intervention schools) Main outcomes = implementation of intervention, water consumption behavioral modification of kids, and teacher/headmaster attitudes towards intervention	11/17 intervention schools maintained fountains at 19 months (cost was the most common reason for discontinuing) Education implementation varied between units from 13-84% Mean water flow highest in the first 3 months of intervention (~225L/school/wk) and stabilized during follow up (~110L/school/wk) Note: schools that removed water fountains during follow-up were removed from analysis	ED + ENV SCHOOL-BASED WATER INTERVENTION MAY HAVE SUSTAINED IMPCAT ON WATER INTAKE

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Kaushik, A., et al. A study of the association between children's access to drinking water in primary schools and their fluid intake: can water be 'cool' in school? *Child: care, health and development*, 2007, Vol.33, No.4:409-15	Observation-al naturalistic experiment	N=145 of 298, 6-7 yrs (from year 2) N=153 of 298, 9-10 yrs (from year 5) UK; 6 Southampton urban schools	Evaluation of the Water is Cool in School campaign during 1 school day; based on intention to treat -Students in groups of 10 -Between the months of Jan and Mar Schools categorized by drinking access policy into prohibited (in classroom), limited (allowed in class but not on desk), and free access (water encouraged on desk)	Intervention foci: -Total fluid intake (TFI) -Total toilet visits N=120 from "prohibited", 91 from "limited," 87 from "free access" from both age groups used for analysis Individual water containers weighed for volume	A total of 81% and 80% of children in prohibited and limited access schools, respectively, consumed below the minimum recommended amount of total fluid at school, compared with 46.5% in the free access schools. Higher TFI in Year 2 free access schools vs. prohibited access (P=0.046), and in Year 5 free access schools vs. prohibited access (P=0.001) and limited access (P=0.003) schools. -Higher intake in free access schools when considering just water intake -Free access to drinking water associated w/ decreased intake of flavored alternatives vs. prohibited access (P=0.019) No correlation between water access and frequency of toilet visits (P=0.605)	MOST CHILDREN HAVE AN INADEQUATE FLUID INTAKE IN SCHOOL. FREE ACCESS TO DRINKING WATER IN CLASS IS ASSOCIATED WITH IMPROVED TOTAL FLUID INTAKE.

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Obesity TREATMENT / longer-term intervention trials						
Dennis, E.A., et al. Water consumption increases weight loss during a hypocaloric diet intervention in middle-aged and older adults. *Obesity*, 2009, doi:10.1038/oby.2009.235	12 weeks RCT Blinded	N=48, 55-75 yrs, and BMI 25-40. Weight stable > 1 year & non-smokers 92% = white WP group > NP in test meal EI at baseline, but not at week 12 2 groups comparable on other factors such as BMI and PA at baseline	Multiple anthropometric and biologic measurements at enrollment All participants on a hypocaloric diet but assigned to either: -a500 mL chilled water preload before each daily meal (water group) or -control (non-water group) At baseline and wk 12, both groups underwent 2 ad libitum test meals within a 2 wk period, separated by a min of 2 days -preload 30 min before test meal of water (WP) -no preload (NP)	Meal Energy Intake (EI) tested at each test meal -food weighed before being served, and after completion of test meal NP condition served as baseline EI for comparison Body weight VAS scale (hunger, fullness, thirst) at 0, 30, 60, 90, 120, and 150 min	Both groups had weight loss, no sex differences Weight loss about 2kg greater in water group, and showed a 44% greater decline in weight vs. non-water group ($P < 0.001$) Test meal EI was lower in the WP than NP condition at baseline, but not at week 12 (baseline: WP 498 ± 25 kcal, NP 541 ± 27 kcal, $P = 0.009$; 12-wk: WP 480 ± 25 kcal, NP 506 ± 25 kcal, $P = 0.069$).	WATER (~16 fl oz) BEFORE DAILY MEALS LED TO GREATER WEIGHT LOSS (2 kg over 12 weeks) COMPARED TO A HYPOCALORIC DIET ALONE (in middle aged & older adults)
Stookey, J.D., et al. Drinking water is associated with weight loss in overweight dieting women independent of diet and activity. Obesity, 2008, Vol.16, No.11	Cross-sectional, cluster analysis	N=173 premenopausal overweight women; 25-50yrs	Data from the Stanford A TO Z weigh loss intervention; randomizes participants into 4 different mainstream diets Diet, physical activity, body weight, percent body fat, and waist circumference assed at baseline, 2, 6, & 12 months 3 unannounced 24hr diet recalls	24hr diet recalls to assess: mean daily intakes of drinking water, noncaloric, unsweetened caloric, and SSBs, and food energy and nutrients Drinking water includes: tap, bottled still, mineral water, soda water, seltzer water, unsweetened sparkling, and carbonated water. Anthropometric measurements	Absolute and relative increases in drinking water were associated with significant loss of body weight and fat over time ($P<0.05$) From baseline, mean water intake increased +447mL after 2 months, but stabilized to +288mL at 12 months ($P<0.05$)	INCREASING WATER INTAKE ASSOCIATED WITH GREATER WEIGHT LOSS

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Stookey, J.D., et al. Replacing sweetened caloric beverages with drinking water is associated with lower energy intake. Obesity, 2007, Vol.15, No.12:3013-22	Cross-sectional	N=118 overweight premenopausal women (BMI 27-40); 25-50yrs Women regularly consumed SCBs	Data from Stanford A TO Z intervention Mean daily beverage intake measured at baseline, 2, 6, and 12 months; data collected within a 3wk period NDS system to code foods	3 24-hr diet recalls to measure mean daily beverage intake, food composition, and total EI	Replacing sweetened caloric beverages (SCB) with drinking water was associated w/ significant decreases in total EI, sustained over time ($P<0.05$) Caloric deficit from replacing SCBs w/ water not negated by compensatory increases in other food or beverages Caloric benefit of decreasing SCBs eliminated if SCBs replaced w/ nutritious caloric beverages; nutritious caloric beverages: 100% fruit juice, vegetable juice, milks.	REPLACING SSBS WITH WATER ASSOCIATED WITH REDUCED ENERGY INTAKE; REPLACING SSBS WITH NUTRITIOUS CALORIC BEVERAGE REMOVED CALORIC BENEFIT

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Observational or epidemiological studies						
Kant, A.K., & Graubard, B.I. Contributors of water intake in US children and adolescents: associations with dietary and meal characteristics-National Health and Nutrition Examination Survey 2005-2006. *American Journal of Clinical Nutrition*, 2010, Vol.92:887-96	Retrospective cross-sectional	N=3,978; 2-19 yrs	2005-06 National Health and Nutrition Examination Survey (NHANES); survey of plain water information -intake of plain water -moisture in foods -moisture in all beverages -moisture in nutritive beverages -total water intake -total water intake/kcal of reported E intake Age groups: 2-5, 6-11, 12-19	Total water intake, and association with sociodemographic characteristics and dietary and meal attributes NOTE: Beverage moisture as defined in NHANES is the proportion of water in that beverage e.g. plain water = water, but SSBs have a beverage moisture	Mean usual intake of total water overall less than Adequate Intake Percentage of total water intake from plain water increased with age; children & adolescents consumed more than 2/3 of their daily beverages with main meals. Higher BMI-for-age percentile associated w/ higher intakes of plain water (P = 0.01), and total water (g)/energy intake (kg) (P=0.0006) Plain water intake not correlated with EI	INTAKE OF PLAIN WATER AND ENERGY INTAKE NOT ASSOCIATED
Wang, Y.C., et al. Impact of change in sweetened caloric beverage consumption on energy intake among children and adolescents. *Arch Pediatr Adolesc Med*, 2009, Vol.163, No.4:336-43	Cross-sectional	N=3,098; 2-19 yrs	2 non-consecutive 24-hr dietary recalls from NHANES ’03-‘04	Within person beverage consumption Association between changes in consumption of SSBs and other drinks, and changes in total energy intake (TEI)	No net change in TEI with change in water intake (P=0.27) Substituting SSBs w/ water associated w/ a decrease in TEI -each 1% of beverage replacement was associated w/ 6.6 kcal lower TEI, which wasn’t negated by compensatory increases in other food or beverages (P<0.001) Among kids 2-5 yrs, no significant change in TEI when replacing water with whole or low-fat milk	CHANGE IN WATER INTAKE NOT ASSOCIATED WITH CHANGE IN TOTAL ENERGY INTAKE

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Popkin B.M. Patterns of beverage use across the lifecycle. *Physiology & Behavior*, 2010, Vol.100:4-9	Cross-sectional	All persons >2 yrs who reported 1 or 2 days of intake	Data from ERS food balance surveys 2-day beverage intake averages from four surveys; beverage intakes weighted to be nationally representative -NFCS 77, CSFII 89, CSFII 96, & NHANES '03-'06	Trends in beverage consumption from 1977 through 2006	Slow continuous decrease in total milk intake, w/ an increasing proportion of reduced fat milk (lower energy density vs. higher fat) From '77-'06, reduced fat milk increased from 21oz/day to 70oz/day for 2-18yrs Biggest shift among 2-18yrs = increased consumption in SSBs, and small increase in juices; but there was a recent slight decrease in SSB intake and overall decrease in kcal/d No trend in water intake–defined as bottled and tap water	NO TREND IN PLAIN WATER INTAKE DURING TIME THAT OBESITY INCREASED
Kahn, H.D., et al Estimated daily average per capita water ingestion by child and adult age categories based on USDA's 1994-1996 and 1998 continuing survey of food intakes by individuals. *Journal of Exposure Science and Environmental Epidemiology*, 2009, Vol.19: 396-404	Cross-sectional	N=20,000+ 13 distinct age groups, from less than 1 month to 65+ yrs	Based on USDA 1994-1996 and 1998 CSFII data 2 nonconsecutive days of food and beverage intake data Total water ingestion = sum of water ingested directly as a beverage and indirectly from food and drink	Water ingestion estimates (in mL/person/day and mL/kg/day) from: -beverages -water added to foods and beverages during preparation	When considering total water ingestion by kids, US Environmental Protection Agency default value is 1L/day for a 10-kg child = 90th percentile for kids <1yr For 2- to <3yr old group, 1L/day is between the 90th and 95th percentile Overall, most water ingestion at young ages is indirect through consumption of baby formula or juice	

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Molloy, C.J., et al. An exploration of factors that influence the regular consumption of water by Irish primary school children. *Journal of Human Nutrition and Dietetics*, 2008, Vol.21, No.5:512-15	Cross sectional; in-depth interviews	N=12 teachers Ireland	In-depth semistructured interviews until saturation achieved with the data	Thematic analysis	Teachers had poor knowledge of hydration requirements, accessibility, and associated health benefits and effect on concentration Barriers identified: disruption to class and increased need to urinate, nutrition not a priority	TEACHERS IDENTIFIED BARRIERS TO STUDENT WATER INTAKE
Patel, A.I., et al. Perceptions about availability and adequacy of drinking water in a large California school district. *Prev Chronic Dis*, 2010, Vol.7, No.2:1-10	In-depth qualitative interviews March-September 2007	N=26 California stakeholders School administrators & staff, health & nutrition agency reps, and families	Semi-structured interviews Thematic analysis at saturation	-drinking water accessibility -attitudes about facilitators and barriers to drinking water provision, and ideas for increasing water consumption	Concerns about appeal, taste, appearance, and safety of fountain water Affordability Environmental effect (plastic waste) of bottled water sold in schools For improvement: water bottles, refrigerated and filtered water, water station	BARRIERS IDENTIFIED TO WATER INTAKE IN SCHOOLS
Stahl, A., et al. Relation between hydration status in children and their dietary profile – results from the DONALD study. *European Journal of Clinical Nutrition*, 2007, Vol.61:1386-92	Cross-sectional	N=717, 4-11 yrs Germany	Dortmund Nutritional and Anthropometric Longitudinally Designed Study (DONALD) Children put into 2 groups; 4-6.99 yrs, 7-10.99 yrs	24hr urine samples for hydration status to calculate “free water reserve” 3-day weighed food records for dietary intake	Kids in the highest group of hydration status had higher total water intake (includes water in food and all beverages), lower energy density of the diet, and a lower proportion of metabolic water vs. kids in the lowest group of hydration status	

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Park, S., et al Factors Associated with Low Drinking Water Intake among Adolescents: The Florida Youth Physical Activity and Nutrition Survey, 2007. *Journal of the American Dietetic Association*, 2011, Vol.111: 1211-17	Cross-sectional	N=4,292 students (of 4,669) Representative sample 6th through 8th grades from 86 FL public middle schools	Based on the 2007 Florida Youth Physical Activity and Nutrition Survey	Plain water intake; glasses or bottled	Approximately 64% had low water intake (<3 glasses/day) Factors associated w/ low plain water intake (selected) include (P<0.0001): -drinking no 100% juice, drinking juice <1 time/day, and 1-2 times/day (ORs 1.83, 1.91, and 1.32 respectively) -drinking no milk and drinking <2 glasses milk/day (ORs 1.42 and 1.41), eating at a fast food restaurant, & not participating in team sports Strongest associated factor of low water-intake was frequent consumption of snacks/sodas while watching TV/movies (OR = 2.20)	WATER INTAKE INVERSELY ASSOCIATED WITH OTHER BEVERAGES (SODA, JUICE, SPORTS DRINKS, MILK)
Sichert-Hellert, W., et al Fifteen year trends in water intake in German children and adolescents: Results of the DONALD Study. *Acta Paediatr*, 2001, Vol.90: 732-37	Retrospective	N=354 males N=379 females 2-13 yrs Germany	3 day weighed dietary records (n=3,736) from the Dortmund Nutritional and Anthropometric Longitudinally Designed Study (1985-99)	Total water intake–a la Stahl et al, DONALD study; includes water from food, beverages, and oxidation (beverages caloric & non-caloric)	Total water intake increased w/ age from 1114g/day in 2-3yr olds to 1363g/day in 4-8 yr olds and to 1801g/day (boys) or 1676g/day (girls) in 9-13 yr olds [P<0.01], mainly due to increase in beverage consumption Total water intake per body weight decreased w/ age Milk (9-17%) and mineral water (12-15%) most important source of total water intake. Plain water “tap water” never exceeded 4% of total water intake.	

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Heller, K.E., et al. Water consumption in the United States in 1994-96 and implications for water fluoridation policy. *J Public Health Cent*, 1999, Vol.59, No.1:3-11	Retrospective cross-sectional	N=14,619 people (0 to 65+ yrs)	1994-96 Continuing Survey of Food Intakes by Individuals (CSFII) compared to 1977-78 Nationwide Food Consumption Survey (NFCS)	Compared food and beverage intake data for 2 24-hour recalls in the CSFII	CSFII showed decreased consumption of tap water and cow's milk in infants vs. the NFCS 1-10 yrs, 11-19 yrs (smaller difference relatively) showed a decrease vs. the 20-64 yrs who showed a slight increase Older kids and adults increased carbonated drinks and juices No association between water intake and month or season	
Popkin, B.M., et al. Water and food consumption patterns of U.S. adults from 1999 to 2001. *Obes Res.*, 2005, Vol.13:2146-52	Cross-sectional, cluster analysis	N=4,755; >18 yrs	NHANES '99-'01, dietary interview Multiple pass 24hr recall, and a short post-recall questionnaire	Total consumption of energy, nutrients, and non-nutrient food components from food & beverages	87% consumed water,(bottled & tap) with an average daily consumption of 1.53L/consumer (P<0.05) Water consumers drank fewer soft/fruit drinks, and consumed 194 fewer calories/day 49% of water consumers also consumed milk vs. 38% of water non-consumers (P<0.05)	PLAIN WATER CONSUMERS DRANK LESS SUGAR SWEETENED BEVERAGES AND HAD LOWER ENERGY INTAKES COMPARED TO NON-WATER DRINKERS

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Kant, A.K., et al. Intakes of plain water, moisture in foods and beverages, and total water in the adult US population-nutritional, meal pattern, and body weight correlates: National Health and Nutrition Examination Surveys 1999-2006. *Am J Clin Nutr*, 2009, Vol.90:655-63	Retrospective cross-sectional	N=12,283 (NHANES ’99-’04) and N=4,112 (NHANES ’05-’06) >20 yrs	Used 24-hr dietary recall from NHANES ’99-’04 and NHANES ’05-‘06 -intake of plain water -moisture in foods reported in 24hr recall -moisture in beverages reported in the recall -total water intake	Plain water intake, food and beverage moisture, and total water with sociodemographic factors, dietary characteristics and meal patterns	Plain water intake unrelated to the dietary intake of energy and BMI, but positively related to dietary fiber and inversely related to beverages, sugars, and energy density of foods	PLAIN WATER INTAKE INVERSELY RELATED TO SUGAR SWEETENED BEVERAGES AND NOT RELATED TO TOTAL ENERGY INTAKE
Stookey, J.D., et al What is the cell hydration status of healthy children in the USA? Preliminary data on urine osmolality and water intake *Public Health Nutrition*, 2011, Vol.27:1-9	Cross-sectional	N=337 (Los Angeles) and 211 (New York City) 9-11 yrs	Households randomly selected for participation, $50 incentive provided Participants grouped by (a) total amount of reported water intake e.g. “higher” vs. “lower”; cutoff =500mL and (b) reported source of water intake i.e. drinking water, other beverages, and from food	Cell hydration status via urine osmolality -Individual urine samples collected on way to school in morning at a clinic -Dietary recall assessing food & beverage intake post-walk/pre-sample -self-reported physical activity complemented by accelerometer, and use of medication and hours of sleep Note: water intake also includes that from solids consumed	Elevated urine osmolality (0.800 mmol/kg) was observed in 63% and66% of participants in LA and NYC, respectively. Elevated urine osmolality associated with not reporting intake of drinking water in morning [1.2,3.5(LA), 1.0,3.5(NYC)] 90% of both samples had breakfast before sample, 75% didn’t drink water Urine osmolality inversely associated with drinking water for LA and NYC (P=0.003 and 0.045 respectively), but only LA for Total Water Intake -not associated with water from other beverages or from food	CHILDREN IN THE U.S. MAY NOT BE CONSUMING ADEQUATE AMOUNTS OF WATER

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Murakami, K., et al. Intake from water from foods but not beverages, is related to lower body mass index and waist circumference in humans. *Nutrition*, 2008, Vol.24:925-32	Observation-al cross-sectional study	N=1136 (of1176) female dietetic students, 18-22 yrs Japan		Dietary intake assessed with a self-report diet-history questionnaire (DHQ): -general dietary behavior -major cooking methods -frequency & amount of 6 alcoholic beverages -frequency & portion size of selected food, and non-alcoholic beverages -dietary supplements -frequency & portion size of staples e.g. cereals -foods consumed regularly DHQ based on *Standard Tables of Food Composition in Japan* BMI& waist circumference	Water intake from beverages (plain water plus caloric beverages) not associated with BMI (P=0.25) or waist circumference (P=0.43) Water intake from foods showed independent and negative associations with BMI (P=0.030) & waist circumference (P=0.0003) Study does not have any plain water beverage results	

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Other Reports & Articles						
Chandran, K Improving Water Consumption in Schools: Challenges, Promising Practices, and Next Steps. *California Food Policy Advocates, 2009*	Policy brief after AB 2704 vetoed (free drinking water in school cafeterias)			DGAs assume consumption of fluids during meals as a necessary strategy to stay properly hydrated Lists current practices with water provision and access points, and also best practices/case studies	Challenges: Infrastructure (incl. active v. passive delivery systems), costs, school meal & vending regulations, water quality/taste, nutrient displacement, safety & sanitation NYC school pilot showed water has no impact on school meals, and LA found that it did not reduce milk consumption. The milk consumption finding for LA referenced "Increasing the Availability and Consumption of Drinking Water in Public Schools: A Pilot Intervention."	
Campbell, SM Hydration Needs throughout the Lifespan *Journal of the American College of Nutrition*, 2007, Vol.26, No.5: 585S-587S	Article based on 2004 IOM report			First time an AI for water was set AIs based on median intakes of total water; AI for kids 1-3 yrs =1.3L/day, for 4-8 yrs =1.7L/day, and boys 9-13 yrs =2.4L/day, girls 9-13 yrs =2.1L/day. AI for men 19+ yrs = 3.7L/day, and women 19+ yrs =2.7L/day Water in food = approximately 19% of total daily water intake		

Citation	Study Design	Sample Population	Intervention Method/Design	Outcomes Measured and Data Collection Methods	Effect and Effect Size	Conclusion
Coe, S. et al. Hydration and health *Nutrition Bulletin*, Vol. 36: 259-66	Summary from a 1-day conference London				Kids have greater water losses and faster water turnover vs. adults because they have greater total body water content Kids also have higher surface to mass ratio, respiratory rate	
Jacobson, MF You Are What You Drink *Nutrition Action Health Letter*, 2007, Vol.34, Issue.8:2					Today Americans get more than 20% of calories from beverages (referencing work by Barry Popkin) humans evolved drinking only water and getting calories from food, hypothesizing that there are separate mechanisms for thirst and hunger satiety	

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Ramirez I. Feeding a liquid diet increases energy intake, weight gain and body fat in rats. J Nutr. 1987 Dec;117(12):2127-34.
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Taylor RW, McAuley KA, Barbezat W, Strong A, Williams SM, Mann JI. APPLE Project: 2-y findings of a community-based obesity prevention program in primary school age children. Am J Clin Nutr. 2007 Sep;86(3):735-42.

Additional study not included in table above as not able to access journal article
Abi Haidar G, Lahham Salameh N, Afifi RA. Jarrib Baleha--a pilot nutrition intervention to increase water intake and decrease soft drink consumption among school children in Beirut. J Med Liban. 2011 Apr-Jun;59(2):55-64. Abstract The Global School-based Student Health Survey (2005) indicated that in Lebanon, 33% of students in grades 7-9 drink carbonated soft drinks two or more times per day. Observational evidence suggests that students do not drink enough water. OBJECTIVE: A pilot project called Jarrib Baleha ['try without it'] was implemented with 110 students in grades 3 and 4 in two schools in Lebanon to promote drinking water instead of soft drinks. Specific objectives included increasing knowledge about the benefits of water and the harms of soft drinks, increasing confidence in choosing water over soft drinks, and increasing actual water drinking behavior while decreasing soft drink consumption. METHODS: Four 50-minute theory-informed, interactive and participatory sessions were implemented --by a graduate student in partial fulfillment of requirements for a MPH degree--over a period of two weeks. The intervention sessions--based on the Health Belief Model--took place during a class period. Process evaluation measured satisfaction of the students with the sessions. Impact evaluation measured changes in knowledge, attitudes including self-efficacy, and behavior, using a self-administered questionnaire completed prior to and after the intervention. Bivariate analysis using crosstabs was carried out to compare pretest and posttest scores on knowledge, attitudes, and behavior. RESULTS: Comparison of the knowledge index between pretest and posttest indicated that, overall, knowledge increased from 6.0769 to 9.1500 (p =

0.000). Compared to pretest, students at posttest also felt more confident to drink less soft drinks and more water ($p < 0.05$), to drink water when thirsty ($p < 0.05$), and to choose water over soft drinks when going to a restaurant ($p < 0.05$). The percentage of students drinking 6 or more cups of water increased from 27.7% to 59.1% ($p = 0.000$); and those drinking less than one can of soft drink/day increased from 25.5% to 57.6% ($p = 0.000$).

DISCUSSION:

These results are encouraging and suggest the Jarrib Baleha intervention could be implemented on a wider scale with students from both public and private schools. A more robust evaluation design is recommended. A comprehensive approach to school-based nutrition is also suggested.

Appendix B. Attendees at the CDC Convening on Water

CDC Expert Panel on Drinking Water Availability in School and Early Care and Education Settings
May 17-18, 2012
Atlanta, GA

1. Javier Arce-Nazario, PhD, Professor, University of Puerto Rico
2. Cheryl Berman, Founding Partner, Unbundled Advertising Agency
3. CDR Heidi Blanck, PhD, Chief of the Obesity Prevention and Control Branch, CDC Division of Nutrition, Physical Activity, and Obesity
4. Ellen Braff Guajardo, JD, MEd, Senior Nutrition Policy Advocate, California Food Policy Advocates (CFPA)
5. Kirk Chase, BS, Georgia Environmental Protection Division's Drinking Water Program
6. Angie Cradock, ScD, Senior Research Scientist and Deputy Director, Harvard Prevention Research Center on Nutrition and Physical Activity (PRC)
7. Brenda Davy, PhD, RD, Associate Professor, Department of Human Nutrition, Foods and Exercise at Virginia Tech
8. Kip Duchon, National Fluoridation Engineer, Division of Oral Health, CDC
9. Brian Elbel, PhD, Assistant Professor of Medicine and Health Policy, New York University School of Medicine and the NYU Wagner Graduate School of Public Service
10. Laurel Firestone, JD, Co-Director, Community Water Center
11. Steven Gortmaker, PhD, Professor of the Practice of Health Sociology, and Director of the Harvard School of Public Health PRC
12. Kordula Green, PhD, Member of the Executive and Foundation Board for the National Association for Family Child Care
13. Karla Hampton, JD, Consultant and former staff attorney for the National Policy & Legal Analysis to Prevent Childhood Obesity (NPLAN)
14. Kenneth Hecht, JD, Consultant and former Executive Director, CFPA
15. Kate Homan, Manager, Evaluation and Systems, Health Innovation, YMCA of the USA
16. Caree J. Jackson, PhD, Research Fellow at the CDC Division of Nutrition, Physical Activity, and Obesity
17. Beverly Kingsley, PhD, MPH, Epidemiologist, CDC Division of Nutrition, Physical Activity, and Obesity
18. Tiffany Sellers Lommel, MS, RD, LD, School Nutrition Director for Gainesville City Schools in Georgia
19. Caitlin Merlo, MPH, Health Scientist, CDC Division of Population Health

20. Stephen Onufrak, PhD, Epidemiologist, CDC Division of Nutrition, Physical Activity, and Obesity
21. Sohyun Park, PhD, Epidemiologist, CDC Division of Nutrition, Physical Activity, and Obesity
22. Anisha I. Patel, MD, MSPH, Assistant Professor, Division of General Pediatrics, UC San Francisco
23. CAPT Meredith Reynolds, PhD, Scientist, USPHS CDC
24. Crystal Rhodes, Kids 'R' Kids Project Consultant and GAYC Public Policy Chair
25. Lorrene Ritchie, PhD, RD, Director of Research, Atkins Center for Weight and Health, UC Berkeley
26. Bettylou Sherry, PhD, Lead Epidemiologist for Research and Surveillance, Division of Nutrition, Physical Activity, and Obesity, CDC
27. Holly Wethington, PhD, Behavioral Scientist, CDC Division of Nutrition, Physical Activity, and Obesity
28. Cara Wilking, JD, Senior Staff Attorney, Public Health Advocacy Institute

Appendix C. References for Literature Review

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