Wisconsin Farm to School Programs: Dietary Outcomes in Elementary Students

By
Andrea Beth H. Bontrager Yoder

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The dissertation is approved by the following members of the Final Oral Committee:

Dale A. Schoeller, Professor Emeritus, Nutritional Sciences
Julie A. Mares, Professor, Ophthalmology
Beth H. Olson, Professor, Nutritional Sciences
Susan K. Riesch, Professor Emerita, Nursing
Roger S. Sunde, Professor, Nutritional Sciences

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Dedications

…to the people who said school-grown produce can't be used in school meals: it can!

…to the numerous people who work to bring farm to school programs to students around the nation: thank you for your tireless energy and effort. My dream is that this dissertation helps support your efforts and shows concretely that your work is important.

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Abstract

Background. High overweight and obesity prevalence has instigated many programs to improve children's health. Farm to School (F2S) is a grassroots-organized program that seeks to improve children's dietary habits, especially fruit and vegetable (FV) consumption, through various educational activities. Long-term goals include reducing obesity prevalence while simultaneously supporting local farmers and bolstering local economies. There is little literature assessing the effectiveness of F2S on achieving these aims. Therefore, this study examines F2S program effects on children's knowledge, attitudes, and behaviors with respect to FV intake and short-term BMI outcomes.

Methods. This study included third- through fifth-grade students from 12 schools participating in F2S programming. In a pre-/post-program year evaluation design, students completed a Knowledge & Attitudes Survey, the Block Kids 2004 Food Frequency Questionnaire, Lunch Tray Photo Observation (LTPO), and BMI *z*-score measurements. Secondary analysis on LTPO data investigated factors associated with FV waste, and the relationship between total- and FV-energy intake in the school lunch setting.

Results. We found small increases in students' dietary knowledge and attitudes toward eating FV, and indications of increased FV access and consumption in school lunch. Several F2S- or FV item-specific-related factors impacted FV waste in school lunch; most importantly with respect to F2S programming, waste of FV items both liked and not liked did not differ. Increased FV intake in school lunches did not reduce total energy intake, but it did increase the meal's proportion of energy from FV, suggesting calorie rather than volume displacement. Finally, we found no change in BMI *z*-scores across a single program year for students in F2S programs.

Conclusions. These results suggest that F2S programs have the potential to be an effective strategy that communities may implement to improve children's health and reduce the burden of obesity. However, F2S alone is not likely a sufficient means to improve health and lower obesity rates. Instead, it should take its place among a collection of program, policy, and environmental strategies where a community has interest in supporting overall health through robust local food systems and activities.

Chapter 1. Literature Review

Childhood Obesity: The Problem, Strategies for Prevention, and the Evolution of Farm to School

Obesity defined

Defined as excess body fat, the terms 'overweight' and 'obesity' describe differing degrees of excess stored energy accumulation.[1] The common quantification of excess body weight relative height is body mass index (BMI), calculated as weight in kilograms divided by meters-squared (kg/m^2). For adults, the healthy BMI range is from 18.0 to less than 25.0. The overweight BMI range is 25.0 to 29.9, and obesity begins with a BMI ≥30.0. BMI values of less than 18.0 are considered underweight. These indexed values are problematic in growing children. Both the Centers for Disease Control and Prevention (CDC)[3] and the World Health Organization (WHO)[2] have developed growth charts to help practitioners better interpret children's relative weights for heights across the developmental stages of infancy, childhood, and adolescence, using referent populations. The CDC growth curves are recommended for children and adolescents, using BMI-for-age-and-sex percentiles to offer estimations of current growth relative to a healthy, historical population. For children, healthy weight is defined as having a BMI-for-age-and-sex between the 5^{th} and 85^{th} percentiles, while overweight ranges from the 85^{th} to $<95^{th}$ percentiles, and obesity is defined as having a BMI-for-age-and-sex $\geq 95^{th}$ percentile.

Obesity prevalence

Obesity in the United States of America has long been a growing public health problem. Adult obesity prevalence is currently 36% (2010 data), whereas prevalence among all child and adolescent age groups combined hovers around 17%.[4] The prevalence of overweight and obesity combined for six- to eleven-year olds is nearly 33%, similar to that among two- to 19-year-olds (32%).[5] Many studies

demonstrate that overweight and obesity in children increase the risk for, and often continue into, that in adulthood.[6–8] Additionally, children do not escape the negative, chronic health consequences of overweight and obesity, with increased risk at an earlier age (and continuing into adulthood) for cardiovascular disease,[9–11] metabolic disease,[12] and diabetes.[13] These problems have impacts beyond health: overweight and obesity (and concurrent low fitness) in children in particular are associated with poorer academic performance[14–16] as well as social and behavioral problems.[17–19] Overweight and obesity also pose a burden to our health care system, costing an estimated $147 billion in 2009 (calculated using 2008 dollars) in the United States.[20,21] In Wisconsin, the Department of Health Services (DHS) reports that 33% of third-graders were overweight or obese in 2012-2013, an increase from 28% in 2007-2008.[22] A 2008 DHS publication summarizing Wisconsin obesity prevalence rates indicates that 65% of adults, 25% of high-schoolers, and 29% of two- through four-year olds were overweight or obese at that time.[23]

Causes of obesity

Dietary habits are one factor solidly attributable to obesity. Adults' self-reported estimated daily total energy intake increased from 2461 kilocalories/day (1971-1974) to 2510 kcal/day (2007-2010) for males and from 1540 to 1772 kcal/day for females.[24] Although most people would consider these relatively small changes, increases of 49-232 kcal/day translates crudely to a weight increase of 5-24 pounds in a single year if not offset by commensurate increases in physical activity. By comparison, a two-pound weight gain in one year results from a positive energy balance averaging just 19 kcal/day. United States Department of Agriculture (USDA) loss-adjusted food availability data from similar times offers evidence that American adults consumed 474 kcal/day more in 2010 than in 1970.[25] Neither the self-reported nor the food availability data are completely accurate, however. Measured adult heights and weights from the same times, combined with physical activity coefficients of 1.11-1.12 (men and women respectively, indicating moderately low activity levels), yield estimated energy requirements (EER) that indicate an EER decrease of approximately 200 kcal over the same time (Table 1.1). The adult self-reported dietary intake data, using the same measured heights and weights, suggest nearly non-

Table 1.1. Calculated Estimated Energy Requirements and Physical Activity Coefficients from National Adult Heights, Weights, and Reported Energy Intake

Sex	Time	Age	Height[1], m	Weight[1], kg	PA coefficient	EER[2]	Difference from EER
Male	1970	25	1.75	78.18	1.11	**2854**	-
	2007-2010	65	1.76	88.86	1.11	**2666**	-
Female	1970	25	1.62	65.00	1.12	**2176**	-
	2007-2010	65	1.62	75.55	1.12	**2015**	-
Calculated PA[3] using USDA/ERS[4] or Self-Reported[5] energy intake data:							
Male [USDA/ERS]	1970	25	1.75	78.18	**0.75**	2064	-28%
	2007-2010	65	1.76	88.86	**1.06**	2538	-5%
Male [SELF]	1970	25	1.75	78.18	**0.93**	2461	-14%
	2007-2010	65	1.76	88.86	**1.04**	2510	-6%
Female[USDA/ERS]	1970	25	1.62	65.00	**1.06**	2064	-5%
	2007-2010	65	1.62	75.55	**1.40**	2538	+26%
Female[SELF]	1970	25	1.62	65.00	**0.76**	1540	-29%
	2007-2010	65	1.62	75.55	**0.99**	1772	-12%

Abbreviations: EER, Estimated Energy Requirements; PA, Physical Activity; USDA/ERS, United States Department of Agriculture/Economic Research Service.

[1] 1970s average heights and weights from CDC.[168] 2007-2010 average heights and weights from CDC.[169]

[2] Calculated from Institute of Medicine energy equations.

[3] IOM energy equations rearranged to calculate PA using measured heights and weights (see footnotes 1 and 2 above) and self-reported or USDA/ERS EER.

[4] United States Department of Agriculture – Economic Research Service, food disappearance data (not distinguished between males and females).[25]

[5] Self-reported dietary intake, reported to the National Health and Nutrition Examination Survey.[24]

physiologic physical activity coefficients. Both self-reported and food disappearance data suggest low estimated energy intake ranging from 5% to 28% below EER for males, and inaccurate estimated energy intake ranging from 29% below to 26% above EER for females.

Excess screen time and other sedentary behaviors also contribute to obesity.[26] Between 1990 and 2000, adults slightly improved their participation in physical activity,[27] but in 2011, still only 21% of US adults age 18 years and above met Physical Activity Guidelines for muscle-strengthening and aerobic activity.[24] Children ages six to eleven years do not do much better: about two-thirds do not engage in vigorous activity.[24] There are, however, some recent indications of improvement. The percent of children not engaging in daily vigorous physical activity decreased from 68% to 62% (2003 – 2007), but this was concurrent with an increase in the percent of children receiving greater than two hours of screen time daily (36% to 40%).[24] Inactivity is a significant problem documented among high-school students: 24% of males and 38% of females were classified as inactive in 2001; moreover, at the same time, grade-level inactivity rates increased with age from 24% (9th grade) to 39% (12th grade).[27,28] Although high schoolers' vigorous activity rates remained relatively stable between 1993-2001, daily physical education class attendance decreased from 42% (1991) to 32% (2001).[27,28] As measured by accelerometry, 42% of six- to eleven-year olds achieved at least 60 minutes/day of physical activity; this decreased to just 8% for adolescents, and only 5% of adults achieved their recommended minimum of 30 minutes/day.[29] Moreover, dietary and activity behaviors tend to cluster together, even for very young children.[30–32] Many additional factors influence an individual's energy balance and resulting weight status, including family, caregivers, peers, marketing, media, genetics, an individual's mother's pregnancy health history, and place of residence.[33,34]

A popular perception is that school foods contribute to children's overweight and obesity, although the amounts eaten of standardized portions seem to be more important than the school foods themselves.[35] Empty calories (found in foods with high solid fat and added sugars content) are obtained equally from schools, stores, and fast-food restaurants.[36] The School Nutrition Dietary Assessment Study (SNDA-III, 2004-2005) showed that participation in the National School Lunch Program (NSLP) was

associated with reduced prevalence of nutrient inadequacy, and only positively associated with excess sodium intake.[37] Most schools met NSLP standards for protein, vitamins and minerals, although not for energy from fat or saturated fat, sodium, or fiber (relative to 2005 Dietary Guidelines for Americans).[38] One study found that NSLP participation improves health outcomes for students who receive free or reduced-price lunches.[39] However, there is an association between french fries and similar potato foods, desserts, and the likelihood of obesity among elementary students.[40] Because students consume a significant amount of their daily energy at school,[41] schools have both the opportunity and the responsibility to offer healthy options for healthful dietary intake.

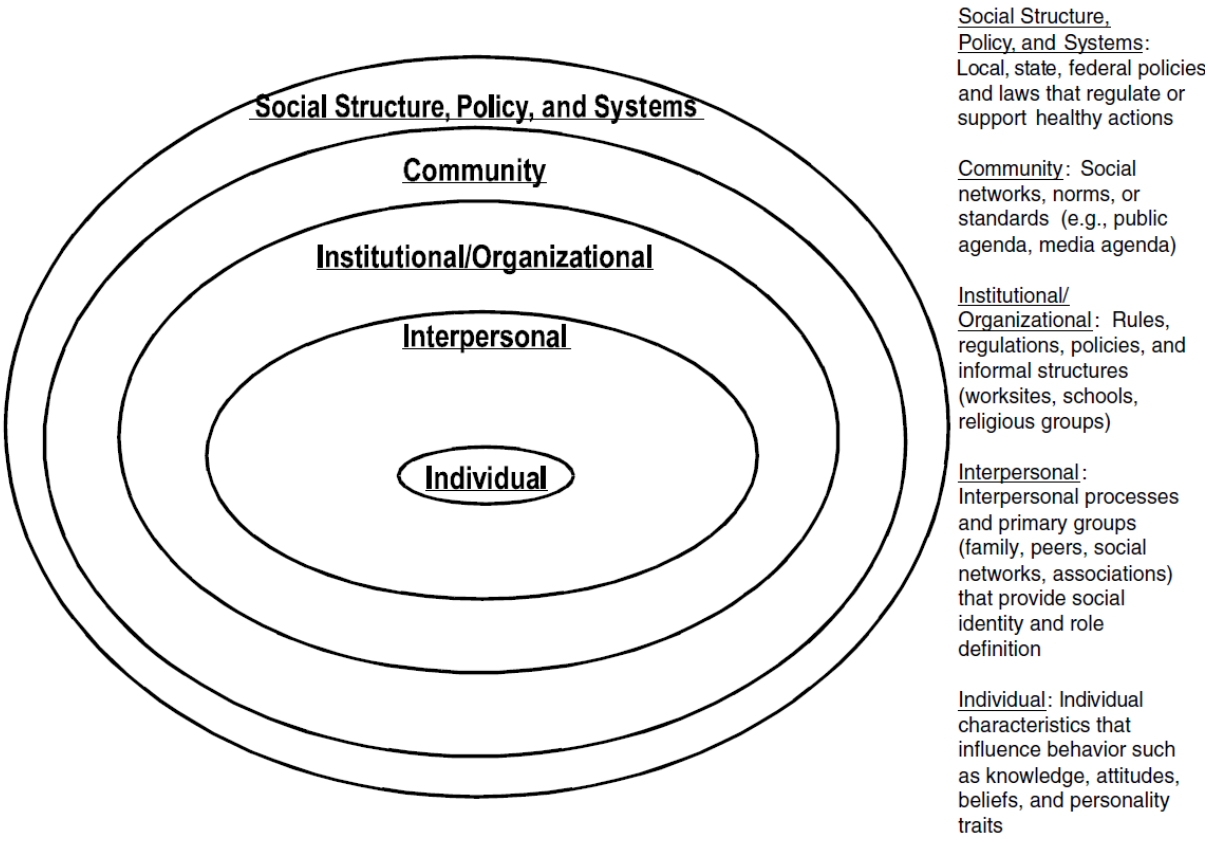
Strategies for preventing childhood obesity

The ability to effect broad-based change in individuals needs to account for the complexity of individual behaviors and social contexts in which we exist. A framework that considers change within those contexts is the Social-Ecological Model (SEM).[42] The SEM identifies individual, interpersonal, institutional/organizational, community, and social structure, policy, and systems as the various levels through which a multicomponent intervention may engage with a person or population (Figure 1.1).[43] Although the SEM is not the only foundation upon which to design obesity prevention programs, it has broad reach across the spectrum of what is possible.

Modifiable individual-level factors that can be used as strategies for obesity prevention include increased physical activity (and its corollary, decreased sedentary time), dietary changes, and combined physical activity-dietary approaches. The SEM proposes that these types of changes have more success when individual-level lifestyle decisions are supported with modifications to more outward-level layers, such as parental support.[44] Policy-level changes also can make it easier for individuals and communities to make healthy choices within the spectra of either diet or activity factors. A large body of information has developed around both dietary and physical activity, especially with regard to school-based interventions. Such interventions are common in the literature due to the fact that most children attend

Figure 1.1. Social-Ecological Model.

Reproduced from Gregson, Foerster, Orr, et al., Journal of Nutrition Education 2001;33(Suppl 1).[43]



and spend the close to half of their waking week-day hours in school, and thus it is easier to facilitate a broad reach with interventions that begin in the school setting.

Increased physical activity

In adults, there are associations between physical activity and attenuated weight gain.[45] Among children, the results are mixed. A four-year randomized trial in France prevented overweight among children who were not overweight when beginning the study at age 12 years.[46] A three-year intervention, Physical Activity Across the Curriculum, showed that schools incorporating 75 minutes of physical activity per week (despite intervention goals of 90 minutes) during the school day had better student Body Mass Index (BMI) outcomes than schools with <75 minutes per week.[47] However, the Promoting Lifestyle Activity for Youth study (conducted in Arizona) showed no differences in children's BMI despite increased physical activity levels.[48] These mixed outcomes likely reflect the challenges described above pertaining to age-related trends of decreasing physical activity time, as well as additional factors that impact sedentary and active time.

Dietary changes

Many studies on dietary modifications study the efficacy of an intervention to effectively modify the diet in the immediate term, rather than take a longer-vision approach to outcomes; this is likely due to limited research funding for long-term follow-up data collection. Among the few studies in children that report on both dietary changes *and* BMI outcomes, the literature presents generally favorable, but still mixed, evidence. One study found that children who increased fruit intake tended to have lower BMI gains than children who decreased fruit intake; the opposite relationship was seen between vegetable consumption and BMI gain (both were nonsignificant).[49] Another interesting observation from that study is that changes in fruit and vegetable consumption did not significantly correlate with changes in other nutritional habits such as intake of sweets or high-calorie drinks, which are often emphasized, possibly over emphasized, in academic and popular literature as the cause of obesity. Another study investigating

adolescents' sugar-sweetened beverage intake and breakfast consumption and their associations with BMI and percent body fat found significant cross-sectional associations, particularly among females, but no longitudinal associations after adjustments for total energy intake, puberty, race, socioeconomic status, and age.[50]

Collectively, these associative and intervention studies of physical activity or dietary change indicate potential for such changes to favorably impact BMI, but suggest that attaining a healthy BMI is a lofty goal in the context of a limited-change intervention (limited in terms of both scope and duration). Limited interventions are unlikely to yield statistically significant or clinically meaningful change. Therefore, it is important to consider broader-scope interventions, such as those that combine goals of dietary change with increased physical activity or policy-level changes.

Combined dietary-activity strategies

Multi-component programs that include both dietary and activity components, as well as role modeling and support from key adults in children's lives, are more effective in ameliorating overweight and obesity.[33,44,51] Several school-based multi-component interventions support the ability of such interventions to reduce BMI[52–55] or moderators of BMI, namely, fitness and body fat.[56] These changes were attributable to improved healthy eating habits in at least two studies.[52,54] One also significantly improved nutrition knowledge.[56] Another study by Donnelly *et al.* (1996), however, showed no difference in children's BMI, fat intake, nor physical activity between intervention and control groups; the authors speculated that the changes achieved during the school day were counteracted by out-of-school compensations in energy intake (increased) and physical activity (decreased).[57] Other studies have taken place outside the school setting; a notable study in France successfully reduced obesity among students referred by their physicians.[58] A one-year lifestyle intervention for obese children, identified by physicians as motivated to participate, yielded successful BMI reduction for immediate and long-term follow-ups, reaching a BMI *z*-score reduction of 0.46 units five years after baseline.[59] Reinehr *et al.* (2010) highlighted that starting multi-component interventions (physical exercise, nutrition education, and

behavior therapy, with attention on both the individual and the family) as early as possible increased the potential for favorable outcomes.[59] As with the single-factor interventions described above, these combinatorial dietary-activity change interventions offer evidence in support of their ability to improve factors believed to modify obesity, yet the evidence remains mixed in ultimate BMI outcomes.

Policy-level strategies to prevent obesity

Another target level for intervention strategies is that of policy. The developmental history of tobacco use prevention often serves as a model for the obesity prevention movement. Tobacco prevention efforts successfully decreased the prevalence of tobacco use through tremendous education campaigns, using solid scientific evidence relating tobacco use to negative health outcomes, alongside policy changes to limit where tobacco use is permitted in public areas. For example, a significant milestone in Wisconsin was a ban on smoking inside of all public buildings, implemented in Madison in July 2005, and throughout the state on July 5, 2010 (State Statute 101.123, Wisconsin Act 12, 2009 Senate Bill 181).[60] Using this field's history and success, obesity prevention efforts find hope in the possibility of enacting policy-level change to facilitate healthier choices more easily by a broad population base.[61] However, it is important to note that many more factors are at play with respect to overweight and obesity as compared to tobacco use, notwithstanding the fact that a single person smoking affects the health of those in proximity via secondhand smoke, whereas an individual's weight status does not directly impact another's by physical proximity. Again, factors across the entire SEM impact weight status; policy changes to modify the obesogenic environment impact both healthy- and non-healthy-weight individuals.

Brennan's, Brownson's, and Orleans's recent (2014) review of policy- and environmental-level strategies that exist in the literature to ameliorate childhood obesity rated a total of 24 nutrition and physical activity policy strategies' effectiveness (Table 1.2).[62] Of these, most nutrition-related strategies were rated as "emerging," while two were rated as "promising." The best evidence for nutrition strategies available in the literature currently are related to childcare and school food and beverage policies and environments, food pricing, and government nutrition assistance. No nutrition strategies currently have

Table 1.2. Policy- and Environmental-Level Strategies Proposed to Ameliorate Childhood Obesity

Adapted from Brennan, Brownson, and Orleans, American Journal of Preventive Medicine 2014[62]

Category	Emerging	Promising	Second-Tier Effective	First-Tier Effective
Rating description	*Recommended for pilot studies*	*Needing further investigation through systematic evaluation studies*	*Ample evidence exists to warrant a formal, systematic review*	*Considered effective per published, rigorous systematic evidence reviews*
Nutrition	Menu labeling Neighborhood availability of food stores/restaurants/ both Provision of drinking water at school Point-of-purchase programs	School wellness policies School and community gardens	Childcare food and beverage policies and environments School food and beverage policies and environments Food pricing Government nutrition assistance	
Physical Activity	Screen time School wellness policies	Safe routes to schools Traffic safety Interpersonal safety	Transportation Childcare physical activity policies and environments	Community design School physical activity policy and environments Street design Availability of parks and recreation facilities Point-of-design prompts

ample documented peer-reviewed literature to demonstrate that they are solidly effective in ameliorating childhood obesity. Five physical activity strategies, however, do: community design, school physical activity policy and environments, street design, availability of parks and recreation facilities, and point-of-design prompts. These again are focused toward the outer layers of the SEM, and studies demonstrate their effectiveness. Additional physical activity strategies included in the review were considered second-tier effective or promising, with only two strategies being classified as emerging.[62]

Integrating research and practice of multidisciplinary efforts to promote health with policy is vitally important in the current context of limited funding and economic stress.[63] This concept increasingly has been applied and the evidence for effectiveness is growing. In 2009, the Centers for Disease Control and Prevention (CDC) presented 24 recommended strategies for obesity prevention, with a measurement for each strategy usable by communities to assess performance and progress over time.[64] The strategies span six categories: (1) increasing healthy food and beverage availability, (2) supporting healthy food and beverage choices, (3) encouraging physical activity/limiting sedentary time, (4) creating safe communities that support physical activity, and, outside the direct realms of dietary and physical activity, (5) encouraging breastfeeding, and (6) encouraging communities to organize for change. More specifically related to children's food environments, evidence showed that students who live in states with laws requiring fruits and vegetables in school meals had higher fruit and vegetable intake, particularly among students without regular fruit and vegetable access at home, prior to implementation of the Healthy, Hunger-Free Kids Act (Child Nutrition and WIC Reauthorization Act of 2010; HHFKA).[65] More recently, schools participating in the USDA's Team Nutrition program activities were found to offer healthier school lunches.[66] As such programs continue, documenting their effectiveness can further improve our understanding and can thus inform future policy implementation at the local, state, or federal level.

Challenges of school-based interventions to increase fruit and vegetable consumption

Engaging with public schools for research or public health interventions is a common approach to gaining access to large, representative populations. It is important to note, however, that school-based interventions are not without their challenges. On one hand, limitations on both research funding (and the necessary associated limitations in study length) and daily/weekly teaching and testing times present a difficult obstacle to reach the levels of change necessary on any given factor to yield measurable outcome changes.[67] Another challenge in demonstrating significant change is specific to fruit and vegetable consumption: students' intake as measured by seven-day food diaries showed poor to moderate tracking over two years.[68] Lytle *et al.* (2000) found that fruit and vegetable consumption decreased between the third and eighth grades.[69] This poses yet another challenge to those conducting interventions with this age group: attempting to increase fruit and/or vegetable intake during age when it typically decreases. Perhaps the biggest challenge, however, is that the major instruments for these studies – that is, any of a variety of self-reported dietary measures – are prone to errors.[70–72] Improved measurement methods on this or other factors may improve the ability to accurately detect change.

The Farm to School Strategy

Despite the challenges of school-based interventions, this setting has potential: schools are known to be an important location for elementary children to access and consume fruits and vegetables.[73–75] To this end, farm to school programs evolved over decades in various locations, initially independently of each other. The earliest versions of such programs employed school gardens as a strategy to combat malnutrition or to improve children's appreciation for natural life processes and how to effectively cultivate plant growth.[76–78] In the early 1900s, school gardens were common for both country and city schools, but they generally fell out of favor as trade programs developed and school garden work appeared to be too similar to work needing to be completed at home (i.e., home gardens).[77]

When the National School Lunch Program (NSLP) was legislated in 1946, it was designed both to ameliorate malnutrition and hunger among America's children and to support America's farmers

through agricultural commodities and school-meal reimbursements.[79,80] Policies enacted in the mid-1970s, however, steered agricultural economic benefits toward large-, rather than small- and mid-, scale farms.[80] In the 1990s, a few food service personnel began piloting farm-to-school-style programs, with goals to improve school food quality, thereby improving children's health through increased fruit and vegetable consumption, and to simultaneously create a reliable market for struggling regional farmers.[80] Thus, early "modern" farm to school programming emerged from simultaneous desires to support small-scale, local/regional farmers and to improve student nutrition in the face of the growing obesity epidemic.

Early programs

Multiple programs developed in the mid- to late-1990s, independently of each other at various locations around the United States. A parent, Bob Gottlieb (Santa Monica-Malibu Unified School District, California), instituted the first Farmers' Market Salad Bar (1996); he has gone on to replicate and expand his original model.[80] At a similar time, a cooperative of small famers in Florida organized washed, cut, ready-to-cook collard greens to one district; they expanded to 72 districts within ten years.[80] The Hartford Food System (a nonprofit organization focused on food security in Connecticut) helped facilitate sales between local farmers and Hartford Public Schools.[80] These early programs had different specific implementation strategies, purchasing locally-grown food, most often produce, for school meals was a common focal point. Many also integrated other activities such as nutrition/food education, cooking, farm tours, composting, and school gardens.[80] In the early 2000s, some farm to school leaders decided to join forces to coordinate their plans; a USDA grant from the Initiative for Future Agriculture and Food Systems permitted nation-wide efforts to be aggregated in developing quantitative evaluation tools and in conducting trainings to facilitate continued expansion of the farm to school model.[80] The USDA, the W.K. Kellogg foundation, and local foundations provided funding as the program spread; in Berkeley, California, the Center for Ecoliteracy, and the Chez Panisse Foundation provided support for The Edible Schoolyard project.[80] The National Farm to School Network, which grew out of the first Farm to Cafeteria conference (Seattle, 2002), estimated that there were 400 programs in 22 states by 2004.[80]

Despite the magnitude of growth, data to concretely support farm to school programs as a mechanism for supporting local farmers and for supporting children's health remains lacking: tools were developed but not published, and of the evaluative studies that were completed, none were controlled.[80]

Farm to School in Wisconsin

Wisconsin's development of F2S programming began in the early 2000s; early initiators Sara Tedeschi and Jack Kloppenberg worked to organize parents and to write a federal Sustainable Agriculture Research in Education (SARE) grant.[81] Supported by that grant, the Wisconsin Homegrown Lunch (WHGL) was established and was coordinated collaboratively by the University of Wisconsin-Madison's Center for Integrated Agricultural Studies (CIAS) and Dane County's REAP Food Group.[81] A major finding from the first-phase SARE grant was that very little Wisconsin-grown produce was feasible to use in schools; this prompted a successful second SARE grant proposal to further explore the possibility of processing Wisconsin-grown produce to increase its usability in schools.[81] The goal was to coordinate producers and processors to facilitate use of Wisconsin-grown produce in Madison Metropolitan School District (MMSD) in Dane County, the home turf of REAP Food Group. Administrative attitudes within MMSD proved challenging to achieving local produce integration. This prompted the decision to focus efforts on a local snack program, thus circumventing the challenges posed by a large school district that serves over 10,000 lunches each day; this happened under WHGL administrator Doug Wubben, who succeed Ms. Tedeschi as coordinator after she chose to pursue other interests.[81] As the idea of farm to school grew in popularity both locally and nationally, WHGL received increasing numbers of requests for start-up support outside of MMSD and Dane County, which challenged the mission of REAP to serve Dane County; eventually, REAP and CIAS ceased co-coordination of REAP's local snack program.[81] Mr. Wubben transitioned solely to CIAS, and the WHGL program hired another coordinator, re-dubbing their program REAP Farm to School (REAP F2S).[81] REAP F2S continued on the trajectory (initiated by Mr. Wubben) to provide technical assistance to small Dane County school districts with particular focus on the snack program; CIAS continued its statewide mission.[81]

In the mid- to late-2000s, farm to school garnered increasing attention from wider and wider circles. A small task force assembled to discuss how to promote farm to school at the state level, including representatives from Wisconsin's DHS (Amy Meinen), DATCP (Teresa Engel), CIAS (Ms. Tedeschi, Mr. Wubben), and lobbying groups such as the American Heart Association, the American Cancer Society, and the Michael Fields Institute (Bridget Holcomb).[81] This was the earliest point at which the public health community stepped forward to support farm to school, including endeavors to drive state-level legislative efforts.[81] This group assembled and worked in the context of a political climate favorable to such public-oriented programming, and successfully wrote a bill that passed unanimously (2009) to implement mini-grants and a state-wide coordinator of farm to school efforts for Wisconsin, as well as to establish a state-level Farm to School Advisory Committee.[81] The 2010 election brought political climate change, and the legislative gains were not successful in garnering funding: the grants program was never funded, the Advisory Committee became defunct, and it was not until late summer 2013 that the state coordinator position was funded and hired (housed at DATCP, Sarah Elliott was hired for this position; in the interim, state-level technical assistance for farm to school was provided by Ms Tedeschi and Vanessa Herald through CIAS and through the National Farm to School Network Great Lakes Region).[81] However, this task force had successfully constructed a farm to school logic model (see *Appendix 1*), which excellently positioned the group to submit a proposal for the American Reinvestment & Recovery Act (ARRA) – Communities Putting Prevention to Work (CPPW) grants in late 2009.[81]

A substantial turning point came for Wisconsin farm to school with CPPW funding. Several additional people joined the original task force, which thus morphed into a much larger strategic planning group that was separate from the Farm to School Advisory Committee. Although this new group improved the possibilities for high-level program evaluation and analysis, it also, from Tedeschi's perspective, diminished the state-level organizational integrity.[81] It is important to remember that during all of this, the idea of farm to school was growing exponentially at state, regional, and national levels, with terminology and activity expanding constantly. The growing interest required that Wisconsin's

Department of Public Instruction (DPI) get on board: despite an initial lack of engagement, DPI chose to demonstrate willingness to partner with grassroots and public health-led efforts to promote farm to school.[81] Another factor that reinforced national-level farm to school efforts and image was the USDA establishing farm to school funding and programming. This supported another piece of Wisconsin F2S history: the establishment of AmeriCorps farm to school programs (housed at DATCP), which is currently (2014) in its third round of USDA funding.[81]

Overall, it can be surmised that Wisconsin farm to school ramped up very quickly from its WHGL origins to substantial federal-level funding, both which occurred simultaneously with significant increases in local purchasing by school districts.[81] This challenged CIAS's ability to meet Wisconsin schools' technical assistance needs: Ms Tedeschi noted that "…at times it's felt like it's promoted growth before we were ready to support it."[81] She also was quick to note that many Wisconsin schools were buying locally-grown products far before the idea of farm to school was popular, especially in smaller, rural districts that did some from-scratch cooking: "…as a rural state, Wisconsin has never been quite as far removed from that potential for local purchasing as some other states."[81] Although Ms Tedeschi felt that farm to school was trying to address far more about NSLP food quality than it can reasonably influence given the tight budgets of school food service authorities, the program's mission is succeeding: local food is more readily available in ways that schools can more easily use it, and the long-term educational value is that children going to farm to school schools are going to have a much clearer picture of food, food systems, and healthy choices.[81]

National-level expansion

President Barack Obama has demonstrated federal support for the farm to school concept and efforts with the "Know Your Farmer/Know Your Food" initiative and by including specific funding for school districts' farm to school efforts in the HHFKA.[80,82] State-level support has increased as well: all states appointed at least a volunteer state-level farm to school leader by spring 2012.[80]

In 2009, the CDC identified increased fruit and vegetable access as a key policy for reducing obesity, specifically naming farm to school as a promising strategy to increase children's fruit and vegetable access.[64] This access, in turn, is a precursor to consumption. Increased fruit and vegetable consumption among American children and adolescents is warranted: very few meet recommendations set forth by United States Dietary Guidelines, with estimations for those who do ranging from less than 1% (14-18 year old boys) to 48% (two- to three-year-olds).[83–85] Some studies have found that increased access to fruits and vegetables, for example using a free distribution program as part of a multicomponent program, does increase children's fruit and/or vegetable consumption.[86,87]

The relationship between fruit and vegetable consumption and adiposity or BMI, however, is mixed. Although significant associations are reported in adults on the basis of experimental and longitudinal studies, the experimental conditions were always concurrent with other targeted behaviors.[88] The 2010 Dietary Guidelines Advisory Committee indicated that strong evidence in adults supported the idea that low-energy-density diets were favorable strategies for weight loss and maintenance.[89] The same Committee ascertained "moderately strong support" for the same associations in children and adolescents.[89,90] For example, large portion sizes of energy-dense foods impact total energy intake in children and adolescents, especially for adolescents, and this increased from 1977 to 2006,[91] which corresponds with increased obesity prevalence. Existing literature, however, collectively leaves the relationship between children's fruit and vegetable intake and BMI less clear than for adults.[88,92] Presumably, the CDC bases its recommendation for increased fruit and vegetable access and consumption for the myriad of health benefits afforded by fiber, vitamins, and minerals, but also due to the fact that their high fiber and water contents provide volumetric bulk (thus providing baroreceptor-mediated satiety signals) but low energy density.

Today, farm to school programs aim to achieve a variety of goals. Enhancing children's health with respect to dietary patterns and, with optimism regarding long-term possibilities, with respect to obesity are certainly focal points in line with the CDC platform of support for farm to school. Beyond that, farm to school programs aim to support local farmers, to thus improve local economies and food

systems.[93–95] Individuals who implement farm to school programming, such as food service directors, report diverse reasons for their interest in farm to school, including support of local economy, improving food quality of school food, and increasing students' fruit and vegetable intake.[96,97] Some groups have demonstrated that new health promotion and education programs are dynamic systems that are open to change as they emerge and develop.[98] This is an important consideration for farm to school programs, especially in the context of a traditionally-grassroots foundation.

Farm to school programs have increased greatly in number in recent decades. The National Farm to School Network (www.farmtoschool.org) estimates that fewer than ten programs existed in 1997, but over 2000 programs were documented in 2008.[99] Farm to school program participation also grew in Michigan between 2004 and 2009,[100] and interest grew for multiple key stakeholder groups (food service directors, food distributors, and local producers) in one Nebraska county in 2010-2011.[101] Part of this increase can be explained by an increase in the number of states with laws pertaining to either farm to school programming or local procurement.[102] In Wisconsin, 264 (of 422) school districts completed the USDA's 2013 Farm to School Census; 55% of those districts reported engaging in farm to school activities, with 41% buying locally-grown fruits and 40% buying locally-grown vegetables.[103] Nineteen percent of respondents reported having edible school gardens. The same Census showed that nationally, 43% of respondents were from districts engaging in F2S activities, with 30% purchasing locally-grown fruits and 29% vegetables, and 13% growing edible school gardens.[104] These data demonstrate the exponential interest in the farm to school concept over the past quarter-century.

But how can farm to school programming be part of the solution to widespread obesity? Anupama Joshi, director of the National Farm to School Network, recently published a framework for research hypotheses to test the causal pathways relating farm to school to pediatric obesity prevention.[105] A recent review of gray and peer-reviewed literature on farm to school programs as a strategy to increase children's fruit and vegetable intake was favorable, but also called for improved study designs and measurement methods.[106] These set the stage for research and evaluation groups who wish to contribute to the evidence base. Fortunately, the Wisconsin Farm to School Evaluation was designed, prior to these

publications, to make strides in addressing some of these questions and methodological issues. Remember that farm to school was founded primarily through grassroots organizing rather than any formal theory. Very recently, however, some have offered Social Cognitive Theory (SCT) as a lens through which to consider farm to school programs.[107,108] SCT has been used as a successful framework for other nutrition education programs,[109–114] lending credibility to farm to school's potential to favorably impact children's knowledge, attitudes, and behaviors with respect to fruit and vegetable consumption. One study used structural equation modeling and a SCT context to explain and predict children's fruit and vegetable intake, finding availability and motivation to be the factors that most consistently related to consumption.[109] Another recent article suggested that school-based nutrition education should include informational components alongside of skills and behaviors development to improve individuals' ability and motivation to prepare food and to recognize cultural and social aspects of eating.[115] Farm to school has the potential to address both informational content and experiential learning of skills and behaviors.

Farm to School: A Working "Definition"

Farm to school programs generally function through a typical paradigm of nutrition education: building knowledge, thus improving attitudes toward tasting and consuming fruits and vegetables, and subsequently increasing actual fruit and vegetable consumption. Today, farm to school programs can consist of a variety of activities.[116] An emerging framework for farm to school programs is the idea of "comprehensive" farm to school, which includes (a) procuring locally-grown foods for use in school meals and snacks, (b) traditional-format classroom lessons, (c) engagement activities, and (d) school gardens. Some programs engage in all components, while others focus on as few as one or two activities within a single domain.

Locally-grown foods in school meals. One of the goals of comprehensive farm to school programs is to support local farmers, often achieved by procuring locally-grown foods for use in school meals and snacks. The literature supporting this facet of farm to school as a viable strategy for increasing

children's fruit and vegetable consumption is nearly non-existent. However, one way that we observed schools incorporating locally-grown produce into school meals was with a lunch time salad bar accompanying the full NSLP. School salad bars have been shown to increase fruit and vegetable consumption, particularly among children living in low-income households.[117] Some schools manage to integrate school-garden-grown produce into school lunches, which also has shown small but positive impacts on children's vegetable consumption at school lunch.[118] The school lunch setting is a natural, in-school opportunity for students to practically apply that which they learn in other lessons or activities. Providing fresh, healthy foods to which children have been exposed through taste-test activities, or providing new foods as an opportunity to further expand children's palates, is an excellent way to increase children's ability to simultaneously access, like, and consume such foods.[119] The recent implementation of the HHFKA mandates a larger number and wider variety of fruits and vegetables to be served to students.[82,120] Schools participating in farm to school who procure locally-grown produce are in a unique position to broaden children's palates through multiple exposures, and they may possibly improve fruit and vegetable consumption in school lunches alongside the HHFKA increased fruit and vegetable mandate as a result of their farm to school programming.

Classroom lessons. School-based nutrition education has been shown to have favorable effects on nutrition knowledge and skills, and generally positive, but inconsistent, effects on attitudes, yet minimal impact on dietary behaviors.[114] In Wisconsin farm to school, classroom lessons of a more traditional format typically cover age-appropriate nutrition or agricultural concepts. Sometimes these are integrated into science or health curricula, and sometimes they are separate from traditional curricula. The number of lessons presented to a grade or classroom ranged, in the Wisconsin Farm to School Evaluation, from as few as five per academic year, to monthly or even weekly lessons. Some nutrition curricula have shown very positive outcomes on students' self-efficacy for healthy eating as well as for self-reported consumption of healthy versus junk foods.[121–123]

Engagement activities. A wide variety of engagement activities can exist as part of farm to school programming. The most common among Wisconsin farm to school programs in 2010-2011 were FV taste-testing, cooking, field trips to farms, and classroom presentations by farmers or chefs. Literature pertaining to many of these specific activities is limited. Taste-testing activities have been shown to increase liking of fruits and vegetables in preschool, elementary-, and high-school aged children.[119,124,125] (This again supports the potential for farm to school to move toward increased fruit and vegetable consumption when access is higher, such as is mandated by the HHFKA.) A formative evaluation of a cooking with a Chef program (for parents) demonstrated high potential to build self-efficacy increased motivation for parents to cook.[126] Cooking programs with children had favorable impacts on knowledge, preferences, and behavioral intention.[127,128] A 90-minute farm field trip with experiential learning stations, the opportunity to take home harvested produce, an educational presentation, and taste-testing increased student's knowledge about vegetables and improved student's liking of vegetables, even for vegetables that students believed they would not like.[129] Other farm to school activities without documented support in the literature include a local foods school fundraiser, family gardening times, various forms of community outreach, high school cooking competitions, or school composting projects. The scope of engagement activities is as vast as individuals are creative in developing activities to educate on a variety of nutrition or agricultural topics.

School gardens. As described above, school gardens historically were used as a means for children to interact with nature;[62] today, their usefulness in teaching a variety of concepts and topics is acclaimed.[130] Garden programs have improved children's attitudes toward school as well as academic performance, particularly for science.[131–136] Garden programs have also been shown to improve nutrition knowledge, and in some cases fruit and/or vegetable intake.[118,136–144] Teacher acceptance of gardens as an effective teaching tool is generally high, though dependent on administrative support and the individual's confidence in horticulture.[136,145,146] Until very recently, the peer-reviewed literature pertaining to school

gardens was relatively scant[147] and the response to a call for well-designed, evidence-based studies reported in peer-reviewed literature has improved.[148]

Multi-component Farm to School. Here, the literature is scant. Knowing fruit and vegetable intake recommendations is associated with favorable consumption behaviors.[149] Access to fruits and vegetables in combination with nutrition education has been shown to improve attitudes toward certain fruits and vegetables as well as consumption.[150] Other multi-component programs (not limited to the scope of farm to school) even have had small but favorable impacts on fruit and vegetable preferences[151–153] dietary patterns,[115,127,154–156] and, in three cases, also on obesity.[157–159] One very limited program combined two nutrition education lessons from the CATCH curriculum with a farm tour (called "farm to school"), and found increased knowledge and reported vegetable consumption at school.[160]

No literature exists documenting fully comprehensive farm to school programs (as defined by inclusivity of all four domains described above). However, it is important to remember that farm to school is a grassroots-initiated set of initiatives. These initiatives draw on the strengths and resources available within a specific community, and implementation occurs at varying degrees based on many factors, including school district priorities, cooperation and support of families and community members, support of different school stakeholders, and the willingness of multiple personnel to strive cooperatively towards the broad goals of these programs. It is only recently that national-level coordination efforts have made it feasible for centralized organizations, such as the National Farm to School Network, state Departments of Public Instruction, or county Extension offices, to facilitate widespread program dissemination with substantial technical assistance in supporting program initiation and development. Much work is needed yet to further empower communities and regional food systems to meet schools' needs in sourcing locally-grown foods and providing concurrent education lessons and experiential learning activities to support students' fruit and vegetable-related knowledge, attitudes, and behaviors.

Increasing interest in farm to school as a strategy to improve children's health

A search of "farm to school programs" in the PubMed database restricted to literature published in 2009 or earlier reveals 66 articles, but only one is even remotely related to farm to school.[96] Between 2010 and 2014, an additional 18 relevant papers were published and indexed on "farm to school." These focused on stakeholder perspectives,[96,97,101] the relationship of program activities to educational or behavioral theory,[107,108,161] student knowledge, attitudes, or dietary outcomes,[105,159,160,162] or program history/development.[80,100,102,163–165] Two papers were validation studies of tools developed for farm to school program evaluation[166,167] and one proposed the links between programming and long-term outcomes.[105] This demonstrates the growth in interest in farm to school programming, as well as a growing drive for evidence on which to base public health programming and education practice. The lack of outcomes papers demonstrates a continued need for evidence to demonstrate the effectiveness of farm to school programs to favorably impact children's knowledge, attitudes, and dietary behaviors.

Chapter 1 References

1. Schoeller DA. The energy balance equation: looking back and looking forward are two very different views. *Nutr Rev*. 2009;67(5):249-54.

2. WHO Multicentre Growth Reference Study Group. *The WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development*. Geneva; 2006:312 pages. Available at: http://www.who.int/childgrowth/standards/en/.

3. Kuczmarski RJ, Ogden CL, Guo SS, et al. *2000 CDC Growth Charts for the United States: methods and development.*; 2002. Available at: http://www.ncbi.nlm.nih.gov/pubmed/12043359.

4. Ogden CL, Carroll MD, Kit BK, Flegal KM. *Prevalence of obesity in the United States, 2009-2010*. U.S. Department of Health and Human Services,Centers for Disease Control and Prevention, National Center for Health Statistics; 2012:1-8. Available at: http://www.ncbi.nlm.nih.gov/pubmed/22617494.

5. Ogden CL, Carroll MD, Kit B, Flegal. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *JAMA*. 2012;307(5):483-490.

6. Freedman DS, Khan LK, Serdula MK, Dietz WH, Srinivasan SR, Berenson GS. The relation of childhood BMI to adult adiposity: The Bogalusa Heart Study. *Pediatrics*. 2005;115(1):22-27.

7. Guo SS, Chumlea WC. Tracking of body mass index in children in relation to overweight in adulthood. *Am J Clin Nutr*. 1999;70(1):145S-148S.

8. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med*. 1997;337(13):869-873.

9. Gunnell DJ, Frankel SJ, Nanchahal K, Peters TJ, Smith GD. Childhood obesity and adult cardiovascular mortality: a 57-y follow-up study based on the Boyd Orr cohort. *Am J Clin Nutr*. 1998;67(6):1111-1118.

10. Must A, Jacques PF, Dallal GE, Bajema CJ, Dietz WH. Long-term Morbidity and Mortality of Overweight Adolescents: A Follow-up of the Harvard Growth Study of 1922 to 1935. *N Engl J Med*. 1992;327(19):1350-1355.

11. Raghuveer G. Lifetime cardiovascular risk of childhood obesity. *Am J Clin Nutr*. 2010;91(Suppl):1514S-1519S.

12. l'Allemand-Jander D. Clinical diagnosis of metabolic and cardiovascular risks in overweight children: early development of chronic diseases in the obese child. *Int J Obes*. 2010;34(2):S32-S36.

13. Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review. *Int J Obes*. 2011;35(7):891-898.

14. Cottrell LA, Northrup K, Wittberg R. The extended relationship between child cardiovascular risks and academic performance measures. *Obesity*. 2007;15(12):3170-3177.

15. Florin TA, Shults J, Stettler N. Perception of overweight is associated with poor academic performance in US adolescents. *J Sch Health*. 2011;81(11):663-670.

16. Krukowski RA, Smith West D, Philyaw Perez A, Bursac Z, Phillips MM, Raczynski JM. Overweight children, weight-based teasing and academic performance. *Int J Pediatr Obes*. 2009;4(4):274-280.

17. Judge S, Jahns L. Association of overweight with academic performance and social and behavioral problems: an update from the early childhood longitudinal study. *J Sch Health*. 2007;77(10):672-678.

18. Halfon N, Larson K, Slusser W. Associations between obesity and comorbid mental health, developmental, and physical health conditions in a nationally representative sample of US children aged 10 to 17. *Acad Pediatr*. 2013;13(1):6-13.

19. Wang F, Veugelers PJ. Self-esteem and cognitive development in the era of the childhood obesity epidemic. *Obes Rev*. 2008;9(6):615-623.

20. Allison DB, Zannolli R, Narayan KM. The direct health care costs of obesity in the United States. *Am J Public Health*. 1999;89(8):1194-1199.

21. Finkelstein EA, Trogdon JG, Cohen JW, Dietz W. Annual medical spending attributable to obesity: payer- and service-specific estimates. *Health Affairs*. 2009;28(5):w822-x831.

22. Olson MA, Chaffin JG, Chudy N, Yang A. *Healthy Smiles / Healthy Body: Wisconsin's Third Grade Children, 2013*. Wisconsin Oral Health Program, Wisconsin Department of Health Services. Madison, WI; 2013. Available at: http://www.dhs.wisconsin.gov/publications/P0/p00589.pdf.

23. Wisconsin Department of Health Services, Division of Public Health, Nutrition, Physical Activity and OP, Wisconsin Partnership for Activity and Nutrition. *Obesity , Nutrition , and Physical Activity in Wisconsin*. Madison, WI; 2008. Available at: http://www.dhs.wisconsin.gov/publications/P0/P00009.pdf.

24. National Center for Health Statistics. *Health, United States, 2012: With Special Feature on Emergency Care.* Hyattsville, MD.; 2013. Available at: http://www.cdc.gov/nchs/data/hus/hus12.pdf. Accessed February 10, 2014.

25. United States Department of Agriculture, Economic Research Service. Food Availability (Per Capita) Data System. 2013. Available at: http://www.ers.usda.gov/data-products/food-availability-(per-capita)-data-system/.aspx#26705. Accessed March 2, 2014.

26. Salmon J, Ball K, Hume C, Booth M, Crawford D. Outcomes of a group-randomized trial to prevent excess weight gain, reduce screen behaviours and promote physical activity in 10-year-old children: Switch-Play. *Int J Obes*. 2008;32(4):601-612.

27. Brownson RC, Boehmer TK, Luke DA. Declining rates of physical activity in the United States: what are the contributors? *Annu Rev Public Health*. 2005;26:421-443.

28. Adams J. Trends in physical activity and inactivity amongst US 14-18 year olds by gender, school grade and race, 1993-2003: evidence from the youth risk behavior survey. *BMC Public Health*. 2006;6:57.

29. Troiano RP, Berrigan D, Dodd KW, Mâsse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc*. 2008;40(1):181-8.

30. Gubbels JS, Kremers SP, Stafleu A, et al. Clustering of dietary intake and sedentary behavior in 2-year-old children. *J Pediatr*. 2009;155(2):194-198.

31. Nelson MC, Gordon-Larsen P. Physical activity and sedentary behavior patterns are associated with selected adolescent health risk behaviors. *Pediatrics*. 2006;117(4):1281-1290.

32. Edwards JU, Mauch L, Winkelman MR. Relationship of nutrition and physical activity behaviors and fitness measures to academic performance for sixth graders in a midwest city school district. *J Sch Health*. 2011;81(2):65-73.

33. Vos MB, Welsh J. Childhood obesity: update on predisposing factors and prevention strategies. *Curr Gastroenterol Rep*. 2010;12(4):280-287.

34. Roblin L. Childhood obesity: food, nutrient, and eating-habit trends and influences. *Appl Physiol Nutr Metab Appl Nutr Metab*. 2007;32(4):635-645.

35. Baxter SD, Paxton-Aiken AE, Tebbs JM, Royer JA, Guinn CH, Finney CJ. Secondary analyses of data from 4 studies with fourth-grade children show that sex, race, amounts eaten of standardized portions, and energy content given in trades explain the positive relationship between body mass index and energy intake at school-prov. *Nutr Res*. 2012;32(9):659-668.

36. Poti JM, Slining MM, Popkin BM. Where Are Kids Getting Their Empty Calories? Stores, Schools, and Fast-Food Restaurants Each Played an Important Role in Empty Calorie Intake among US Children During 2009-2010. *J Acad Nutr Diet*. 2013.

37. Clark MA, Fox MK. Nutritional quality of the diets of US public school children and the role of the school meal programs. *J Am Diet Assoc*. 2009;109(2 Suppl):S44-56.

38. Crepinsek MK, Gordon AR, McKinney PM, Condon EM, Wilson A. Meals offered and served in US public schools: do they meet nutrient standards? *J Am Diet Assoc*. 2009;109(2 Suppl):S31-43.

39. Gundersen C, Kreider B, Pepper J. The impact of the National School Lunch Program on child health: A nonparametric bounds analysis. *J Econom*. 2012;166(1):79-91.

40. Fox MK, Dodd AH, Wilson A, Gleason PM. Association between School Food Environment and Practices and Body Mass Index of US Public School Children. *J Am Diet Assoc*. 2009;109(Supplement 2):S108-S117.

41. Briefel RR, Wilson A, Gleason PM. Consumption of low-nutrient, energy-dense foods and beverages at school, home, and other locations among school lunch participants and nonparticipants. *J Am Diet Assoc*. 2009;109(2 Suppl):S79-90.

42. McLeroy KR, Bibeau D, Steckler A, Glanz K. An Ecological Perspective on Health Promotion Programs. *Health Educ Q*. 1988;15(4):351-377.

43. Gregson J, Foerster SB, Orr R, et al. System, environmental, and policy changes: using the social-ecological model as a framework for evaluating nutrition education and social marketing programs with low-income audiences. *J Nutr Educ*. 2001;33(Supplement 1):S4-15.

44. Burrows T, Janet WM, Collins CE. Long-term Changes in Food Consumption Trends in Overweight Children in the HIKCUPS Intervention. *J Pediatr Gastroenterol Nutr*. 2011;53(5):543-547.

45. Lee IM, Djousse L, Sesso HD, Wang L, Buring JE. Physical activity and weight gain prevention. *JAMA*. 2010;303(12):1173-1179.

46. Simon C, Schweitzer B, Oujaa M, et al. Successful overweight prevention in adolescents by increasing physical activity: a 4-year randomized controlled intervention. *Int J Obes*. 2008;32(10):1489-1498.

47. Donnelly JE, Greene JL, Gibson CA, et al. Physical Activity Across the Curriculum (PAAC): a randomized controlled trial to promote physical activity and diminish overweight and obesity in elementary school children. Yancey AK, ed. *Prev Med (Baltim)*. 2009;49(4):336-341.

48. Pangrazi RP, Beighle A, Vehige T, Vack C. Impact of Promoting Lifestyle Activity for Youth (PLAY) on children's physical activity. *J Sch Health*. 2003;73(8):317.

49. Bayer O, Nehring I, Bolte G, von Kries R. Fruit and vegetable consumption and BMI change in primary school-age children: a cohort study. *Eur J Clin Nutr*. 2014;68(2):265-270.

50. Laska MN, Murray DM, Lytle L a, Harnack LJ. Longitudinal associations between key dietary behaviors and weight gain over time: transitions through the adolescent years. *Obesity*. 2012;20(1):118-25.

51. Melanson KJ. Dietary considerations for the prevention and treatment of obesity in youth. *Am J Lifestyle Med*. 2009;3(2):106-109.

52. Angelopoulos PD, Milionis HJ, Grammatikaki E, Moschonis G, Manios Y. Changes in BMI and blood pressure after a school based intervention: the CHILDREN study. *Eur J Public Health*. 2009;19(3):319-325.

53. Hollar D, Lombardo M, Lopez-Mitnik G, et al. Effective multi-level, multi-sector, school-based obesity prevention programming improves weight, blood pressure, and academic performance, especially among low-income, minority children. *J Health Care Poor Underserved*. 2010;21(2 Suppl):93-108.

54. Marcus C, Nyberg G, Nordenfelt A, Karpmyr M, Kowalski J, Ekelund U. A 4-year, cluster-randomized, controlled childhood obesity prevention study: STOPP. *Int J Obes*. 2009;33(4):408-417.

55. Spiegel SA, Foulk D, Samuel A, Reducing DF. Diet and Physical Activity Reducing Overweight through a Multidisciplinary School-based Intervention. *Obesity*. 2006;14(1):88-96.

56. Slawta JN, Deneui D. Be a Fit Kid: Nutrition and Physical Activity for the Fourth Grade. *Health Promot Pract*. 2010;11(4):522-529.

57. Donnelly JE, Jacobsen DJ, Whatley JE, et al. Nutrition and physical activity program to attenuate obesity and promote physical and metabolic fitness in elementary school children. *Obes Res*. 1996;4(3):229-243.

58. Vanhelst J, Marchand F, Fardy P, et al. The CEMHaVi Program: Control, Evaluation, and Modification of Lifestyles in Obese Youth. *J Cardiopulm Rehabil Prev*. 2010;30(3):181-185.

59. Reinehr T, Kleber M, Lass N, Toschke AM. Body mass index patterns over 5 y in obese children motivated to participate in a 1-y lifestyle intervention: age as a predictor of long-term success. *Am J Clin Nutr*. 2010;91(5):1165-1171.

60. *2009 Senate Bill 181*. Senate; 2009:1-17. Available at: http://docs.legis.wisconsin.gov/2009/related/proposals/sb181.pdf. Accessed 2/10/2014.

61. Blouin C, Dubé L. Global health diplomacy for obesity prevention: lessons from tobacco control. *J Public Health Policy*. 2010;31(2):244-255.

62. Brennan LK, Brownson RC, Orleans CT. Childhood obesity policy research and practice: evidence for policy and environmental strategies. *Am J Prev Med*. 2014;46(1):e1-e16.

63. Chapman-Novakofski K. Best practices for school nutrition efforts. *J Nutr Educ Behav*. 2012;44(5):389.

64. Centers for Disease Control and Prevention. Recommended Community Strategies and Measurements to Prevent Obesity in the United States. *MMWR*. 2009;58(No. RR-07):1-26. Available at: http://www.cdc.gov/mmwr/PDF/rr/rr5807.pdf.

65. Taber DR, Chriqui JF, Chaloupka FJ. State laws governing school meals and disparities in fruit/vegetable intake. *Am J Prev Med*. 2013;44(4):365-372.

66. Ohri-Vachaspati P, Turner L, Chaloupka FJ. Elementary school participation in the United States Department of Agriculture's Team Nutrition program is associated with more healthful school lunches. *J Nutr Educ Behav*. 2013;45(6):733-738.

67. Van Stralen MM, Yildirim M, Velde SJ Te, et al. What works in school-based energy balance behaviour interventions and what does not? A systematic review of mediating mechanisms. *Int J Obes*. 2011;35(10):1251-1265.

68. Resnicow K, Smith M, Baranowski T, Baranowski J, Vaughan R, Davis M. 2-Year tracking of children's fruit and vegetable intake. *J Am Diet Assoc*. 1998;98(7):785-789.

69. Lytle LA, Seifert S, Greenstein J, McGovern P. How do children's eating patterns and food choices change over time? Results from a cohort study. *Am J Heal Promot*. 2000;14(4):222-228.

70. Kristal AR, Vizenor NC, Patterson RE, Neuhouser ML, Shattuck AL, McLerran D. Precision and bias of food frequency-based measures of fruit and vegetable intakes. *Cancer Epidemiol Biomarkers Prev*. 2000;9(9):939-944.

71. Subar AF, Kipnis V, Troiano RP, et al. Using intake biomarkers to evaluate the extent of dietary misreporting in a large sample of adults: The OPEN Study. *Am J Epidemiol*. 2003;158(1):1-13.

72. Burrows TL, Martin RJ, Collins CE. A systematic review of the validity of dietary assessment methods in children when compared with the method of doubly labeled water. *J Am Diet Assoc*. 2010;110(10):1501-1510.

73. Katz DL. School-Based Interventions for Health Promotion and Weight Control: Not Just Waiting on the World to Change. *Annu Rev Public Health*. 2009;30:253-272.

74. Baranowski T, Smith M, Hearn MD, et al. Patterns in children's fruit and vegetable consumption by meal and day of the week. *J Am Coll Nutr*. 1997;16(3):216-223.

75. Briefel RR, Wilson A, Gleason PM. Consumption of low-nutrient, energy-dense foods and beverages at school, home, and other locations among school lunch participants and nonparticipants. *J Am Diet Assoc*. 2009;109(2 Suppl):S79-S90.

76. Kailasapathy K. Studies of the Role of School Gardens in Combatting Malnutrition in Sri Lankan Children. *Ecol Food Nutr*. 1988;21(2):131-141.

77. Kohlstedt SG. "A Better Crop of Boys and Girls": The School Gardening Movement, 1890-1920. *Hist Educ Q*. 2008;48(1):58-93.

78. Loring PA, Gerlach SC. Outpost Gardening in Interior Alaska: Food System Innovation and the Alaska Native Gardens of the 1930s through the 1970s. *Ethnohistory*. 2010;57(2):183-199.

79. Gunderson GW. The National School Lunch Program Background and Development. 1971. Available at: http://www.fns.usda.gov/nslp/history. Last accessed May 19, 2014.

80. Feenstra G, Ohmart J. The evolution of the school food and farm to school movement in the United States: Connecting childhood health, farms, and communities. *Child Obes*. 2012;8(4):280-289.

81. Tedeschi S. Personal Communication, February 24, 2014.

82. *Pub L No. 111-296, 124 Stat. 3183*. Congress; 2010:1-84. Available at: http://www.gpo.gov/fdsys/pkg/PLAW-111publ296/pdf/PLAW-111publ296.pdf.

83. Zapata LB, Bryant CA, McDermott RJ, Hefelfinger JA. Dietary and Physical Activity Behaviors of Middle School Youth: The Youth Physical Activity and Nutrition Survey. *J Sch Health*. 2008;78(1):9-18.

84. Kimmons J, Gillespie C, Seymour J, Serdula M, Blanck HM. Fruit and vegetable intake among adolescents and adults in the United States: Percentage meeting individualized recommendations. *Medscape J Med*. 2009;11(1):26-36.

85. Guenther PM, Dodd KW, Reedy J, Krebs-Smith SM. Most Americans eat much less than recommended amounts of fruits and vegetables. *J Am Diet Assoc*. 2006;106(9):1371-1379.

86. Reinaerts E, Crutzen R, Candel M, De Vries NK, De Nooijer J. Increasing fruit and vegetable intake among children: comparing long-term effects of a free distribution and a multicomponent program. *Health Educ Res*. 2008;23(6):987-996.

87. Hoffman JA, Franko DL, Thompson DR, Power TJ, Stallings VA. Longitudinal behavioral effects of a school-based fruit and vegetable promotion program. *J Pediatr Psychol*. 2010;35(1):61-71.

88. Ledoux TA, Hingle MD, Baranowski T. Relationship of fruit and vegetable intake with adiposity: a systematic review. *Obes Rev*. 2011;12(5):e143-e150.

89. Pérez-Escamilla R, Obbagy JE, Altman JM, et al. Dietary energy density and body weight in adults and children: a systematic review. *J Acad Nutr Diet*. 2012;112(5):671-684.

90. Vernarelli JA, Mitchell DC, Hartman TJ, Rolls BJ. Dietary energy density is associated with body weight status and vegetable intake in U.S. children. *J Nutr*. 2011;141:2204-2210.

91. Piernas C, Popkin BM. Increased portion sizes from energy-dense foods affect total energy intake at eating occasions in US children and adolescents: Patterns and trends by age group and sociodemographic characteristics, 1977-2006. *Am J Clin Nutr*. 2011;94(5):1324-1332.

92. Tohill BC, Seymour J, Serdula M, Kettel-khan L, Rolls BJ. What epidemiologic studies tell us about the relationship between fruit and vegetable consumption and body weight. *Nutr Rev*. 2004;62(10):365-374.

93. Vallianatos M, Gottlieb R, Haase MA. Farm-to-school: Strategies for urban health, combating sprawl, and establishing a community food systems approach. *Journal of Planning Education and Research*. 2004;23(4):414-423.

94. National Farm to School Network. The Benefits of Farm to School. 2013. Available at: http://www.farmtoschool.org. Accessed January 2, 2014.

95. Bagdonis JM, Hinrichs CC, Schafft KA. The emergence and framing of farm-to-school initiatives: Civic engagement, health and local agriculture. *Agric Human Values*. 2009;26(1-2):107-119.

96. Izumi BT, Rostant OS, Moss MJ, Hamm MW. Results from the 2004 Michigan farm-to-school survey. *J Sch Health*. 2006;76(5):169-174.

97. Izumi BT, Alaimo K, Hamm MW. Farm-to-School Programs: Perspectives of School Food Service Professionals. *J Nutr Educ Behav*. 2010;42(2):83-91.

98. Bisset S, Potvin L. Expanding our conceptualization of program implementation: lessons from the genealogy of a school-based nutrition program. *Health Educ Res*. 2007;22(5):737-746.

99. Joshi A, Azuma AM. *Bearing Fruit: Farm to School Program Evaluation Resources and Recommendations*.National Farm to School Network, Center for Food and Justice, Urban and Environmental Policy Institute. Occidental College. 2009. Available at: http://www.uepi.oxy.edu/pubs/bearing-fruit/. Accessed July 1, 2013.

100. Colasanti KJA, Matts C, Hamm MW. Results from the 2009 Michigan Farm to School Survey: Participation Grows from 2004. *J Nutr Educ Behav*. 2012;44(4):343-349.

101. Pinard CA, Smith TM, Carpenter LR, Chapman M, Balluff M, Yaroch AL. Stakeholders' Interest in and Challenges to Implementing Farm-to-School Programs, Douglas County, Nebraska, 2010-2011. *Prev Chronic Dis*. 2013;10:130182.

102. Schneider L, Chriqui J, Nicholson L, Turner L, Gourdet C, Chaloupka F. Are Farm-to-School Programs More Common in States With Farm-to-School-Related Laws? *J Sch Health*. 2012;82(5):210-216.

103. United States Department of Agriculture, Food and Nutrition Service. The Farm to School Census: Wisconsin. 2013. Available at: http://www.fns.usda.gov/farmtoschool/census#/state/wi. Accessed February 10, 2014.

104. United States Department of Agriculture, Food and Nutrition Service. The Farm to School Census: National Overview. 2013. Available at: http://www.fns.usda.gov/farmtoschool/census#/national. Accessed February 10, 2014.

105. Joshi A, Ratcliffe MM. Causal pathways linking Farm to School to childhood obesity prevention. *Child Obes*. 2012;8(4):305-314.

106. Taylor JC, Johnson RK. Farm to School as a strategy to increase children's fruit and vegetable consumption in the United States: Research and recommendations. *Nutr Bull*. 2013;38:70-79.

107. Roche E, Conner D, Kolodinsky J, Buckwalter E, Berlin L, Powers A. Social cognitive theory as a framework for considering Farm to School programming. *Child Obes*. 2012;8(4):357-363.

108. Berlin L, Norris K, Kolodinsky J, Nelson A. The Role of Social Cognitive Theory in Farm-to-School-Related Activities: Implications for Child Nutrition. *J Sch Health*. 2013;83(8):589-595.

109. Reynolds KD, Hinton AW, Shewchuk RM, Hickey CA. Social cognitive model of fruit and vegetable consumption in elementary school children. *J Nutr Educ*. 1999;31(1):23-30.

110. Harvey-Berino J, Ewing JF, Flynn B, Wick JR. Statewide dissemination of a nutrition program: Show the way to 5-a-day. *J Nutr Educ*. 1998;30(1):29-36.

111. Geller KS, Dzewaltowski DA, Rosenkranz RR, Karteroliotis K. Measuring Children's Self-Efficacy and Proxy Efficacy Related to Fruit and Vegetable Consumption. *J Sch Health*. 2009;79(2):51-57.

112. Shilts MK, Lamp C, Horowitz M, Townsend MS. Pilot study: EatFit impacts sixth graders' academic performance on achievement of mathematics and English education standards. *J Nutr Educ Behav*. 2009;41(2):127-131.

113. Freedman MR, Nickell A. Impact of after-school nutrition workshops in a public library setting. *J Nutr Educ Behav*. 2010;42(3):192-196.

114. Contento IR, Manning AD, Shannon B. Research Perspective on School-Based Nutrition Education. *J Nutr Educ*. 1992;24(5):247-260.

115. Pérez-Rodrigo C, Aranceta J. School-based nutrition education: lessons learned and new perspectives. *Public Health Nutr*. 2001;4(1A):131-139.

116. Graham H, Feenstra G, Evans AM, Zidenberg-Cherr S. Davis school program supports life-long healthy eating habits in children. *Calif Agric*. 2004;58(4):200-205.

117. Slusser WM, Cumberland WG, Browdy BL, Lange L, Neumann C. A school salad bar increases frequency of fruit and vegetable consumption among children living in low-income households. *Public Health Nutr*. 2007;10(12):1490-1496.

118. Cotugna N, Manning CK, DiDomenico J. Impact of the Use of Produce Grown in an Elementary School Garden on Consumption of Vegetables at School Lunch. *J Hunger Environ Nutr*. 2012;7(1):11-19.

119. Anzman-Frasca S, Savag JS, Marini ME, Al E. Repeated exposure and associated conditioning promote preschool children's liking of vegetables. *Appetite*. 2012;58(2):543-553.

120. Marcason W. What are the new national school lunch and breakfast program nutrition standards? *J Acad Nutr Diet*. 2012;112(7):1112.

121. Fahlman MM, Dake JA, McCaughtry N, Martin J. A Pilot Study to Examine the Effects of a Nutrition Intervention on Nutrition Knowledge, Behaviors, and Efficacy Expectations in Middle School Children. *J Sch Health*. 2008;78(4):216-222.

122. Fernandes PS, Bernardo Cde O, Campos RM, Vasconcelos FA. Evaluating the effect of nutritional education on the prevalence of overweight/obesity and on foods eaten at primary schools. *J Pediatr (Rio J)*. 2009;85(4):315-321.

123. Greenwood B, Ralston PA, Young-Clark I, et al. Nutrition Education Initiative: A School-Based Program to Promote Healthy Eating Practices of Preadolescents. *J Fam Consum Sci*. 2009;101(2):47-52.

124. Lakkakula A, Geaghan JP, Wong W-P, Zanovec M, Pierce SH, Tuuri G. A cafeteria-based tasting program increased liking of fruits and vegetables by lower, middle and upper elementary school-age children. *Appetite*. 2011;57(1):299-302.

125. Cullen KW, Watson KB, Konarik M. Differences in fruit and vegetable exposure and preferences among adolescents receiving free fruit and vegetable snacks at school. *Appetite*. 2009;52(3):740-744.

126. Condrasky MD, Griffin SG, Catalano PM, Clark C. A formative evaluation of the cooking with a Chef program. *J Ext*. 2010;48(2):2FEA1. Available at: http://www.joe.org/joe/2010april/a1.php.

127. Liquori T, Koch PD, Contento IR, Castle J. The cookshop program: Outcome evaluation of a nutrition education program linking lunchroom food experiences with classroom cooking experiences. *J Nutr Educ*. 1998;30(5):302-313.

128. Cunningham-Sabo L, Lohse B. Cooking with kids positively affects fourth graders' vegetable preferences and attitudes and self-efficacy for food and cooking. *Child Obes*. 2013;9(6):549-556.

129. Bevan S, Vitale T, Wengreen H. Farm field trips provide sensory-based experiences with fresh, local produce. *J Nutr Educ Behav*. 2012;44(3):278-9.

130. Ozer EJ. The Effects of School Gardens on Students and Schools: Conceptualization and Considerations for Maximizing Healthy Development. *Heal Educ Behav*. 2007;34(6):846-863.

131. Waliczek TM, Bradley JC, Zajicek JM. The effect of school gardens on children's interpersonal relationships and attitudes toward school. *Horttechnology*. 2001;11(3):466-468.

132. Pigg AE, Waliczek TM, Zajicek JM. Effects of a gardening program on the academic progress of third, fourth, and fifth grade math and science students. *Horttechnology*. 2006;16(2):262-264.

133. Klemmer CD, Waliczek TM, Zajicek JM. Growing Minds : The Effect of a School Gardening Program on the Science Achievement of Elementary Students. *Horttechnology*. 2005;15(3):448-452.

134. Smith LL, Motsenbocker CE. Impact of Hands-on Science through School Gardening in Louisiana Public Elementary Schools. *Horttechnology*. 2005;15(3):439-443.

135. Tangen D, Fielding-Barnsley R. Environmental Education in a Culturally Diverse School. *Aust J Environ Educ v23 p23-30 2007*. 2007;23:23.

136. Blair D. The Child in the Garden: An Evaluative Review of the Benefits of School Gardening. *J Environ Educ*. 2009;40(2):15-38.

137. Morris JL, Zidenberg-Cherr S. Garden-enhanced nutrition curriculum improves fourth-grade school children's knowledge of nutrition and preferences for some vegetables. *J Am Diet Assoc*. 2002;102(1):91-93.

138. McAleese JD, Rankin LL. Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents. *J Am Diet Assoc*. 2007;107(4):662-665.

139. Heim S, Stang J, Ireland M. A garden pilot project enhances fruit and vegetable consumption among children. *J Am Diet Assoc*. 2009;109(7):1220-1226.

140. Parmer SM, Salisbury-Glennon J, Shannon D, Struempler B. School Gardens: An Experiential Learning Approach for a Nutrition Education Program to Increase Fruit and Vegetable Knowledge, Preference, and Consumption among Second-grade Students. *J Nutr Educ Behav*. 2009;41(3):212-217.

141. Somerset S, Markwell K. Impact of a school-based food garden on attitudes and identification skills regarding vegetables and fruit: a 12-month intervention trial. *Public Health Nutr*. 2009;12(2):214-221.

142. Morgan PJ, Warren JM, Lubans DR, Saunders KL, Quick GI, Collins CE. The impact of nutrition education with and without a school garden on knowledge, vegetable intake and preferences and quality of school life among primary-school students. *Public Health Nutr*. 2010;13(11):1-10.

143. Meinen A, Friese B, Wright W, Carrel A. Youth Gardens Increase Healthy Behaviors in Young Children. *J Hunger Environ Nutr*. 2012;7(2-3):192-204.

144. Nolan GA, McFarland AL, Zajicek JM, Waliczek TM. The Effects of Nutrition Education and Gardening on Attitudes, Preferences, and Knowledge of Minority Second to Fifth Graders in the Rio Grande Valley Toward Fruit and Vegetables. *Horttechnology*. 2012;22(3):299-304.

145. Graham H, Zidenberg-Cherr S. California teachers perceive school gardens as an effective nutritional tool to promote healthful eating habits. *J Am Diet Assoc*. 2005;105(11):1797-1800.

146. Graham H, Beall DL, Lussier M, McLaughlin P, Zidenberg-Cherr S. Use of school gardens in academic instruction. *J Nutr Educ Behav*. 2005;37(3):147-151.

147. Robinson-O'Brien R, Story M, Heim S. Impact of garden-based youth nutrition intervention programs: a review. *J Am Diet Assoc*. 2009;109(2):273-280.

148. Williams DR, Dixon PS. Impact of Garden-Based Learning on Academic Outcomes in Schools: Synthesis of Research Between 1990 and 2010. *Rev Educ Res*. 2013;83(2):211-235.

149. Thompson OM, Yaroch AL, Moser RP, et al. Knowledge of and Adherence to Fruit and Vegetable Recommendations and Intakes: Results of the 2003 Health Information National Trends Survey. *J Health Commun*. 2011;16(3):328-340.

150. He M, Beynon C, Sangster Bouck M, et al. Impact evaluation of the Northern Fruit and Vegetable Pilot Programme - a cluster-randomised controlled trial. *Public Health Nutr*. 2009;12(11):2199-2208.

151. Gatto NM, Ventura EE, Cook LT, Gyllenhammer LE, Davis JN. LA Sprouts: A Garden-Based Nutrition Intervention Pilot Program Influences Motivation and Preferences for Fruits and Vegetables in Latino Youth. *J Acad Nutr Diet*. 2012;112(6):913-920.

152. Jaenke RL, Collins CE, Morgan PJ, Lubans DR, Saunders KL, Warren JM. The Impact of a School Garden and Cooking Program on Boys' and Girls' Fruit and Vegetable Preferences, Taste Rating, and Intake. *Heal Educ Behav*. 2012;39(2):131-141.

153. Gibbs L, Staiger PK, Johnson B, et al. Expanding children's food experiences: the impact of a school-based kitchen garden program. *J Nutr Educ Behav*. 2013;45(2):137-46.

154. Reynolds KD, Franklin FA, Binkley D, et al. Increasing the fruit and vegetable consumption of fourth-graders: Results from the High 5 project. *Prev Med (Baltim)*. 2000;30(4):309-319.

155. Reynolds KD, Yaroch AL, Franklin F a., Maloy J. Testing mediating variables in a school-based nutrition intervention program. *Heal Psychol*. 2002;21(1):51-60.

156. Prelip M, Kinsler J, Thai C Le, Erausquin JT, Slusser W. Evaluation of a school-based multicomponent nutrition education program to improve young children's fruit and vegetable consumption. *J Nutr Educ Behav*. 2012;44(4):310-8.

157. Davis JN, Ventura EE, Cook LT, Gyllenhammer LE, Gatto NM. LA Sprouts: A Gardening, Nutrition, and Cooking Intervention for Latino Youth Improves Diet and Reduces Obesity. *J Am Diet Assoc*. 2011;111(8):1224-1230.

158. Hollar D, Messiah SE, Lopez-Mitnik G, Hollar TL, Almon M, Agatston AS. Healthier options for public schoolchildren program improves weight and blood pressure in 6- to 13-year-olds. *J Am Diet Assoc*. 2010;110(2):261-267.

159. Chomitz VR, Mcgowan RJ, Wendel JM, et al. Healthy Living Cambridge Kids : A Community-based Participatory Effort to Promote Healthy Weight and Fitness. *Obesity*. 2010;18(Supplement 1):S45-S53.

160. Moss A, Smith S, Null D, Roth SL, Tragoudas U. Farm to School and Nutrition Education: Positively Affecting Elementary School-Aged Children's Nutrition Knowledge and Consumption Behavior. *Child Obes*. 2013;9(1):51-56.

161. Ratcliffe MM. A sample theory-based logic model to improve program development, implementation, and sustainability of Farm to School programs. *Child Obes*. 2012;8(4):315-322.

162. Smith C, Corriveau N, Aaronson S, et al. School intervention incorporates farm to school programs to highlight healthy eating: a report from Project Healthy Schools. *Child Obes*. 2012;8(6):584-587.

163. Turner L, Chaloupka FJ. Slow Progress in Changing the School Food Environment: Nationally Representative Results from Public and Private Elementary Schools. *J Acad Nutr Diet*. 2012;112(9):1380-1389.

164. Harris D, Lott M, Lakins V, Bowden B, Kimmons J. Farm to Institution : Creating Access to Healthy Local and Regional Foods 1 , 2. *Adv Nutr*. 2012;3(3):343-349.

165. Smith S, Wleklinski D, Roth S, Tragoudas U. Does school size affect interest for purchasing local foods in the midwest? *Child Obes*. 2013;9(2):150-156.

166. Hollar D, Paxton-Aiken A, Fleming P. Exploratory validation of the Fruit and Vegetable Neophobia Instrument among third- to fifth-grade students. *Appetite*. 2013;60(1):226-30.

167. Paxton A, Baxter SD, Fleming P, Ammerman A. Validation of the School Lunch Recall Questionnaire to Capture School Lunch Intake of Third- to Fifth-Grade Students. *J Am Diet Assoc*. 2011;111(3):419-424.

168. Abraham S. *Weight and height of adults 18-74 years of age: United States, 1971-74*. National Center for Health Statistics, Vital and Health Statistics 11(211). US Department of Health, Education and Welfare (Public Health Service) Publication No. 79-1659, Hyattsville, MD; 1979. Available at: http://www.cdc.gov/nchs/data/series/sr_11/sr11_211.pdf. Accessed March 23, 2014.

169. Fryar C, Gu Q, Ogden C. *Anthropometric Reference Data for Children and Adults: United States, 2007–2010.* National Center for Health Statistics. Vital Health Stat 11(252); 2012. Available at: http://www.cdc.gov/nchs/data/series/sr_11/sr11_252.pdf. Accessed March 23, 2014.

Chapter 2. Aims and Hypotheses

In recent decades, the prevalence of obesity rates among all age groups in the United States has increased substantially.[1–4] This has driven much research into the causal mechanisms. Many factors have substantial evidence for their partial contributions to obesity, including genetics, hunger and satiety hormones, and excess energy intake. While some recent evidence indicates a decline in prevalence in selected groups,[5] all classes of obesity increased between 1999-2012, particularly among the more severely obese.[6] Therefore, it remains important to continue to elucidate effective approaches of creating environments that support healthy lifestyles to ameliorate and prevent obesity. Many factors and potential policy strategies for primary prevention have been documented by the Centers for Disease Control and Prevention (CDC) with particular focus on environmental-level factors, ranging from increasing the availability of healthy foods and beverages, to community planning to facilitate and encourage regular physical activity.[7] Among these factors, the CDC identified increased fruit and vegetable (FV) consumption as a key strategy to reduce obesity, naming farm to school (F2S) programs as a specific approach for children.[7]

F2S is a national program that connects schools with local farms to serve locally-grown, fresh meals in school cafeterias, thereby increasing fruit and vegetable (FV) access, and to provide nutrition education through both traditional classroom lessons and experiential learning activities to motivate children to increase FV consumption.[8] Simultaneously, F2S provides agricultural/food systems education and seeks to support small-scale local farmers by purchasing locally-grown or -produced foods for schools (and promoting the same to the wider community) to strengthen the local food system and economy.[9] Through the program activities, F2S aims to improve children's knowledge and dietary choices. Little peer-reviewed data exists to document support for or against the effectiveness of F2S programs specifically in improving students' nutrition, much less broader health outcomes including

obesity prevention, although recent publications offer roadmaps for those who wish to contribute to the literature.[10–12]

The Wisconsin Farm to School Evaluation, which began in 2010, sought to address this literature gap. Although the slightly earlier work of a task force previously brought together important agricultural and public health personnel to begin the journey of writing state-level legislature and creating a logic model to guide F2S work in Wisconsin,[13] an important boost in broad program funding further facilitated coordinated efforts to promote, implement, and evaluate Wisconsin F2S programs by the AmeriCorps F2S program (housed in the WI Department of Agriculture, Trade, and Consumer Protection [DATCP], funded by a grant from the Corporation for National and Community Service) and by the CDC-administrated American Reinvestment & Recovery Act/Communities Putting Prevention to Work (ARRA/CPPW) grants.[13] Both grant programs required student outcomes data to document program effectiveness; the AmeriCorps F2S program particularly needed evaluation data to bolster future program funding applications. Thanks to the partnerships developed during the work of the task force, further partnerships emerged involving DATCP, the WI Department of Health Services (DHS), the University of Wisconsin-Madison Center for Integrated Agricultural Studies (CIAS), and UW-Madison's Wisconsin Prevention of Obesity and Diabetes (WiPOD, a multidisciplinary group of researchers and health practitioners committed to effecting evidence-based change among WI communities). These partners collaboratively designed a program evaluation based on a toolkit from the University of North Carolina at Chapel Hill[14] (see *Appendix 2*). Evaluation goals were to investigate F2S programs as broadly and as specifically as possible within the time and budget limits:

- Qualitative: identify challenges/barriers and strengths/opportunities of F2S; learn perceptions of key stakeholders
- Quantitative: evaluate potential economic impact
- Quantitative: evaluate student outcomes in dietary knowledge, attitudes, and behaviors with respect to FV consumption; collect health outcome information for calculation of age- and

sex-specific BMI *z*-score where feasible, as a starting point for identifying the programs' potential to impact overweight and obesity.

- Qualitative/Quantitative: document F2S activities taking place in Wisconsin AmeriCorps F2S sites.

Results of this evaluation were envisioned not only as useful for contributing to the literature, which was essentially void of F2S-specific literature at the time that this evaluation began, but also as a means of providing the public with evidence-based information, thereby offering the potential to impact statewide legislation. The quantitative student outcomes (third on the above list) formed the foundation of this dissertation. Planned analyses included baseline cross-sectional (comparing schools with differing prior years of programming) and pre-/post-program (one-program-year longitudinal) analyses.

Central Hypothesis: The central hypotheses for this research was that farm to school programs serve as a viable strategy for reducing the prevalence of overweight and obesity among children through improved mediators of, and measured, fruit and vegetable consumption.

Specific Aim 1: *Evaluate the effectiveness of farm to school programs as a strategy to improve children's dietary knowledge, attitudes, and fruit and vegetable consumption*.

We hypothesized that farm to school programming would increase children's knowledge about nutrition and agriculture concepts. This aim was addressed through pre- and post-program year administrations of a student Knowledge and Attitudes Survey (KA; see *Appendix 2.1*), which measures a variety of constructs, one of which was *Knowledge* of age-appropriate nutritional and agricultural concepts. Fifteen questions assessed knowledge of concepts included in the curriculum typically used by AmeriCorps F2S members in classroom lessons, including how different vegetables grow, composting, what items do or do not grow in Wisconsin, food groups, and the importance of nutrients and energy.

We hypothesized that farm to school programming would improve children's attitudes toward trying and eating FV. The same KA survey described above included a series of 20 questions to assess *Attitudes* toward eating FV in general (10 identical questions, repeated separately for fruits and vegetables), also termed FV neophobia. Additionally, two questions assessed students' *Perception/Self-Efficacy* for making healthy food choices, and a further 22 questions assessed students' *Exposure* to, *Liking* of, and *Willingness* to try a series of specific FV items (26 items in the revised survey, beginning May 2013; see *Appendix 3.1*). The outcome constructs for attitudes used to address this hypothesis were *Attitudes* and *Willingness*. It was determined that *Perception/Self-Efficacy* did not adequately assess the intended outcome; *Exposure* and *Liking* were more useful in describing children's relationships to specific FV items than in describing broader attitudes.

We hypothesized that farm to school programming would increase children's FV consumption. We assessed potential dietary behavior change in two ways: first, self-reported FV consumption in the total diet using the Block Kids 2004 Food Frequency Questionnaire (NutritionQuest, Berkeley, CA),[15] and second, measured FV consumption at school lunch using visual assessments of students' school lunch trays (see protocol, *Appendix 2.2* and *Appendix 3.2*). The Block Kids Food Frequency Questionnaire, designed for use with 8-17 year old children, asks children to report what food items, and how much of each (picture-assisted), they have consumed over the past seven days. However, it has limited reproducibility in children under age 12 years, especially for estimation of food group intake, with the exception of fruits.[16] Despite the limited validity of this tool to assess children's FV intake, it was selected due to its widespread use and ease of administration. Moreover, we expected limited ability for F2S programming to measurably impact FV consumption in the total diet over a single program year due to the complex nature of dietary intake, including the home food environment and parent-modeled attitudes and consumption behaviors,[17–19] even if we observed the hypothesized improvements in knowledge and attitudes described above.

To focus objective evaluation efforts on measured FV consumption, the school lunch meal was considered by the evaluation design team to be of interest given the F2S programmatic emphasis on

improving school meal offerings through local-produce procurement. The combination of digital photography with visually-estimated food amounts has been used by other groups and found to be a reliable assessment of dietary intake.[20–23]

Specific Aim 2: *Examine the relationship of total energy intake to energy from fruits and vegetables in school lunch.*

We hypothesized that higher consumption of energy from FV would be associated with lower total energy consumption within a single meal, in accordance with the volume displacement hypothesis. To test this, food consumption data based on visual estimations of student lunch trays were combined with energy data from the United States Department of Agriculture's Nutrient Database[24] or manufacturer nutrition information, where necessary/possible (e.g., packaged containers on lunch trays), to estimate total energy consumed and energy consumed from FV.

Specific Aim 3: *Examine factors associated with fruit and vegetable waste in the school lunch setting, within the context of farm to school programs.*

We hypothesized that farm to school programs would yield reduced waste volume of FV items in school lunches. To test this, we used data from school lunch tray photos, school lunch menus, and communication with evaluation site personnel to collect and classify information on various factors pertaining to specific fruit and vegetable items. In addition to the number of prior years of F2S programming conducted at the evaluation site, we examined FV items according to associations of particular factors for their potential influence on waste:

- whether the item was purchased from a local/regional producer or via conventional distribution systems
- whether the item was presented to students as part of the main menu or on the salad bar
- whether the item was a fruit or a vegetable

- whether the item was prepared/presented to students in a cooked (e.g., canned, boiled, baked, etc.) or raw (fresh, uncooked) form
- how the item appeared within the meal (entrée, side dish, or topping, i.e. lettuce or tomato on a sandwich)

The first two items in the list above were considered to be factors related to F2S programming; the remaining factors were considered to be item-specific. Additionally, a subsample of items were assessed according to whether they had been reported as liked or not by integrating individual-level responses to the *Exposure* and *Liking* KA survey questions where it was possible to match specific FV items on students' lunch trays in the same semester that specific students completed the survey.

Specific Aim 4: *Examine short-term longitudinal BMI z-score outcomes in children participating in farm to school programs.*

We hypothesized that increased time in a farm to school program would be associated with reductions in BMI *z*-scores. We acknowledge that this evaluation lacked a much important information about other factors known to impact children's BMI: physical activity, sedentary time, screen time, parental dietary and activity habits, the home food environment, total dietary intake (outside of fourth graders), and genetics, to name a few. Although we did not expect to see BMI *z*-score reductions within the scope of this evaluation period, we did hypothesize that F2S programs may be associated with longer-term favorable impacts on children's BMI, and that we may specifically be able to detect that by comparing students new to F2S with students in established programs.

Chapter 2 References

1. Ogden CL, Carroll MD, Kit BK, Flegal KM. *Prevalence of obesity in the United States, 2009-2010.* U.S. Department of Health and Human Services,Centers for Disease Control and Prevention, National Center for Health Statistics; 2012:1–8.

2. Ogden CL, Carroll MD, Kit B, Flegal. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *JAMA*. 2012;307(5):483–490.

3. Ogden CL, Carroll MD, Curtin LR, Lamb MM, Flegal KM. Prevalence of high body mass index in US children and adolescents, 2007-2008. *JAMA*. 2010;303(3):242–249.

4. Ogden C, Carroll M. Prevalence of Obesity Among Children and Adolescents: United States , Trends 1963 – 1965 Through 2007 – 2008. *Natl Cent Heal Stat E-Stat*. 2010;(June). Available at: http://www.cdc.gov/nchs/data/hestat/obesity_child_07_08/obesity_child_07_08.htm. Accessed February 4, 2014.

5. Centers for Disease Control and Prevention. Trends in the prevalence of extreme obesity among US preschool-aged children living in low-income families, 1998-2010. *JAMA*. 2012;308(24):2563–2565.

6. Skinner AC, Skelton JA. Prevalence and trends in obesity and severe obesity among children in the United States, 1999-2012. *JAMA Pediatr*. 2014;(Epub ahead of print, April 7):E1–E6.

7. Centers for Disease Control and Prevention. Recommended Community Strategies and Measurements to Prevent Obesity in the United States. *MMWR*. 2009;58(No. RR-07):1–26.

8. National Farm to School Network. The Benefits of Farm to School. 2013. Available at: http://www.farmtoschool.org. Accessed January 2, 2014.

9. Feenstra G, Ohmart J. The evolution of the school food and farm to school movement in the United States: Connecting childhood health, farms, and communities. *Child Obes*. 2012;8(4):280–289.

10. Joshi A, Azuma AM. *Bearing Fruit: Farm to School Program Evaluation Resources and Recommendations*.National Farm to School Network, Center for Food and Justice, Urban and Environmental Policy Institute. Occidental College. 2009. Available at: http://www.uepi.oxy.edu/pubs/bearing-fruit/. Accessed July 1, 2013.

11. Joshi A, Ratcliffe MM. Causal pathways linking Farm to School to childhood obesity prevention. *Child Obes*. 2012;8(4):305–14.

12. Taylor JC, Johnson RK. Farm to School as a strategy to increase children's fruit and vegetable consumption in the United States: Research and recommendations. *Nutr Bull*. 2013;38:70–79.

13. Tedeschi S. Personal Communication, February 24, 2014.

14. *Farm to School Evaluation Toolkit*. University of North Carolina at Chapel Hill: Center for Health Promotion and Disease Prevention; 2010. Available at: http://www.cias.wisc.edu/wp-content/uploads/2011/09/8-evaluate-your-work.pdf. Accessesd May 28, 2014.

15. Block Questionnaire for Ages 8-17 - 2004 FFQ. 2009. Available at: http://nutritionquest.com/assessment/list-of-questionnaires-and-screeners/. Accessed April 22, 2013.

16. Cullen KW, Watson K, Zakeri I. Relative reliability and validity of the Block Kids Questionnaire among youth aged 10 to 17 years. *J Am Diet Assoc*. 2008;108(5):862–866.

17. Cutler GJ, Flood A, Hannan P, Neumark-Sztainer D. Multiple sociodemographic and socioenvironmental characteristics are correlated with major patterns of dietary intake in adolescents. *J Am Diet Assoc*. 2011;111(2):230–240.

18. Roblin L. Childhood obesity: food, nutrient, and eating-habit trends and influences. *Appl Physiol Nutr Metab Appl Nutr Metab*. 2007;32(4):635–645.

19. Verloigne M, Van Lippevelde W, Maes L, Brug J, De Bourdeaudhuij I. Family- and school-based correlates of energy balance-related behaviours in 10-12-year-old children: a systematic review within the ENERGY (EuropeaN Energy balance Research to prevent excessive weight Gain among Youth) project. *Public Health Nutr*. 2012;15(8):1380–1395.

20. Swanson M. Digital photography as a tool to measure school cafeteria consumption. *J Sch Health*. 2008;78(8):432–437.

21. Martins Rodrigues AG, da Costa Proenca RP. Use of food images for evaluating food intake. *Revista de Nutrição - Brazilian Journal of Nutrition*. 2011;24(5):765–776.

22. Williamson DA, Allen R, Martin PD, Alfonso AJ, Gerald B, Hunt A. Comparison of digital photography to weighed and visual estimation of portion sizes. *J Am Diet Assoc*. 2003;103(9):1139–1145.

23. Martin CK, Nicklas T, Gunturk B, Correa JB, Allen HR, Champagne C. Measuring food intake with digital photography. *J Hum Nutr Diet*. 2013:1–10.

24. U.S. Department of Agriculture, Agricultural Research Service. USDA National Nutrient Database for Standard Reference, Release 25. 2012. Nutrient Data Laboratory Home Page. Available at: http://www.ars.usda.gov/ba/bhnrc/ndl. Last accessed March 25, 2013.

Chapter 3. Evaluation Setting

School Selection

In early 2010, the Wisconsin Department of Health Services (DHS) was awarded an American Reinvestment & Recovery Act/Communities Putting Prevention to Work (ARRA/CPPW) grant, funded by the Centers for Disease Control and Prevention (CDC). This grant provided the impetus for a variety of public health interventions and evaluations, one of which was farm to school (F2S) programming as a CDC-identified strategy to reduce childhood overweight and obesity.[1] For the Wisconsin F2S Evaluation, Wisconsin's Department of Health Services (DHS) partnered with personnel from the University of Wisconsin-Madison (Departments of Family Medicine and Nutritional Sciences), the UW's Center for Integrated Agricultural Studies (CIAS), and the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP). All groups collaborated to design a package of evaluation tools to assess a wide variety of outcomes, including for students, but also to collect information on key stakeholder perceptions and the potential economic impact of F2S programs on communities. The evaluation package was largely based on an evaluation toolkit assembled by researchers at the University of North Carolina-Chapel Hill[2] but was adapted in hopes of better filling the knowledge gap described in the literature review chapter of this dissertation. CIAS, DATCP, and DHS provided technical assistance pertaining to program implementation; UW academic personnel provided training and technical assistance pertaining to the evaluation protocol and data collection, including an evaluation training manual written and assembled for the benefit of AmeriCorps F2S members at participating sites (see *Appendix 2*). At a similar time, personnel from CIAS and the Michael Fields Institute collaborated to write state-level legislation to authorize farm to school mini-grants and a state farm to school coordinator.[3]

Wisconsin schools participating the AmeriCorps F2S program (overseen by DATCP) were eligible to participate in the Wisconsin F2S Evaluation. Schools that were believed by the Program Manager (at the time the study began, Camilla Vargas) to have adequate support for such a comprehensive evaluation were invited to participate (n=10). Of these, nine schools agreed to participate, for which they received a

mini-grant for the 2010-2011 academic year. Evaluation efforts included all third-, fourth-, and fifth-graders in participating schools; student participation was obtained by passive consent (parents received an information form with the opportunity to opt their child(ren) out of the evaluation; see *Appendix 4*). In the 2011-2012 academic year, some schools continued to collect and provide evaluation data to the central coordinating office at UW-Madison, including the same grades, with no additional mini-grant.

Beginning in the 2012-2013 academic year, new grant funding permitted ongoing evaluation of F2S activities: also from the CDC, a Community Transformation Grant was awarded to the Wisconsin Clearinghouse for Prevention Services, in partnership with personnel from UW-Madison Department of Nutritional Sciences. This grant, branded as Transform Wisconsin, invited community coalitions and county health departments to submit mini-grant proposals to implement various public health initiatives ranging from multi-unit housing, to tobacco use prevention, to food systems development, including F2S program implementation and development. Food Systems grantees were further invited to participate in a comprehensive F2S Evaluation, for which they received an additional mini-grant.

In order to maximize longitudinal data, schools that participated in both 2010-2011 and 2011-2012 evaluation efforts and where there was a continuing AmeriCorps presence were invited to participate in a final set of evaluation activities in May 2013 (n=3), to include only fifth-graders (these students began in the 2010-2011 Evaluation as third-graders). These three agreed to participate, for which they received a $1000 honorarium.

Counties of selected schools

Nine schools participating in the AmeriCorps WI F2S Evaluation (2010-2011) were scattered around the state, with a general clustering tendency toward the north and west (Figure 3.1). Most communities were small and in rural areas; only one was in a large metropolitan district. Census populations from 2010 for the counties ranged from just 3,423 to 488,073 (Table 3.1).[4] Excluding the large metropolitan-based county, the average county population was 37,172 (median 16,644).

Figure 3.1. Wisconsin counties with school(s) participating in farm to school evaluation

County map from Wisconsin Department of Transportation.[16]

Legend:

- Transform Wisconsin F2S site
- AmeriCorps F2S site

Counties with both colors of dots indicate that a school participated in both AmeriCorps and Transform Wisconsin F2S Evaluation activities.

Table 3.1. County-specific Region, Population, and Evaluation Participation

County	Region	2010 Census Population[1]	Evaluation Participation			
			2010-2011	2011-2012	May 2013	May 2014 (planned)
Clark/Marathon	North central	34,690 / 134, 063	X			
Dane	South central	488,073	X	X		
Bayfield (2 schools)	North west	15,014	X	X	X	
Portage[2]	Central	70,019	X	X		X
Washburn	North west	15,911	X	X	X	
Vernon	West/south-west	29,773	X	X	X	
Crawford	South west	16,644	X	X	X	X
Barron	North west	3,423	X	X	X	
Marathon	North central	134,063			X	X
Winnebago	East central	166,994			X	X
Brown	North east	248,007			X	X

[1] Census data obtained from United States Census Bureau.[4]

[2] Planned participation in May 2014 evaluation, but not in May 2013.

An additional five schools participated in the Transform WI F2S Evaluation, which began in May 2013. Data from this evaluation is integrated into the chapter on FV waste (chapter 5). Two of these communities also participated in the original Wisconsin F2S Evaluation. As before, the counties where schools were located were largely smaller and rural, though this is reflected less in the average county population of 127,145 (median 134,063) relative to the AmeriCorps counties from previous evaluation years (Table 3.1).[4] The May 2013 iteration of the evaluation included a total of nine schools, with county populations averaging 80,178 (median 23,209).

Partner Training

Prior to beginning the WI F2S Evaluation, AmeriCorps members received a single, two-hour session as part of their annual training (September 2010). This training session offered an overview of the Evaluation project history and goals, as well as a thorough explanation of the Evaluation measures and methods. Following this training, the UW-Madison Evaluation Team (primary contacts: Andrea Bontrager Yoder, Tara LaRowe, PhD, and Dale Schoeller, PhD) provided ongoing technical assistance to AmeriCorps staff by e-mail and phone throughout the school year. Prior to the May 2011 evaluation data collection, additional phone conferences were conducted to remind AmeriCorps members of protocols and to provide the opportunity for members to share successful strategies for conducting evaluation activities efficiently.

Additional training took place for the ensuing academic years (2011-2012 and 2012-2013). In September 2011, Andrea Bontrager Yoder provided a ninety-minute information and training session to AmeriCorps members, again during their annual training week. This was similar to the 2010 training session, but also included preliminary results from the first year of evaluation. Again, the UW-Madison Evaluation Team provided ongoing technical assistance upon request throughout the year. Because no evaluation activities were conducted in fall 2012, no training session occurred in September 2012. Instead, a webinar format training session took place in early April that was open to both Transform Wisconsin F2S Evaluation and continuing AmeriCorps schools. The webinar was archived for future

reference.[5] Like previous trainings, this webinar provided an overview of the project's history and evaluation goals, and instructions on Evaluation methods. Additionally, two experienced AmeriCorps members (Amy Young, Kathleen Hein) participated, and they offered their expertise in practical implementation of Evaluation activities. The Transform Wisconsin evaluation continued in the 2013-2014 academic year, with a final set of evaluation activities planned for April-June 2014; therefore, ongoing technical assistance was provided to these grantees throughout the year and a phone conference took place in mid-February to prepare for the final round of evaluation activities.

Evaluation Team Meeting and Evaluation Design: Selection of Survey Items

During the spring and summer of 2010, several people collaborated to design the Wisconsin F2S Evaluation for use with Wisconsin AmeriCorps F2S sites participating in the evaluation. Core collaborators primarily came from the task force that worked to write state-level F2S legislature[6] and the Wisconsin Farm to School Logic Model (see *Appendix 1*) but expanded to include academic personnel.[3] The core individuals included Andrea Bontrager Yoder, Sarah Combs, Alicia Dill, Tara LaRowe, Janice Liebhart, Daniel McCarty, Amy Meinen, Dale Schoeller, Sara Tedeschi, Camilla Vargas, and Doug Wubben. Evaluation tools and methods were largely based on the toolkit developed by the University of North Carolina-Chapel Hill[2] (UNC) but were adapted as described below. The final version of each tool to be used in the Wisconsin F2S Evaluation, as well as the complete Evaluation package and design, was agreed upon by consensus.

Qualitative Data. Key stakeholder interview questions, based on the UNC toolkit, were examined and deemed to be satisfactory questions for the Wisconsin F2S Evaluation. The interview guides selected for use in this evaluation were originally written for school food service staff (used here for food service directors *or* staff), farmers (redesigned into a pre/post program year format), and stakeholder (used for each of school administrators, teachers, parents, and community members). Additionally, the Wisconsin F2S Evaluation Design group developed a short series of questions to be

used with small numbers of students in a focus group setting. Final versions of the Wisconsin F2S Evaluation Interview Guides are in *Appendix 2.3.*

Quantitative data: student outcomes. Student outcomes pertained to mediators of FV intake (knowledge of, attitudes toward, exposure to, and liking of FV) as well as measured FV intake in the total diet and in the school lunch setting. The first tool was a student Knowledge and Attitudes Survey (*Appendix 2.1*). This survey combined a FV Neophobia scale (Attitudes construct),[2] questions from a survey used previously to evaluate the USDA Fresh Fruit & Vegetable Program in Wisconsin (Knowledge, Perception/Self-Efficacy, Exposure, Liking, and Willingness constructs),[7] and additional knowledge-based questions written by the AmeriCorps F2S Program Manager at DATCP to assess topics typically covered in classroom lesson curricula used by AmeriCorps members (Knowledge construct; *no reference*). Scoring procedures are described in *Appendix 5* (2010-2011) and *Appendix 6* (2013-2014). FV intake in the total diet was assessed through administration of the Block Kids 2004 Food Frequency Questionnaire (FFQ; NutritionQuest, Berkeley, CA).[8] FV intake during school lunch was assessed through digital photographs of student school lunch trays (Lunch Tray Photo Observation, LTPO; see *Appendices 2.2* [2010-2011] and *3.2* [2013-2014]), generally using the quarter-waste method of visually estimating consumption (0, 0.25, 0.50, 0.75, or 1.00). The quarter-waste method of estimating waste, recently validated by another group for use in real-time visual assessment rather than in photographs, has generally good reliability with the exception of difficulties in assessing consumption of packaged foods such as milk.[9] Additionally, students' heights and weights were measured for BMI *z*-score calculation; AmeriCorps members were instructed to use the methods and policies presented in the 2008 Wisconsin DHS publication *To Weigh and Measure*, including the use of calibrated scales and stadiometers.[10] Scripts to describe the tools and their purpose to students were provided to AmeriCorps members (see *Appendices 3.3* and *7*).

Activity Reports: Quantitative and Qualitative. Using prior experiential knowledge of F2S programs, brought to the table primarily by Sara Tedeschi and Camilla Vargas, the Evaluation Design team devised a series of survey- and table-format-based questions to collect information about Wisconsin

F2S activity (see *Appendix 8*). The goal was to obtain, for each grade within each school, information about the specific activities taking place each month, in order to aggregate this information both quantitatively and qualitatively for the entire program year to describe what was happening in Wisconsin F2S.

Data Collection

For the 2010-2011 Wisconsin AmeriCorps F2S Evaluation, three primary groups of data were collected. First, qualitative data was collected via key stakeholder interviews designed to elucidate perceived barriers/challenges and strengths/opportunities of F2S programs. Interviews, conducted by AmeriCorps members, were structured and each evaluation site was instructed to interview at least one person from each of the stakeholder categories described above. Interviews were recorded using a digital audio recorder (either SONY IC Recorders provided by the evaluation coordinating center, or school- or personally-owned devices), or careful notes were taken by the interviewer; recorded interviews were transcribed. In a few cases, interviewees preferred to conduct their interview by way of an online survey rather than in person; the Qualtrics survey platform (available through UW-Madison) was used to offer that to those who requested it. In all, 26 stakeholder surveys were conducted (6 farmers; 4 food service directors; 2 parents; 6 school administrators; 3 teachers; 2 community members; 6 student focus groups); analysis of this data is not part of this dissertation.

The second group of data collected pertained to student outcomes. The KA survey and the FFQ were administered online (unless paper copies were specifically requested; n=2 schools KA, n=1 school FFQ). FFQ administration was limited to fourth-graders due to limited funding and computer laboratory time. Primary outcomes of interest from this measure were fruits and vegetables intake, adjusted for energy intake to cups per 1,000 kilocalories (kcal). Because F2S programming includes a focus on procurement and service of locally-grown produce, examination of school lunch dietary consumption was of interest. To address this, we conducted the LTPO (see protocol, *Appendices 2.2* and *3.2*). Briefly, digital photos of student school lunch trays were taken by AmeriCorps members and recruited volunteers,

and the photos were visually assessed for items on the tray and their respective amounts, and the percents disappeared, translated (by calculation) into cups consumed. Finally, seven schools voluntarily submitted students' heights and weights for calculation of BMI *z*-scores.

The third and final group of information collected in the 2010-2011 academic year was monthly program reports from each evaluation site. AmeriCorps members completed monthly reports by way of an online survey administered from the Qualtrics platform (see *Appendix* 8). This data clarified the array of programmatic differences across AmeriCorps F2S sites. Table 3.2 summarizes 2010-2011 program activities.

In the 2011-2012 academic year, only student outcomes were part of the evaluation activities. To lessen the time burden on schools and AmeriCorps members, only fourth graders were included in the photo collection. The FFQ was removed from the evaluation due to lack of funding. In the May 2013 evaluation of student outcomes (KA survey, LTPO, and BMI *z*-scores), AmeriCorps sites included only fifth graders, while Transform Wisconsin sites included third-, fourth-, and fifth-graders. The May 2014 evaluation (ongoing) is currently underway and includes student outcomes, as well as key stakeholder interviews. The 2013-2014 Transform Wisconsin F2S Evaluation also collected monthly activity reports throughout the 2013-2014 academic year.

Schedule of Data Collection

The timeline of data collection is shown in Figure 3.2. Not all schools participated in all activities, nor at both fall and spring. Specific school-level participation in evaluation activities are described fully in Tables 3.3 (2010-2011) and 3.4 (2011-2013). Each evaluation was designed as a pre-/post-F2S program intervention within grant cycles.

Student Characteristics

Table 3.5 describes student characteristics according to site, and overall for both the cohort starting in fall 2010 evaluation activities as well as the cohort starting in spring 2013 evaluation activities.

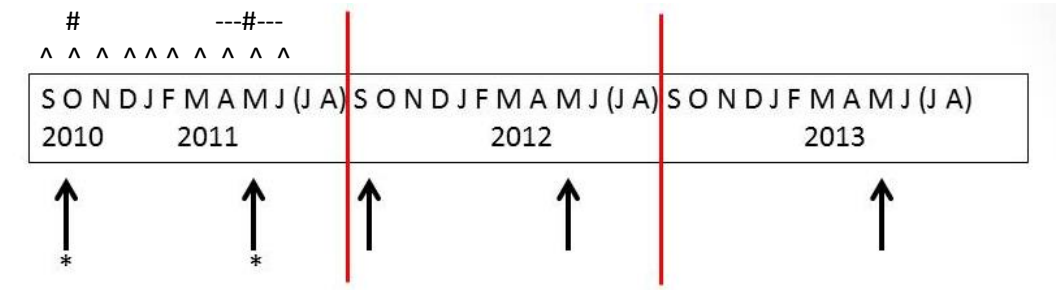
Table 3.2. Farm to School Program Activities, 2010-2011, as Reported by AmeriCorps Members

County:	Clark/Marathon	Dane	Bayfield (1)	Washburn	Portage	Vernon	Bayfield (2)	Crawford	Barron[1]
***Farmers selling to the district**	X		X			X	X	X	X
Farmers visiting student classrooms								X	
Classroom tastings	X		X	X	X	X	X	X	
Cafeteria tastings	X		X	X	X	X	X		
***Local items on school lunch menu**	X		X	X	X	X	X	X	X
***Local items on school breakfast menu**	X		X	X		X	X		
***Local items on school snack menu**				X			X		
Classroom FV snacks	X		X	X					
Field trips to farms			X	X	X				
Classroom lessons	X	X	X	X	X	X	X	X	
School gardens	X		X	X		X	X	X	X
Information sent home to parents			X	X	X	X	X	X	X
Local foods fundraiser				X				X	
***USDA Fresh Fruit & Vegetable Program**	X			X		X	X		
Total Number of activities:									
3rd grade	68	6	54	52	29	94	75	27	13
4th grade	67	6	72	44	15	68	57	25	13
5th grade	n/a	n/a	67	n/a	13	60	54	33	n/a

* An asterisk next to an activity indicates that it was not included due to non-inclusion, or to uncertain inclusion, in F2S "branding" as communicated to students.

[1] Extrapolated data due to missing activity reports

Figure 3.2. Timeline of Wisconsin Farm to School Evaluation Data Collection



→ Knowledge & Attitudes Survey
Lunch Tray Photo Observation
Height, Weight

* Block Kids' Food Frequency Questionnaire (FFQ; 4th graders)
^ Monthly Activity Report
# Stakeholder Interviews

Table 3.3. Participation in Student Evaluation Measures, by Site: 2010-2011

County	--KA Survey--		--FFQ[1]--		------BMI------		----------LTPO----------	
	Fall 2010	Spring 2011	Fall 2010	Spring 2011	Fall 2010	Spring 2011	Fall 2010 (# paired trays)	Spring 2011
Clark/ Marathon	3rd = 52 4th = 55	3rd = 49 4th = 46	35	14	Opted out		3rd, 4th = 159 (4 days, aggregate)	3rd = 64 4th = 85 (2 days, grade aggregate)
Dane	4th = 35 5th =36	4th = 23 5th = 29	36	22	4th = 39 5th = 35	4th = 39 5th = 35	Opted out	
Bayfield (1)	3rd = 0 4th = 20 5th = 26	3rd = 0 4th = 19 5th= 29	22	22	3rd = 26 4th = 26 5th = 31	3rd = 27 4th = 24 5th = 32	4th = 53 (4 days, individual)	4th = 53 (4 days, individual)
Washburn	3rd = 63 4th = 80	3rd = 80 4th = 77	81	73	3rd = 60	Opted out	4th = 145 (3 days, grade aggregate)	4th = 186 (4 days, grade aggregate)
Portage	3rd = 50 4th = 49 5th = 70	3rd = 48 4th = 74 5th = 78	56	78	Opted out		4th, 5th = 523 (4 days, aggregate)	4th, 5th = 492 (4 days, aggregate)
Vernon	3rd = 56 4th = 70 5th = 75	3rd = 55 4th = 69 5th = 71	69	62	3rd = 60 4th = 71 5th = 79	3rd = 60 4th = 20 5th = 77	3rd/4th (1 day) = 111 3rd = 149 (3 days) 4th = 178 (3 days) 5th = 282 (4 days) (grade aggregate)	3rd = 161 4th = 229 5th = 263 (4 days, grade aggregate)
Bayfield (2)	3rd = 23 4th = 29 5th = 30	3rd = 22 4th = 29 5th = 28	30	16	3rd = 23 4th = 29 5th = 33	3rd = 23 4th = 30 5th = 32	4th = 71 (4 days, individual)	4th = 33 (3 days, individual)
Crawford	3rd = 23 4th = 26 5th = 28	3rd = 24 4th = 26 5th = 28	Opted out		3rd = 26 4th = 27 5th = 30	3rd = 26 4th = 26 5th = 30	3rd = 70 4th = 92 5th = 112 (4 days, individual)	3rd = 75 4th = 66 5th = 97 (4 days, individual)
Barron	3rd = 53 4th = 63	3rd = 53 4th = 57	57	56	3rd = 54 4th = 66	3rd = 51 4th = 56	3rd = 137 4th = 140 (4 days, grade aggregate)	3rd = 172 4th = 184 (4 days, grade aggregate)

Abbreviations: KA=Knowledge & Attitudes Survey; FFQ= Food Frequency Survey; BMI=Body Mass Index; LTPO=Lunch Tray Photo Observation.

[1]Fourth-grade only

Table 3.4. Participation in Student Evaluation Measures, by Site: 2011-2012, 2012-2013

County	KA Survey			BMI			LTPO[1]		
	Fall 2011	Spring 2012	Spring 2013	Fall 2011	Spring 2012	Spring 2013	Fall 2011	Spring 2012	Spring 2013
Dane	4th, 5th = 55	4th, 5th = 50	Did not participate	Did not participate			Did not participate		
Bayfield (1)	3rd = 20 4th = 30 5th = 21	3rd = 25 4th = 28 5th= 10	3rd = 0 4th = 0 5th = 28	3rd = 26 4th = 26 5th = 21	3rd = 25 4th = 23 5th = 19	5th = 32	4th = 103	4th = 89	5th = 78
Washburn	3rd = 24 4th = 55	3rd = 86 4th = 5	5th = 86	4th = 68	Did not participate	5th = 66[2]	4th = 285	Did not participate	5th = 305
Portage	3rd = 81 4th = 50 5th = 77	3rd = 73 4th = 51 5th = 77	Did not participate	Opted out			4th = 177	4th = 182	Did not participate
Vernon	3rd = 72 4th = 64 5th = 72	3rd = 58 4th = 55 5th = 0	5th = 68	3rd = 60 4th = 67 5th = 74	Did not participate	5th = 68	4th = 205	Did not participate	5th = 204
Bayfield (2)	3rd = 30 4th = 29 5th = 21	3rd = 29 4th = 33 5th = 0	Did not participate	3rd = 25 4th = 32 5th = 40	Did not participate	5th = 35[2]	4th = 103	4th = 108	Did not participate
Crawford	3rd = 0 4th = 22 5th = 0	3rd = 0 4th = 21 5th = 0	3rd = 21 4th = 31 5th = 18	3rd = 35 4th = 22 5th = 25	Did not participate	3rd = 24 4th = 31 5th = 17	4th = 80	Did not participate	3rd = 81 4th = 117 5th = 77
Marathon	Not part of evaluation		3rd = 18 4th = 19 5th = 16	Not part of evaluation		3rd = 18 4th = 18 5th = 15	Not part of evaluation		3rd = 71 4th = 75 5th = 56
Winnebago	Not part of evaluation		3rd = 39 4th = 38 5th = 44	Not part of evaluation		3rd = 36 4th = 32 5th = 41	Not part of evaluation		3rd = 99 4th = 70 5th = 100
Brown	Not part of evaluation		3rd = 29 4th = 30 5th = 27	Not part of evaluation		3rd = 34 4th = 29 5th = 29	Not part of evaluation		3rd = 131 4th = 124 5th = 112

Abbreviations: KA=Knowledge & Attitudes Survey; FFQ= Food Frequency Survey; BMI=Body Mass Index; LTPO=Lunch Tray Photo Observation.

[1]All trays in 2011-2012 and 2013 were numbered such that they matched students' evaluation IDs. Numbers here represent numbers of trays assessed.

[2]Spring 2013 BMI data submitted to the evaluation team was actually measured in Fall 2012.

Table 3.5. Student Characteristics

County	N (3^{rd}/4^{th}/5^{th})	Baseline age, Mean (SD)	Gender (% Male/% Female)	Race/ Ethnicity[1]		Baseline BMI percentile, Mean (SD)[2]	Prior years of F2S
Those starting in 2010 evaluation	**1047 (321 / 458 / 268)**	**9.65 (0.84)**	**52.68 / 47.32**	**82.79% C 4.30% AfAm 3.44% H**	**5.07% AI 2.01% AsAm 2.39% O**	**68.03 (28.42)** ***1.5% U 15.5% O 59.5% H 23.4% Ob***	**1.41** ***22% 0 yrs 42% 1 yrs 14% ≥2 yrs***
Clark/Marathon	**N=113** (55 / 57 / 0)	9.10 (0.62)	46.90 / 53.1	77.88% C 6.19% AfAm 11.50% H	1.77% AI 0.00% AsAm 2.65% O	Opted out	1
Dane	**N=80** (0 / 42 / 38)	10.10 (0.65)	51.25 / 48.75	31.25% C 27.50% AfAm 12.50% H	3.75 AI 16.25% AsAm 8.75% O	64.57 (29.54) *0.0% U 14.9% O 64.9% H 20.3% Ob*	2
Bayfield (1)	**N=88** (27 / 27 / 34)	9.79 (0.95)	47.73 / 52.27	14.77% C 2.27% AfAm 3.41% H	73.86% AI 1.14% AsAm 4.55% O	69.67 (35.20) *6.0% U 14.5% O 36.1% H 43.4% Ob*	0
Washburn	**N=171** (86 / 85 / 0)	9.20 (0.66)	52.63 / 47.37	90.06% C 2.34% AfAm 1.17% H	2.92% AI 1.75% AsAm 1.75% O	75.11 (24.98) *1.7% U 20.0% O 51.7% H 26.7% Ob*	3
Portage	**N=223** (60 / 85 / 88)	9.81 (0.88)	52.65 / 47.35	96.90% C 1.33% AfAm 0% H	1.33% AI 0% AsAm 0.44% O	Opted out	0
Vernon	**N=210** (60 / 71 / 79)	9.83 (0.87)	53.81 / 46.19	92.86% C 1.90% AfAm 1.90% H	0.95% AI 0.95% AsAm 1.43% O	67.82 (26.47) *0.5% U 18.6% O 64.3% H 16.7% Ob*	2
Bayfield (2)	**N=88** (24 / 30 / 34)	9.89 (0.93)	53.41 / 46.59	86.21% C 0% AfAm 2.30% H	5.75% AI 1.15% AsAm 4.60% O	71.51 (25.02) *0.0% U 10.6% O 65.9% H 23.5% Ob*	2
Crawford	**N=83** (26 / 27 / 30)	9.86 (0.92)	57.83 / 42.17	98.8% C 0% AfAm 0% H	0% AI 0% AsAm 1.20% O	61.25 (30.91) *3.6% U 16.9% O 61.5% H 18.1% Ob*	2
Barron	**N=125** (57 / 68 / 0)	9.34 (0.60)	60.80 / 39.20	85.80% C 8.80% AfAm 3.20% H	0% AI 2.40% AsAm 0.80% O	71.57 (25.83) *0.8% U 14.2% O 57.5% H 27.5% Ob*	1
Those starting in 2013 evaluation[3]	**N=370 (120 / 130 / 120)**	**10.27 (0.90)**	**53.05 / 46.95**	**61.10% C 3.40% AfAm 3.10% H**	**23.90% AI 8.50% AsAm 0.00% O**	**66.79 (30.80)** ***3.4% U 17.6% O 53.1% H 25.9% Ob***	**0.66** ***50% 0yrs 26% 3 yrs 24% 5 yrs***
Marathon	**N=51** (18 / 18 / 15)	10.09 (0.87)	54.90 / 45.10	35.29% C 0.00% AfAm 13.73% H	0.00% AI 50.98% AsAm 0.00% O	72.53 (28.12) *0.0% U 21.6% O 49.0% H 29.4% Ob*	0
Winnebago	**N=134** (43 / 42 / 49)	10.31 (0.94)	50.75 / 49.25	79.70% C 9.02% AfAm 3.76% H	0.75% AI 6.77% AsAm 0.00% O	59.11 (30.50) *5.6% U 15.6% O 65.1% H 14.7% Ob*	0
Brown	**N=97** (35 / 33 / 30)	10.33 (0.96)	51.55 / 48.45	0.00% C 0.00% AfAm 0.00% H	100.00% AI 0.00% AsAm 0.00% O	71.65 (30.36) *3.3% U 14.1% O 46.7% H 35.9% Ob*	3

[1] C=Caucasian; AfAm=African American; H=Hispanic; AI=American Indian; AsAm=Asian American; O=Other

[2] U=underweight; H=healthy weight; O=overweight; Ob=Obese

[3] Includes schools from counties that opted in to the Transform Wisconsin F2S Evaluation: Crawford, Marathon, Winnebago, and Brown

The fall 2010 cohort included 1047 students distributed relatively evenly across third, fourth, and fifth grades (mean age 9.7 ± 0.8 years), and balanced between the sexes. Students were predominantly Caucasian, with some substantial (5%) representation of Native American students, and lesser representation of African-American, Asian-American, Hispanic, and mixed- or other-ethnicity students. Most students (60%) were classified as healthy weight at baseline according to age- and sex-specific BMI percentile, but 16% were classified as overweight and 23% as obese. The site-specific proportion of obese students ranged from 17% to 43%, while the proportion of healthy-weight students ranged from 36% to 66%. Most students (42%) came from schools with one prior year of F2S programming, and the next largest proportion of students (22%) attended schools brand-new to F2S programming at the start of the 2010-2011 academic year. Actual participation in specific evaluation activities varied (for example, based on an individual's attendance on the day of evaluation activities) at each data collection point.

The cohort who began evaluation activities under the auspices of the Transform Wisconsin grant program in spring 2013 included Crawford, Marathon, Winnebago, and Brown counties (Portage County will participate in the spring 2014 evaluation). This included 370 students, balanced across grades three, four, and five (mean age 10.3 ± 0.9 years), and balanced across the sexes. Most students were again Caucasian (61%), but a larger proportion of students were Native American (24%) or Asian-American (9%), with remaining students self-identifying as African-American or Hispanic. In May 2013, 53% of these students were classified as healthy weight, while 18% were considered overweight and 26% were obese. Site-specific proportions of students classified as healthy weight ranged from 47% to 65%, while the proportion classified as obese ranged from 15% to 36%. Half of students were from schools brand-new to F2S programming (0 prior years, 50%); the remaining half came from established programs with either three (26%) or five (24%) prior years. Like the earlier evaluation cohort, individuals' actual participation in evaluation activities varied.

Table 3.6 shows broader school characteristics, with state-level data provided for comparison, according to academic year (2010-2011, 2011-2012, and 2012-2013). This data was obtained at the district level from Wisconsin's Department of Public Instruction (DPI).[11–13] The percent of students

Table 3.6. Site Characteristics: District-level Enrollment, Free/Reduced-Price Lunch Eligibility, Lunch Program Participation, and Attendance

County in which school district is located	District Enrollment[1]	Students eligible for FRPL, %[1]	School Lunch Average Daily Participation, %[1]	Attendance (%)[2]
2010-2011				
Statewide	**835184**	**41.4**	**61.0**	**95.4**
Clark/Marathon	969	54.7	79.7	95.3
Dane	24796	67.1	51.2	97.3
Bayfield (1)	406	85.8	72.2	92.0
Washburn	1268	57.9	67.5	95.5
Portage	916	26.9	78.3	97.8
Vernon	1178	45.9	65.4	96.3
Bayfield (2)	535	48.8	69.0	94.4
Crawford	356	63.5	80.3	96.5
Barron	1334	62.0	67.2	95.5
2011-2012				
Statewide	**831240**	**42.5**	**60.7**	**95.6**
Dane	24861	56.6	51.5	94.5
Bayfield (1)	419	73.0	Not reported	91.3
Washburn	1247	55.2	67.3	94.7
Portage	924	22.0	74.6	97.9
Vernon	1140	48.9	64.7	96.7
Bayfield (2)	545	43.9	65.7	95.5
Crawford	348	59.8	79.9	96.8
2012-2013				
Statewide	**829631**	**43.2**	**58.3**	**94.9**
Bayfield (1)	417	72.7	69.5	90.3
Washburn	1237	58.8	65.8	94.3
Vernon	1125	46.8	60.4	96.2
Bayfield (2)	541	44.9	63.4	94.7
Crawford	325	62.8	74.8	96.5
Marathon	7792	49.4	76.2	95.6
Winnebago	9295	45.6	48.6	95.8
Brown[3]	238	90.0	85.6	94.3

[1] Source of School Lunch Program Participation and Free/Reduced-Price Eligibility data source (district-level): Wisconsin Department of Public Instruction[11]

[2] School Attendance data source (school-level): Wisconsin Department of Public Instruction[12]

[3] The Brown County school participating in this evaluation submitted their K-5 data directly to the evaluation team.

eligible for free or reduced-price lunches (FRPL) served as proxy for socio-economic status in this project, and ranged from 27% to 86% in the 2010-2011 academic year, as compared to the state average of 41%. The ranges and state averages were similar in the following academic years. The percent of students participating in the school lunch program each day across the state was 61% in 2010-2011 (similar in the following years). District-specific participation for this ranged from 51% to 80% in 2010-2011, and was also similar in the following years. School attendance at the state level was approximately 95% for all three academic years; all schools maintained attendance rates above 90% for all three years.

Table 3.7 gives information about schools' participation in the Wisconsin Nutrition Education Program,[14] a program provided through the University of Wisconsin Cooperative Extension.[15] The program is provided to schools that qualify (that is, have a high proportion of students eligible for FRPL; this can cause a school's eligibility to change from year to year), with aims of educating students to choose healthful diets.[14,15] A typical WNEP model is a series of five nutrition education lessons, though this in practice varies between counties, as described in the Comments column of Table 3.7.[14] Most schools participating in this farm to school evaluation also received WNEP lessons, and many of those schools coordinated WNEP with farm to school efforts. Only one county did not receive any WNEP programming, although three county agents did not respond to a request for information on farm to school sites' participation in WNEP programming. Farm to school and WNEP program goals and educational content overlap to some extent, but it is important to consider that the presence of both programs in most schools is a potential confounder to the results described herein.

Table 3.7. Recipients of Wisconsin Nutrition Education Program, 2010-2013

County[1]	2010-2011	2011-2012	2012-2013	Comments
Clark/Marathon	X	n/a	n/a	
Dane	X	X	n/a	WNEP nutrition education lessons are conducted beyond F2S
Bayfield (1)	X	X	X	WNEP works closely with F2S; 3rd through 5th graders receive 5 lessons per year
Washburn	X	X	X	WNEP works closely with F2S for various presentations during the school year. In 2013-2014, new F2S personnel brought the need to re-establish WNEP-F2S relationships, thus making the working relationship more difficult.
Portage	No WNEP	No WNEP	No WNEP	
Vernon	X	X	X	
Bayfield (2)	X	X	X	This school does not always qualify for WNEP. When it does, WNEP and F2S work together
Crawford	X	X	X	F2S and WNEP began at the same time; WNEP programming is age-specific (different at each grade level, 6 consecutive lessons) while F2S does one lesson per month, highlighting the harvest of the month item. The programs reinforce each other.
Barron		n/a	n/a	No response from county extension agent
Marathon	n/a	n/a	X	WNEP works with grades Kg, 2, 4 only.
Winnebago	n/a	n/a		No response from county extension agent
Brown	n/a	n/a		No response from county extension agent

Abbreviations: X, school received WNEP programming; n/a, school not involved in F2S evaluation this year; WNEP, Wisconsin Nutrition Education Program; F2S, Farm to School; Kg, Kindergarten.

[1]Although counties are listed, information was obtained for specific schools. Counties correspond to those described in earlier tables for F2S participants.

Chapter 3 References

1. Centers for Disease Control and Prevention. Recommended Community Strategies and Measurements to Prevent Obesity in the United States. *MMWR*. 2009;58(No. RR-07):1–26.

2. *Farm to School Evaluation Toolkit*. University of North Carolina at Chapel Hill: Center for Health Promotion and Disease Prevention; 2010. Available at: http://www.cias.wisc.edu/wp-content/uploads/2011/09/8-evaluate-your-work.pdf. Accessesd May 28, 2014.

3. Tedeschi S. Personal Communication., February 24, 2014.

4. United States Census Bureau, United States Department of Commerce. State & County QuickFacts. 2014. Available at: http://quickfacts.census.gov/qfd/states/55000.html. Accessed February 4, 2014.

5. Bontrager Yoder AB. Transform Wisconsin Farm to School Evaluation Training Webinar, April 9 2013. 2013. Available at: https://wisc.adobeconnect.com/_a825758332/p98vwxibvrj/?launcher=false&fcsContent=true&pbMode=normal. Accessed May 23, 2014.

6. *2009 Senate Bill 181*. Senate; 2009:1–17. Available at: http://docs.legis.wisconsin.gov/2009/related/proposals/sb181.pdf. Accessed March 18, 2014.

7. Jamelske E, Bika LA, McCarty DJ, Meinen AM. Preliminary Findings from an Evaluation of the USDA Fresh Fruit and Vegetable Program in Wisconsin Schools. *Wis Med J*. 2008;107(5):225–230.

8. Block Questionnaire for Ages 8-17 - 2004 FFQ. 2009. Available at: http://nutritionquest.com/assessment/list-of-questionnaires-and-screeners/. Accessed April 22, 2013.

9. Hanks AS, Wansink B, Just DR. Reliability and accuracy of real-time visualization techniques for measuring school cafeteria tray waste: validating the quarter-waste method. *J Acad Nutr Diet*. 2014;114(3):470–4.

10. *To Weigh and Measure*. Department of Health and Family Services, Division of Public Health, Wisconsin Nutrition and Physical Activity Program; 2008. Available at: http://www.dhs.wisconsin.gov/health/physicalactivity/Sites/School/To_Weigh_Measure.pdf. Accessed August 28, 2010.

11. Wisconsin Department of Public Instruction. Program Statistics. Available at: http://fns.dpi.wi.gov/fns_progstat. Accessed February 17, 2014.

12. Wisconsin's Information Network for Successful Schools, Wisconsin Department of Public Instruction. What percent of students attend school each day? Available at: http://data.dpi.state.wi.us/data/AttendancePage.aspx. Accessed March 17, 2014.

13. Wisconsin Department of Public Instruction. Wisconsin Information System for Education Data Dashboard. Available at: http://wisedash.dpi.wi.gov/Dashboard/Page/Home/Topic Area/Attendance/. Accessed March 17, 2014.

14. Coleman G. Personal communication, April 2, 2014.

15. University of Wisconsin Cooperative Extension. Wisconsin Nutrition Education Program. 2014. Available at: http://www.uwex.edu/ces/wnep/overview/index.cfm. Accessed May 22, 2014.

16. County maps - Wisconsin Department of Transportation. Available at: http://www.dot.wisconsin.gov/travel/maps/county.htm. Accessed March 16, 2014.

Chapter 4. Farm to Elementary School Programming Increases Access to Fruits and Vegetables and Increases Their Consumption Among Those with Low Intake

Introduction

Childhood obesity is a public health problem in the United States.[1] Overweight and obesity track into adulthood and increase the risk of early-onset weight-related chronic diseases.[2,3] Obesity's causes are multi-factorial, many of which begin early in life.[4,5] Given the magnitude of the problem, current research efforts focus on primary prevention. The Centers for Disease Control and Prevention (CDC) identified environmental and policy strategies for obesity prevention.[6] Increasing fruit and vegetable (FV) consumption is one of these strategies, despite mixed evidence for FV intake to decrease excess weight. One study found lower, but nonsignificant, BMI gains in children who increased fruit consumption, but found the opposite trend those who increased only vegetable consumption.[7] A recent review reported associations, in experimental studies, between increased FV consumption and reduced adiposity for overweight/obese adults, but not in children; however, half of longitudinal studies in children showed a significant inverse association between FV consumption and weight gain.[8]

Strategy choices require examining opportunities to reach individuals in various settings. Children spend significant time in school, making it a prime setting for impacting a wide range of individuals through interventions and policy.[9,10] Echoing the Institute of Medicine's belief that schools play an important role in teaching healthy behaviors, the CDC identified increased FV consumption in school meals as a key strategy for obesity prevention, highlighting Farm to School (F2S) programs as a specific approach.[6,11]

F2S, a national program with grassroots foundations, is proposed to positively influence children's dietary choices and consumption. F2S combines nutrition and agriculture education activities to increase FV access in schools, and ultimately aims to improve eating behavior.[12–14] F2S programs are

not theory-grounded by design,[14,15] although their curricular programming has evolved to align with logical approaches to nutrition education: increasing knowledge, subsequently improving attitudes, and finally improving dietary behaviors. Nutrition knowledge and attitudes predict adolescent and adult dietary behaviors.[16,17] Experiential knowledge gained in school gardens or farm visits may improve children's attitudes and preferences for specific FV.[18,19] Preference for individual FV, in turn, improves consumption.[20,21] F2S program effects on dietary behavior may function by increasing children's knowledge and FV exposure through curricular nutrition/agricultural lessons and hands-on activities (e.g., taste-testing, cooking demonstrations, or school gardens).

In a successful effort to foster F2S programming in Wisconsin, a coalition formed among the Departments of Health Services, and of Agriculture, Trade, and Consumer Protection (AmeriCorps F2S); the University of Wisconsin system; and the Michael Fields Agricultural Institute. As part of this, an evaluation was designed and performed to assess F2S programs' effectiveness in improving students' knowledge, attitudes, and behaviors relative to FV consumption. A novel aspect of this evaluation was using photographs of school lunch trays to examine F2S program impacts on children's lunch consumption. This article presents student-related results of the Wisconsin F2S evaluation, with objectives of assessing cross-sectional baseline outcomes according to schools' prior F2S years, as well as change (overall and within prior-exposure groups) across a single program year.

Methods

Participants and Recruitment. Elementary schools hosting AmeriCorps F2S (through Wisconsin's Department of Agriculture, Trade, and Consumer Protection) deemed by the program supervisor to have sufficient logistical and administrative support to conduct this evaluation (N=11) were invited to participate in the evaluation. Schools that opted in (N=9; 82%) were geographically distributed throughout Wisconsin, including one urban-area and eight rural-area districts. From this representative, but non-random, sample, all third-, fourth-, and fifth-graders were invited to participate. These grades

were expected to have the literacy and computer skills needed to complete the survey tools. Based on the known number of students opting out of the entire evaluation (n=20 within two schools) and the number of students for whom AmeriCorps members submitted an evaluation ID (n=1183), there was approximately a 94% participation rate. An additional 66 students did not opt out but did not complete KA or FFQ measures (presumably due to absence on survey administration days), yielding approximately a 95% participation rate.

Parents received a description of the planned evaluation, offering an opt-out opportunity; without this, students participated by default. The University of Wisconsin-Madison Institutional Review Board reviewed the design and determined it to be exempt. Of the nine schools, two were new to F2S programming at the start of the evaluation (fall 2010); two had one, and five had two or more, prior years. Program implementation at each school varied; AmeriCorps members could select from a list of 14 activities, which were monitored through monthly activity reports submitted by AmeriCorps members (Supplementary Table 4.1).

Study Design. Data was collected at the start and end of the 2010-2011 academic year. AmeriCorps members attended one, two-hour training in September 2010 detailing evaluation tools and methods. Members received additional technical assistance throughout the evaluation period via phone and e-mail. AmeriCorps members coordinated and administered all measures, with additional volunteers as needed, and submitted data to the coordinating center at the University of Wisconsin. AmeriCorps members compiled de-identified data at each school and submitted to the coordinating center with evaluation ID numbers, gender, age, and ethnicity (used to connect across student measures). The percent of students eligible for free/reduced-price lunches (%FRPL), obtained from Wisconsin's Department of Public Instruction, served as proxy for socioeconomic status.[22]

Measures, Instruments. Students participated in at least one of the following: Knowledge and Attitudes survey (KA); the Block Kids Food Frequency Questionnaire 2004 (FFQ) (NutritionQuest, Berkeley, CA); and a Lunch Tray Photo Observation (LTPO). The KA and FFQ were administered

online (paper versions were available upon request) during class time with adult supervision. The LTPO involved digital photography during school lunch.

The 60-item **KA** survey was developed from a previously-validated food neophobia scale adapted previously for use with FV,[23,24] questions used to assess knowledge about F2S curricula used in Wisconsin, and a survey used to assess the USDA Fresh FV Program in Wisconsin,[25] combined selectively to yield a 15-20 minute survey. From it, six constructs were calculated: *Knowledge* of food, nutrition, and agriculture (15 questions); *Attitudes* toward trying FV (20 questions); *Perception/Self-efficacy* for eating healthfully (2 questions); and, for 20 specific FV, *Exposure* (tasted/not), *Liking* (of those previously-tasted), and *Willingness* to try the FV. Construct scores were summed responses of the coded values, except Liking (calculated as a percentage relative to Exposure) and Willingness (calculated as FV students were willing to try, or had tasted and liked). Because the Perception construct, upon reflection, could not adequately assess a child's perception of his/her ability to choose FV over less-healthy snacks or desserts, these results are not reported.

The **FFQ** assessed students' overall dietary intake. It is a 77-item questionnaire, validated for reproducibility among children ages 8 and above, that surveys foods and beverages consumed during the last seven days, including portion sizes, with pictures to enhance quantification.[26,27] Due to budget and class time limitations, only fourth grade students completed the FFQ; third graders were less likely to have the reading and computer skills needed, and not all schools included fifth graders. Outliers were excluded based on extreme reported energy intake (<500 kcal and >3500 kcal). Outcome measures were self-reported FV intake, in cups per 1,000 kcal. To examine differential effects among students with the lowest intakes, FV intake levels were grouped as very low (<25th percentile), low (25th percentile to adequate), and adequate (Supplementary Table 4.2). Adequate FV intake was defined using USDA food guide recommendations for mean age- and gender-specific energy requirements per the Dietary Reference Intakes.[28,29]

The **LTPO** provided an objective measure of FV intake in school lunches. Others have used digital photography to assess food intake in a cafeteria setting and found it reliable.[30,31] Digital

photographs were taken of students' school lunch trays before and after students ate, on four days, at baseline and follow-up. Trays were numbered to enable pairing before- and after-eating photos; side-by-side pairs were visually assessed by one investigator for the number of different FV available on trays, amount (cups) of FV available on students' trays, and FV consumption (as 100, 75, 50, 25, or 0% of the FV volume on the tray that disappeared, converted to cups based on serving sizes). Tray numbers were not identical across the four days in five of the eight participating schools, so it was not possible to create individual-student averages, nor link these data to other measures. Additional school cafeteria environment factors (FV serving sizes; whether students selected or were served FV items; presence of a salad bar and how it was incorporated into school meals; presence of other self-serve items) were assessed by interviews with food service directors, and foods identified were verified against menus. Some school lunch programs included a salad bar (79% of trays); some of these included locally-grown or school-garden-grown produce. Among these, 85% of trays came from schools where students were permitted to serve themselves from the salad bar, and the remainder of trays came from schools where some staff supervision or serving occurred. Among sites with a salad bar, there was variation across sites regarding how the salad bar was used to present FV as a strategy for increasing students' FV consumption. This categorical variable classified food service directors' (open-ended) descriptions as (a) no report of salad bar, (b) salad bar with minimal instructions, or (c) salad bar with frequent verbal and poster material; the latter two categories pertained to instructions regarding adding FV to the diet through selection and preparation of items in appropriate portion sizes from the salad bar.

***Data analysis*.** Statistical analyses were performed using SAS 9.2 (SAS Institute Inc., Cary, NC). Baseline results were compared according to prior F2S years (categorized as 0, 1, or ≥2) using mixed modeling, adjusting for sex (not LTPO), grade, and %FRPL, and treating school as a random effect. The LTPO was evaluated additionally according to assessed aspects of the school food environment (see Methods), adjusting for variables that were significantly unevenly distributed across prior-year groups and yielded better models. Academic-year change was assessed first overall, then stratified by prior years of F2S program, using student's T-tests (pre-/post-program student-paired: KA, FFQ). Additionally,

degree-of-change differences between prior year groups were evaluated (mixed modeling), using the same adjustments as for baseline. Significance was determined at $p<0.05$ (two-tailed) with Tukey's adjustment for multiple comparisons.

Results

Participants included 1117 students from nine schools who completed at least one measure, with a mean age of 9.6 ± 0.9 years; 53% of students were male (Table 4.1). Most students (44%) were fourth-graders; 36% were third-graders, and 27% were fifth-graders. Most (57%) of students came from schools that had ≥2 prior years of F2S programming; 21% were in their second year, and 29% were in schools new to F2S programming in fall 2010.

A total of 888 students finished at least one complete construct within baseline and follow-up KA surveys and could be paired across the year (79% participation; mean age 9.6 ± 0.9 years) (Table 4.2). At baseline, adjusted Attitudes scores were higher with increasing prior F2S exposure (3.9 points or 5% higher among students with the most prior F2S compared to new schools). The remaining constructs did not differ at baseline according to prior F2S exposure.

Across the year, there were significant increases overall in Attitudes (3%), Knowledge (4%), Exposure (3%, or approximately half of one FV item), and Willingness (2%; all $p<.001$) scores (Table 4.2; Supplementary Table 4.3). When change scores were categorized by prior F2S years, only two constructs yielded significant differences: Knowledge (larger increase among second-year F2S students' scores) and Liking (new-site students decreased their liking of FV tasted). All constructs (except Liking) showed small school-year increases in continuing groups.

Among LTPO-participating grades and schools, a total of 850 students (mean age 9.3 ± 1.0 years) could have had lunch trays photographed, which, for four days, would have yielded 3400 trays at both baseline and follow-up (6800 total) if all students took school lunch and no pictures of trays were missed.

Table 4.1. Characteristics of Schools (n=9) and Children (n=1117) Participating in Wisconsin Farm to School Program Evaluation

F2S Prior Years	*n* (3rd/4th/5th)	Age at baseline, years, Mean (SD)	Sex (%M/%F)	Race/ Ethnicity (%)[1]						BMI *z*-score, Baseline Mean (SD)	2010-2011 %FRPL[2,3] Mean (SD)
				C	AfAm	H	AI	AsAm	O		
All	**1117 (397/493/306)**	**9.6 (0.9)**	**53 / 47**	**81.0**	**4.5**	**3.2**	**7.2**	**1.9**	**2.2**	**0.69 (1.10)**	**52.2 (16.0)**
0	321 (87/112/122)	9.8 (0.9)	51 / 49	73.9	1.6	1.0	21.7	0.3	1.6	0.87 (1.52)	43.1 (26.3)
1	238 (113/125/0)	9.2 (0.6)	54 / 46	81.5	7.6	7.1	0.8	1.3	1.7	0.85 (1.03)	58.5 (3.7)
≥2	634 (197/256/181)	9.7 (0.7)	54 / 46	84.2	4.7	2.8	2.5	3.0	2.7	0.62 (1.01)	54.5 (7.9)

[1] C=Caucasian; AfAm=African American; H=Hispanic; AI=American Indian; AsAm=Asian American; O=Other

[2] %FRPL, Percent of students eligible for Free or Reduced-Price Lunches

[3] Obtained from Wisconsin Department of Public Instruction for each school participating in the F2S evaluation.[22]

Table 4.2. Academic Year Changes in Knowledge and Attitudes Survey Construct Scores

KA Construct	Prior F2S, years	*n*	Baseline[1]	Adjusted Difference[1]	*p*[2]
Attitudes[3]	All	874	59.4 (11.5)	2.0 (9.9)	<.001
Range 20-80	0	166	56.8 (1.4)[a]	0.6 (2.9)	.10
	1	193	58.7 (1.3)[a]	2.9 (2.9)	<.001
	≥ 2	515	60.7 (0.8)[b]	2.4 (1.8)	<.001
Knowledge[3]	All	888	11.7 (2.1)	0.6 (2.1)	<.001
Range 0-15	0	180	11.8 (0.2)	0.1 (0.2)[c]	.06
	1	192	11.3 (0.2)	1.4 (0.2)[d]	<.001
	≥ 2	516	11.8 (0.1)	0.5 (0.1)[c]	<.001
Exposure[3]	All	859	16.6 (3.5)	0.6 (2.3)	<.001
Range 0-20	0	177	16.3 (0.4)	0.4 (0.4)	.03
	1	183	16.1 (0.4)	1.0 (0.4)	<.001
	≥ 2	499	16.9 (0.2)	0.7 (0.2)	<.001
Liking[4]	All	851	81.5 (15.7)	-0.2 (13.4)	.63
Range 0-100%	0	172	83.0 (2.1)	-2.6 (1.2)[c]	.003
	1	183	82.1 (2.0)	-0.3 (1.1)[cd]	.92
	≥ 2	496	81.2 (1.3)	0.7 (0.6)[d]	.22
Willingness[3]	All	854	17.9 (2.8)	0.4 (1.9)	<.001
Range 0-20	0	175	17.7 (0.3)	0.1 (0.4)	.31
	1	183	17.7 (0.3)	0.7 (0.4)	<.001
	≥ 2	496	18.1 (0.2)	0.5 (0.2)	<.001

[1] SD used for simple means ("All"); SE presented for adjusted means (mixed models data – "Prior F2S - 0, 1, ≥2 years)

[2] Pre/post differences, as indicated by matched-pairs T-test.

[3] Attitudes, Knowledge, Exposure, and Willingness: when broken down by prior F2S years, are presented as LS Means (SE), adjusted for sex, grade, %FRPL, and school (random effect); Tukey's adjustment for multiple comparisons.

[4] Liking scores, when broken down by prior F2S program exposure, are presented as LS Means (SE), adjusted for grade, %FRPL, and school (random effect); Tukey's adjustment for multiple comparisons (no significant effect according to sex).

[a,b; c,d] Within-time-point construct differences were evaluated using mixed modeling (adjustments described in notes 3-4 above). Significant differences (p <0.05) within each KA construct, and within each time point (baseline, difference), are indicated by different superscripts.

Across all schools (all grades), 69.3% of students participated in the National School Lunch Program;[22] 68% and 63% of the potential 3400 pre/post photos were obtained, coming close to the school-level lunch program participation rates. Table 4.3 summarizes FV items, cups available, and cups disappeared (assumed to have been consumed) for a total of 4,451 student school lunch trays (52% of trays were at baseline) for which we had acceptable photos, with all final adjustments. Photos came from eight schools, although at half of these schools only one (N=3) or two grades (N=1) were included due to AmeriCorps members' time or other logistical limitations. Initial adjusted means (grade, %FRPL, school) revealed no significant differences by prior F2S years at baseline, nor in the degree of change (Supplementary Table 4.4). Education accompanying a salad bar was unequally distributed across schools: one of two new schools reported minimal education, one of the 1-prior-year schools had no salad bar, and of the four ≥2-prior-year schools, two had ongoing education, one had minimal/previous-year education, and one had no salad bar. Other assessed cafeteria-environment variables were not significantly different across prior year groups. Adjustments for salad bar education showed that trays from sites with more prior F2S programming had approximately one more FV item and one-half cup more FV available, and almost one-half cup more FV disappeared.

Across the year, there were significant increases overall only in the variety of FV available on students' trays. Trays from schools with more prior F2S showed increases in the number of FV, but also a small decrease in the FV cups available (unadjusted, data not shown). Adjusted across-year degrees of change did not differ significantly between groups (Table 4.3).

Table 4.3. Changes in Adjusted Mean FV Items and FV Cups Available and Disappeared, by Prior Years in F2S (LTPO[1])

	Prior F2S, years	*n*[2] pre, post	Baseline[3]	Difference, Mean (SD)[4]	*p*[4]
Number of items available[3]	**All**	2296, 2155	1.4 (0.9)	0.1 (1.0)	<.001
	0	573, 557	0.7 (0.3)[a]	-0.0 (0.9)	.99
	1	521, 497	1.8 (0.3)[b]	0.3 (0.8)	<.001
	≥2	1202, 1101	1.7 (0.2)[b]	0.1 (1.0)	.001
Amount available, cups[3]	**All**	2295, 2155	0.54 (0.42)	-0.02 (0.44)	.06
	0	572, 557	0.31 (0.11)[a]	0.02 (0.48)	.51
	1	521, 497	0.83 (0.12)[b]	-0.04 (0.40)	.03
	≥2	1202, 1101	0.71 (0.07)[b]	-0.03 (0.43)	.07
Amount disappeared, cups[3]	**All**	2296, 2155	0.38 (0.36)	-0.01 (0.37)	.14
	0	573, 557	0.19 (0.09)[a]	0.02 (0.35)	.35
	1	521, 497	0.60 (0.11)[b]	-0.02 (0.42)	.16
	≥2	1202, 1101	0.47 (0.06)[ab]	-0.02 (0.36)	.10

[1] Lunch Tray Photo Observation

[2] Number of trays

[3] The *All* category is presented as means (SD). Prior F2S year groups are presented as LS Means (SE) with adjustments for grade, %FRPL, education accompanying a salad bar (no salad bar; not reported; none; minimal/previous years; current/ongoing), and school (random effect); Tukey's adjustment for multiple comparisons.

[4] Differences and significances calculated by T-test (follow-up minus baseline).

[a,b] Significant differences ($p<0.05$) within each variable and time point are indicated by different superscripts. Differences within baseline and follow-up time-points were assessed using mixed modeling. See adjustments in note 3 above.

The percent of trays with no FV items and no disappearance were determined to represent lunches with the most inadequate FV consumption. At baseline, 24% of trays showed no FV disappearance (Supplementary Table 4.5). The percent of trays showing no FV items and no FV disappearance was lower among trays from schools with more prior F2S at baseline and follow-up, and all groups improved across the year, except new schools' percent of trays with no disappearance (Table 4.4).

A total of 305 fourth-graders completed the FFQ at both baseline and follow-up (445 pre, 343 post) and met inclusion criteria described in methods (62% of 4th graders; mean age 9.8 ± 0.4 years). The overall mean reported baseline intakes were 1.2 (±0.8) cups/1000 kcal fruit and 0.7 (±0.5) cups/1000 kcal vegetables (Supplementary Table 4.6). There was no baseline trend in reported intake according to prior F2S years, nor across-year change, except students with the most prior F2S, who decreased reported fruit consumption (-0.11 ± 0.06 cups/1000 kcal, p=0.03).

According to reported intake levels, students with less-than-adequate baseline fruit intake increased at follow-up; this was not the case for vegetables (Supplementary Table 4.7). Students with the most favorable reported baseline FV intakes decreased at follow-up, but approximately 2% of students moved from very low to low reported fruit intake, and the percent of students reporting adequate vegetable consumption doubled (9% vs 4%) (Figure 4.1; Supplementary Table 4.8). This was driven heavily by students from schools with no prior F2S program exposure, which changed from just 45% to 57% of students with adequate fruit intake and 0% to 10% with adequate vegetable intake.

Discussion

At baseline, Attitudes (toward eating and trying FV) improved as a function of prior F2S years. Academic-year increases, both overall and within continuing-program (not new) groups, were detected for Attitudes, Knowledge, Exposure, and Willingness constructs. While there were no overall program-year changes in reported FV consumption (FFQ), the LTPO demonstrated a substantial reduction in the

Table 4.4. Adjusted Percent of Trays with No FV Items, No FV Disappearance

Prior Years of F2S	*n*,[1] pre, post	Baseline[2], LS Mean (SE)	Follow-up[2], LS Mean (SE)	Difference[2], LS Mean (SE)	*p*[3]
No FV Items					
0	573, 539	31.4 (5.2)[a]	26.9 (5.2)[c]	-3.5 (0.1)	<.001
1	521, 497	1.2 (6.1)[b]	-0.2 (6.1)[d]	-1.4 (0.1)	<.001
≥2	1202, 1103	10.8 (3.4)[b]	8.1 (3.4)[cd]	-2.7 (0.1)	<.001
No FV Disappearance					
0	573, 539	41.9 (2.3)[a]	41.7 (2.3)[c]	-0.2 (0.3)	.99
1	521, 497	15.6 (2.7)[b]	13.9 (2.7)[d]	-1.6 (0.3)	<.001
≥2	1202, 1103	14.5 (1.5)[b]	14.0 (1.5)[d]	-0.5 (0.2)	.05

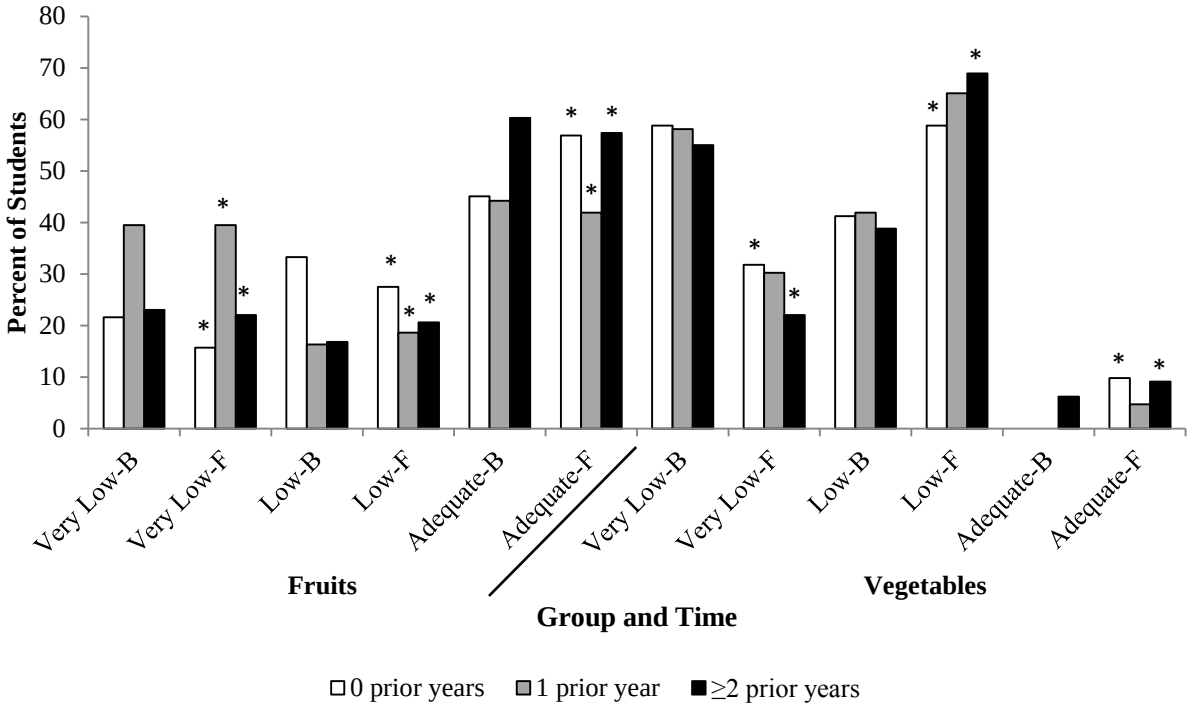
[1] Number of trays

[2] Values for all time points calculated using mixed modeling with adjustments for grade, education accompanying a salad bar, %FRPL, and school (random effect); Tukey's adjustment for multiple comparisons.

[3] Significant pre/post differences within prior-F2S exposure groups were calculated using mixed modeling, including the adjustments described in footnote 2 above.

[a,b; c,d] Significant differences ($p<0.05$) between prior-year groups at each time point (baseline, follow-up) were calculated using mixed modeling, including the adjustments described in footnote 2 above.

Figure 4.1. Percent of Fourth-Graders with Varying Levels of Fruit Intake (Block FFQ), According to Prior F2S Program Years, at Baseline and Follow-up.



B, Baseline; F, Follow-up.

Asterisk (*) indicates a significant change ($p<0.05$) in proportion of students from baseline for a within-prior-F2S-exposure group as determined by chi-squared test of proportions.

proportion of student lunch trays containing no FV and indicating no FV consumption. These lunch-time proportional FV consumption outcomes are, to our knowledge, the first objective measures of eating behavior changes associated with F2S programming in elementary school students. Both baseline cross-sectional and program-year-change findings were small, but program-year improvements were most pronounced at continuing, rather than new, F2S sites, and were greatest among those with the least favorable indicators of baseline consumption, that is, those with very low baseline fruit intake (FFQ) or the percent of trays with no FV items or no FV consumption (LTPO).

Knowledge and attitudes are modeled as mediators of FV consumption.[16,17] The observed knowledge improvements align with other literature pertaining to nutrition education lessons.[32] Previous findings on experiential learning activity interventions similar to F2S have found similar knowledge improvments.[19,33–38] The small improvements in attitudes toward trying and eating FV strengthens support for previous findings of positive associations between this and nutrition education or other experiential learning activities[34,38,39] that often are components of F2S such as cooking[33,40] or gardening,[38,39] even though nutrition education lessons historically have yielded inconsistent effects on attitudes.[32]

The observed changes in mediators of FV intake were followed by improved school lunch FV access. These improvements did not translate to large changes in FV consumption. At school lunch, the improved access was accompanied by slight reductions in the percent of trays with >2 FV items and ≥½ cup FV disappearance (LTPO). In the total diet (FFQ), only students with low baseline FV intake indicated longitudinal consumption improvements. The small behavior changes may be explained by the fact that preference for new FV can take multiple tastes.[41–43] These findings largely agree with previous findings that F2S primarily impacts lunch FV consumption[44] and that nutrition education programming minimally impacts FV consumption,[32] and further supports more recent findings that F2S-like program activities (including gardening, cooking, or taste-testing activities) may improve FV consumption.[19,37,45–47] This study indicates that F2S exerts its largest influence on low-FV-consuming students and, conversely, possibly a negative effect on initially-high-FV-consumers. This is not surprising, but it suggests that F2S

programming places a high emphasis on messages for more FV consumption rather than some specified amount to be consumed. FV consumption outcomes vary by assessment method, with recalls and direct observations typically indicating increases, but not weighed plate waste.[44] It is possible that outcomes also vary with F2S program comprehensiveness (not part of this analysis). There are likely additional factors (such as menu offerings or individuals' preferences) not assessed here that impacted LTPO outcomes.

It is unique that this evaluation included measures of knowledge, attitudes *and* dietary behaviors, whereas others have only assessed one or two of those outcomes,[18–20,37,44,48,49] thus providing a foundation for more rigorous future research. The LTPO distinctively assessed school lunch tray contents both qualitatively and quantitatively, in a feasible, more objective manner, answering a recent call for direct observation of children's consumption to assess F2S impacts on dietary behaviors.[44] While observed effects were small, the greatest effects were apparent among students with the least favorable baseline measures, indicating that F2S programming most pronounced impact is where there is greater need.

The FFQ findings should be interpreted with caution: they may reflect a regression to the mean, as there were also decreases in mean intake among students with adequate baseline intake and in the percent of students reporting very low F or V intake. While this could indicate that the positive effect observed in school lunches did not transform habitual intake, it is also likely that this illustrates the well-recognized weaknesses of self-reported dietary intake.[50–52] Future investigation of F2S's total-diet effects should include objective home-diet measures. Since students with the least favorable baseline FV consumption showed the greatest change, it again seems that F2S programming currently places a high emphasis on messages for more FV consumption rather than some specified amount.

Perhaps the greatest weaknesses of our study were the lack of randomly-selected schools and of a control group. Randomized controlled trials provide the strongest evidence to support prevention strategies, and future examination of F2S outcomes could be enhanced by partnering with schools and communities under such conditions, particularly with use of a control group. Community-based interventions, however, are informed from evaluations designed similarly to this study and these, taken in

aggregate, also contribute to the evidence base. This study was able to make a cursory examination of dose-response by comparing new with continuing F2S sites. Combining baseline cross-sectional with academic-year change analyses somewhat strengthens our findings of F2S exposure-related differences in attitudes towards eating FV, and the percent of school lunch trays showing no FV items or consumption. Other weaknesses include the aforementioned inability to completely link individuals' measures. Furthermore, not all students completed every measure at both time points, and not all schools included all measures, which reduced our power. Student migration among schools could also have affected outcomes, but was not considered to be large factor (<1% of students migrated). Additional factors impact these outcomes, such as community characteristics, that were not assessed due to the constraints of a limited budget and funding appropriations.

The tools also have limitations. The KA survey had high baseline Knowledge scores, indicating a possible ceiling effect. Exposure, Liking, and Willingness constructs are limited to the 20 specific FV, which may or may not have been part of these schools' F2S program activities, and they are difficult to interpret without examining individual FV items' responses. More generally, a short computer-based survey was found to be reliable for assessing nutrition knowledge in elementary students.[53] The FFQ has limited reliability for assessing food group intake, especially for children ≤12 years, although it serves well for servings of fruit.[27] While conducting surveys with elementary students may yield questionable reliability, others have found that self-reported dietary intake can be as reliable as parent-reported data for children aged 8-10,[52] although others have found food records to better asses FV intake for fourth-graders.[54]

Implications for Research and Practice

F2S programs were associated with small increases in knowledge about, attitudes toward, and access and exposure to FV. Specifically, FV variety increased on students' lunch trays and there were lower percentages of trays with no FV and no apparent consumption. These outcomes improved at

schools with more prior years of F2S programming, as well as with a single year of program exposure. All observed influences were small; it is likely that longer times are required for F2S programs' maximal effects, as habits take time to establish. As such, continuing F2S throughout school systems is supported by these positive findings. However, F2S programs are only part of the child's sphere of influences rather than some juggernaut answer to a major public health problem. More extensive changes to children's total environments will be necessary to create meaningful shifts in the prevalence of overweight and obesity.

Chapter 4 References

1. Ogden CL, Carroll MD, Kit B, Flegal. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *JAMA*. 2012;307:483–490.

2. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med*. 1997;337:869–873.

3. Guo SS, Chumlea WC. Tracking of body mass index in children in relation to overweight in adulthood. *Am J Clin Nutr*. 1999;70:145S–148S.

4. l'Allemand-Jander D. Clinical diagnosis of metabolic and cardiovascular risks in overweight children: early development of chronic diseases in the obese child. *Int J Obes*. 2010;34:S32–S36.

5. Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review. *Int J Obes*. 2011;35:891–898.

6. Centers for Disease Control and Prevention. Recommended Community Strategies and Measurements to Prevent Obesity in the United States. *MMWR*. 2009;58(No. RR07):1–26.

7. Bayer O, Nehring I, Bolte G, von Kries R. Fruit and vegetable consumption and BMI change in primary school-age children: a cohort study. *Eur J Clin Nutr*. 2014;68(2):265-270.

8. Ledoux T a, Hingle MD, Baranowski T. Relationship of fruit and vegetable intake with adiposity: a systematic review. *Obes Rev*. 2011;12:e143–e150.

9. Story M, Kaphingst KM, Robinson-O'Brien R, Glanz K. Creating healthy food and eating environments: Policy and environmental approaches. *Annu Rev Public Health*. 2008;29:253–272.

10. Sallis JF, Glanz K. Physical Activity and Food Environments: Solutions to the Obesity Epidemic. *Milbank Q*. 2009;87:123–154.

11. National Research Council. *Nutrition Standards for Foods in Schools: Leading the Way Toward Healthier Youth*. Washington, DC: The National Academies Press; 2007.

12. National Farm to School Network. http://www.farmtoschool.org. Accessed January 2, 2014.

13. Joshi A, Azuma AM. *Bearing Fruit: Farm to School Program Evaluation Resources and Recommendations*. National Farm to School Network. Center for Food & Justice, Urban & Environmental Policy Institute, Occidental College. 2009. http://departments.oxy.edu/uepi/cfj/publications/BF_full_report.pdf. Accessed July 1, 2013.

14. Izumi BT, Rostant OS, Moss MJ, Hamm MW. Results from the 2004 Michigan farm-to-school survey. *J Sch Health*. 2006;76:169–174.

15. Feenstra G, Ohmart J. The evolution of the school food and farm to school movement in the United States: Connecting childhood health, farms, and communities. *Child Obes*. 2012;8:280–289.

16. Thompson OM, Yaroch AL, Moser RP, et al. Knowledge of and adherence to fruit and vegetable recommendations and intakes: Results of the 2003 Health Information National Trends Survey. *J Health Commun*. 2011;16:328–340.

17. Kersting M, Sichert-Hellert W, Vereecken CA, et al. Food and nutrient intake, nutritional knowledge and diet-related attitudes in European adolescents. *Int J Obes*. 2008;32:S35–S41.

18. Kalich KA, Bauer D, McPartlin D. "Early Sprouts" – Establishing healthy food choices for young children. *Young Child*. 2009;64:49–55.

19. Parmer SM, Salisbury-Glennon J, Shannon D, Struempler B. School gardens: An experiential learning approach for a nutrition education program to increase fruit and vegetable knowledge, preference, and consumption among second-grade students. *J Nutr Educ Behav*. 2009;41:212–217.

20. Cullen KW, Baranowski T, Owens E, Al E. Availability, accessibility, and preferences for fruit, 100% fruit juice, and vegetables influence children's dietary behavior. *Health Educ Behav*. 2003;30:615–626.

21. Domel SB, Thompson WO, Davis HC, Baranowski T, Leonard SB, Baranowski J. Psychosocial predictors of fruit and vegetable consumption among elementary school children. *Health Educ Res*. 1996;11:299–308.

22. Wisconsin Department of Public Instruction. Program Statistics. http://fns.dpi.wi.gov/fns_progstat. Accessed February 17, 2014.

23. *Farm to School Evaluation Toolkit*. University of North Carolina at Chapel Hill: Center for Health Promotion and Disease Prevention; 2010. http://www.cias.wisc.edu/wp-content/uploads/2011/09/8-evaluate-your-work.pdf. Accessesd May 28, 2014.

24. Pliner P, Hobden K. Development of a scale to measure the trait of food neophobia in humans. *Appetite*. 1992;19:105–120.

25. Jamelske E, Bika LA, McCarty DJ, Meinen AM. Preliminary findings from an evaluation of the USDA Fresh Fruit and Vegetable Program in Wisconsin schools. *Wis Med J*. 2008;107:225–230.

26. Block Questionnaire for Ages 8-17 - 2004 FFQ. 2009. http://nutritionquest.com/assessment/list-of-questionnaires-and-screeners/. Accessed April 22, 2013.

27. Cullen KW, Watson K, Zakeri I. Relative reliability and validity of the Block Kids Questionnaire among youth aged 10 to 17 years. *J Am Diet Assoc*. 2008;108:862–866.

28. United States Department of Agriculture. My Pyramid Food Intake Patterns. http://www.choosemyplate.gov/food-groups/downloads/MyPyramid_Food_Intake_Patterns.pdf. Accessed May 17, 2013.

29. National Academy of Sciences, Institute of Medicine, Food and Nutrition Board. *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (Macronutrients)*. Washington, DC: National Academy of Sciences, Institute of Medicine, Food and Nutrition Board; 2005.

30. Swanson M. Digital photography as a tool to measure school cafeteria consumption. *J Sch Health*. 2008;78:432–437.

31. Martins Rodrigues AG, da Costa Proenca RP. Use of food images for evaluating food intake. *Revista de Nutrição – Brazilian Journal of Nutrition*. 2011;24:765–776.

32. Contento IR, Manning AD, Shannon B. Research perspective on school-based nutrition education. *J Nutr Educ*. 1992;24:247–260.

33. Liquori T, Koch PD, Contento IR, Castle J. The cookshop program: Outcome evaluation of a nutrition education program linking lunchroom food experiences with classroom cooking experiences. *J Nutr Educ*. 1998;30:302–313.

34. Bevan S, Vitale T, Wengreen H. Farm field trips provide sensory-based experiences with fresh, local produce. *J Nutr Educ Behav*. 2012;44:278–9.

35. Blair D. The child in the garden: An evaluative review of the benefits of school gardening. *J Environ Educ*. 2009;40:15–38.

36. Morris JL, Zidenberg-Cherr S. Garden-enhanced nutrition curriculum improves fourth-grade school children's knowledge of nutrition and preferences for some vegetables. *J Am Diet Assoc*. 2002;102:91–93.

37. Morgan PJ, Warren JM, Lubans DR, Saunders KL, Quick GI, Collins CE. The impact of nutrition education with and without a school garden on knowledge, vegetable intake and preferences and quality of school life among primary-school students. *Public Health Nutr*. 2010;13:1–10.

38. Nolan GA, McFarland AL, Zajicek JM, Waliczek TM. The effects of nutrition education and gardening on attitudes, preferences, and knowledge of minority second to fifth graders in the Rio Grande Valley toward fruit and vegetables. *Horttechnology*. 2012;22:299–304.

39. Somerset S, Markwell K. Impact of a school-based food garden on attitudes and identification skills regarding vegetables and fruit: A 12-month intervention trial. *Public Health Nutr*. 2009;12:214–221.

40. Cunningham-Sabo L, Lohse B. Cooking with kids positively affects fourth graders' vegetable preferences and attitudes and self-efficacy for food and cooking. *Child Obes*. 2013;9:549–556.

41. Hausner H, Olsen A, Moller P. Mere exposure and flavour-flavour learning increase 2-3 year-old children's acceptance of a novel vegetable. *Appetite*. 2012;58:1152–1159.

42. Anzman-Frasca S, Savag JS, Marini ME, Al E. Repeated exposure and associated conditioning promote preschool children's liking of vegetables. *Appetite*. 2012;58:543–553.

43. Lakkakula A, Geaghan JP, Wong W-P, Zanovec M, Pierce SH, Tuuri G. A cafeteria-based tasting program increased liking of fruits and vegetables by lower, middle and upper elementary school-age children. *Appetite*. 2011;57:299–302.

44. Taylor JC, Johnson RK. Farm to School as a strategy to increase children's fruit and vegetable consumption in the United States: Research and recommendations. *Nutr Bull*. 2013;38:70–79.

45. Cotugna N, Manning CK, DiDomenico J. Impact of the use of produce grown in an elementary school garden on consumption of vegetables at school lunch. *J Hunger Environ Nutr*. 2012;7:11–19.

46. McAleese JD, Rankin LL. Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents. *J Am Diet Assoc*. 2007;107:662–665.

47. Heim S, Stang J, Ireland M. A garden pilot project enhances fruit and vegetable consumption among children. *J Am Diet Assoc*. 2009;109:1220–1226.

48. Morris JL, Koumjian KL, Briggs M, Zidenberg-Cherr S. Nutrition to grow on: A garden-enhanced nutrition education curriculum for upper-elementary schoolchildren. *J Nutr Educ Behav*. 2002;34:175–176.

49. Baxter SD, Thompson WO. Fourth-grade children's consumption of fruit and vegetable items available as part of school lunches is closely related to preferences. *J Nutr Educ Behav*. 2002;34:166–171.

50. Kristal AR, Vizenor NC, Patterson RE, Neuhouser ML, Shattuck AL, McLerran D. Precision and bias of food frequency-based measures of fruit and vegetable intakes. *Cancer Epidemiol Biomarkers Prev*. 2000;9:939–944.

51. Burrows TL, Martin RJ, Collins CE. A systematic review of the validity of dietary assessment methods in children when compared with the method of doubly labeled water. *J Am Diet Assoc*. 2010;110:1501–1510.

52. Livingstone MBE, Robson PJ, Wallace JMW. Issues in dietary intake assessment of children and adolescents. *Br J Nutr*. 2004;92:S213–S222.

53. Gower JR, Moyer-Mileur LJ, Wilkinson RD, Slater H, Jordan KC. Validity and reliability of a nutrition knowledge survey for assessment in elementary school children. *J Am Diet Assoc*. 2010;110:452–456.

54. Domel SB, Baranowski HD, Leonard SB, Riley P, Baranowski J. Fruit and vegetable food frequencies by fourth and fifth grade students: Validity and reliability. *J Am Coll Nutr*. 1994;13:33–39.

Supplementary Table 4.1. Site Activity Participation by Prior F2S Exposure

	All	F2S Prior Exposure (Years)		
		0	1	2+
N, number of schools	9	2	2[1]	5
Farmers selling to district	7/9	1/2	2/2	4/5
Farmers visiting student classrooms	1/9	0/2	0/2	1/5
Classroom tastings	7/9	2/2	1/2	4/5
Cafeteria tastings	6/9	2/2	1/2	3/5
Local items on school lunch menu	8/9	2/2	2/2	4/5
Local items on school breakfast menu	6/9	2/2	1/2	3/5
Local items on after-school snack menu	2/9	0/2	0/2	2/5
Classroom F/V snacks	3/9	1/2	1/2	1/5
Field trips to farms	3/9	2/2	0/2	1/5
Classroom lessons	8/9	2/2	1/2	5/5
School garden	7/9	1/2	2/2	4/5
Information sent home to parents	7/9	2/2	1/2	4/5
Local foods fundraiser	2/9	0/2	0/2	2/5
USDA Fresh Fruit & Vegetable Program	2/9	1/2	0/2	1/5
Other	4/9	0/2	1/2	4/5

[1]Activity reports from 1 of these 2 schools were missing for 3 of 10 months.

Supplementary Table 4.2. Definitions of Very Low, Low, and Adequate FV Intake (FFQ)

	Fruit[1]		Vegetables[2]	
	Boys	**Girls**	**Boys**	**Girls**
Recommendation[1]	2.00 cups/day	1.75 cups/day	2.75 cups/day	2.50 cups/day
Upper bound of lower quartile	0.567		0.347	
Very Low intake	<0.57		<0.35	
Low intake	0.57 – 0.95	0.57 – 0.92	0.35 – 1.31	0.35 – 1.32
Adequate intake	≥ 0.95	≥ 0.92	≥ 1.31	≥ 1.32

[1] Units are cups/1000 kcal unless otherwise indicated

[2] Recommendations are based on USDA age- and sex-specific recommendations for FV intake according to estimated daily caloric requirements. Estimated caloric requirements are based on Dietary Reference Intakes of 1900 kcal/day for girls and 2100 kcal/day for boys.[28,29]

Supplementary Table 4.3. Academic Year Changes in Knowledge and Attitudes Survey Construct Scores[1]

KA Construct	Prior F2S, years	*n*	Baseline, Mean (SD)	Follow-up, Mean (SD)	Difference, Mean (SD)	*p*
Attitudes[3]	All	874	59.4 (11.5)	61.3 (11.7)	2.0 (9.9)	<.001
Range 20-80	0	166	55.9 (12.5)	57.2 (13.0)	1.3 (10.4)	.10
	1	193	58.4 (10.9)	61.0 (11.1)	2.6 (9.1)	<.001
	≥ 2	515	60.9 (11.1)	62.8 (11.1)	2.0 (10.0)	<.001
Knowledge[3]	All	888	11.7 (2.1)	12.3 (2.1)	0.6 (2.1)	<.001
Range 0-15	0	180	12.1 (1.9)	12.4 (2.4)	0.3 (2.1)	.06
	1	192	10.9 (2.1)	12.2 (2.1)	1.3 (2.2)	<.001
	≥ 2	516	11.8 (2.1)	12.3 (2.1)	0.5 (2.0)	<.001
Exposure[5]	All	859	16.6 (3.5)	17.2 (3.1)	0.6 (2.3)	<.001
Range 0-20	0	177	16.4 (3.4)	16.8 (3.2)	0.3 (2.1)	.03
	1	183	15.9 (3.4)	17.0 (3.2)	1.1 (2.4)	<.001
	≥ 2	499	16.8 (3.5)	17.4 (3.0)	0.6 (2.3)	<.001
Liking[5]	All	851	81.5 (15.7)	81.3 (16.11)	-0.2 (13.4)	.63
Range 0-100%	0	172	83.7 (13.8)	80.7 (15.8)	-3.0 (12.7)	.003
	1	183	81.2 (17.8)	81.1 (18.0)	-0.1 (15.4)	.92
	≥ 2	496	80.8 (15.5)	81.5 (15.5)	0.7 (12.7)	.22
Willingness[3]	All	854	17.9 (2.8)	18.3 (2.5)	0.4 (1.9)	<.001
Range 0-20	0	175	17.8 (3.1)	17.9 (2.8)	0.2 (2.1)	.31
	1	183	17.6 (2.8)	18.3 (2.7)	0.7 (2.1)	<.001
	≥ 2	496	18.1 (2.7)	18.5 (2.3)	0.4 (1.7)	<.001

[1] All values in this table were determined by matched-pairs t-tests and are, therefore, unadjusted.

Supplementary Table 4.4. Changes in Adjusted Mean FV Items, Cups Available, and Cups Disappeared, by Prior Years in F2S (LTPO[1]), Without Adjustment for Education to Assist Students in Serving Themselves from the Salad Bar

	Prior F2S, years	*n*[2] pre, post	Baseline[3]	Difference, Mean (SD)[4]	*p*[4]
Number of items available[3]	**All**	2296, 2155	1.4 (0.9)	0.1 (1.0)	<.001
	0	573, 557	1.2 (0.4)	-0.0 (0.9)	.99
	1	521, 497	1.8 (0.4)	0.3 (0.8)	<.001
	≥2	1202, 1101	1.5 (0.3)	0.1 (1.0)	.001
Amount available, cups[3]	**All**	2295, 2155	0.54 (0.42)	-0.02 (0.44)	.06
	0	572, 557	0.43 (0.17)	0.02 (0.48)	.51
	1	521, 497	0.72 (0.18)	-0.04 (0.40)	.03
	≥2	1202, 1101	0.65 (0.12)	-0.03 (0.43)	.07
Amount disappeared, cups[3]	**All**	2296, 2155	0.38 (0.36)	-0.01 (0.37)	.14
	0	573, 557	0.28 (0.11)	0.02 (0.35)	.36
	1	521, 497	0.52 (0.11)	-0.02 (0.42)	.16
	≥2	1202, 1101	0.44 (0.08)	-0.02 (0.36)	.10

[1] Lunch Tray Photo Observation

[2] Number of trays

[3] The *All* category is presented as means (SD). Prior F2S year groups are presented as LS Means (SE) with adjustments for grade, %FRPL, and school (random effect); Tukey's adjustment for multiple comparisons.

[4] Differences and significances calculated by T-test (follow-up minus baseline).

[a,b,c] Significant differences ($p<0.05$) within each variable and time point are indicated by different superscripts. Differences within baseline and follow-up time-points were assessed using mixed modeling. See adjustments in note 3 above.

Supplementary Table 4.5. Changes (Unadjusted) in Percent of Trays with Varying Levels of FV Variety, and Amounts Available and Disappeared (LTPO[1])

	n[2] (pre, post)	Baseline			Follow-up			*p*[3]
Number of FV items available		**0**	**1-2**	**>2**	**0**	**1-2**	**>2**	
All	2296, 2155	16.7	73.4	9.8	13.7	71.5	14.9	<.001
0	573, 539	34.0	60.2	5.8	30.4	64.8	4.8	.14
1	521, 497	1.9	86.8	11.3	0.4	74.5	25.2	<.001
≥2	1202, 1103	14.9	74.0	11.2	12.5	72.9	14.6	.002
Total FV cups available		**0**	**>0, < ½**	**≥ ½**	**0**	**>0, < ½**	**≥ ½**	
All	2295, 2155	16.7	24.1	59.1	15.4	39.9	44.7	<.001
0	572, 539	34.1	25.4	40.6	30.6	35.3	34.1	.001
1	521, 497	1.9	11.5	86.6	0.4	40.4	59.2	<.001
≥2	1202, 1103	14.9	29.0	56.1	13.6	42.3	44.2	<.001
Total FV cups consumed		**0**	**>0, < ½**	**≥ ½**	**0**	**>0, < ½**	**≥ ½**	
All	2296, 2155	24.1	37.9	38.0	22.8	48.8	29.0	<.001
0	573, 539	39.1	36.8	24.1	36.6	42.3	21.2	0.18
1	521, 497	14.0	30.9	55.1	11.9	51.9	36.2	<.001
≥2	1202, 1103	21.3	41.4	37.3	19.0	51.0	30.0	<.001

[1] Lunch Tray Photo Observation

[2] Number of trays

[3] Within-group change across the year, determined by Chi-squared test of proportions.

Supplementary Table 4.6. Academic Year Changes in Reported Fruit and Vegetable Intakes[1] (FFQ)

	Prior F2S, years	N	Baseline[2]	Difference[2]	*P*[3]
Fruit,	**All**	**305**	**1.18 (0.79)**	**-0.04 (0.85)**	.42
cups per 1000 kcal[4]	0	52	1.10 (0.12)[ab]	0.14 (0.14)	.09
	1	43	0.87 (0.12)[a]	0.13 (0.13)	.33
	≥2	210	1.26 (0.05)[b]	-0.11 (0.06)	.03
Vegetables,	**All**	**305**	**0.67 (0.49)**	**-0.01 (0.49)**	.65
cups per 1000 kcal[4]	0	52	0.73 (0.11)	-0.11 (0.08)	.17
	1	43	0.51 (0.14)	0.07 (0.08)	.41
	≥2	210	0.72 (0.06)	-0.01 (0.03)	.72

[1] Outliers were defined on the basis of reported caloric intake (<500 and >3500 kcal) and excluded from analysis. Only pre/post matched-pairs data are included.

[2] Baseline and Difference means for Group "All" are unadjusted means (SD). When broken down by prior F2S program exposure, reported intakes are presented as LS Means (SE).

[3] Differences tested by PROC TTEST determined to be significant at $p<0.05$.

[4] Controlling for sex, %FRPL, and school (random effect), with Tukey's adjustment for multiple comparisons.

[a,b] Significant differences(within time point) as determined by mixed modeling (with adjustments described in note 2 above) at $p<0.05$.

Supplementary Table 4.7. Fruit and Vegetable Intake According to Levels of Intake at Baseline[1] (FFQ)

	Intake Level[2]	N (baseline)	Baseline Mean (SD)	Difference Mean (SD)	*p*[3]
Fruit, cups per 1000 kcal	Very Low	76	0.34 (0.15)	0.46 (0.65)	<.001
	Low	59	0.74 (0.10)	0.25 (0.56)	.001
	Adequate	168	1.71 (0.66)	-0.36 (0.88)	<.001
Vegetables, cups per 1000 kcal	Very Low	170	0.48 (0.32)	0.04 (0.37)	.14
	Low	120	0.73 (0.65)	0.01 (0.49)	.78
	Adequate	13	2.34 (0.87)	-1.00 (0.86)	.001

[1] All students were 4th graders. Outliers were defined on the basis of caloric intake reported (<500 and >3500 kcal) and excluded from analysis. Only pre/post matched pairs data are included.

[2] See table of definitions of Very Low, Low, and Adequate, Supplementary Table 4.2.

[3] Change from Baseline to Follow-up among students who reported < or ≥ the Fruit/Vegetable recommendation were calculated by matched-pairs T-test.

Supplementary Table 4.8. Percent of Students with Varying Levels of Fruit and Vegetables Intake (FFQ)

Prior F2S, years	N	Baseline			Follow-up			p^2
		Very Low	Low	Adequate	Very Low	Low	Adequate	
Fruit[1]	**All (305)**	**25.1**	**19.5**	**55.5**	**23.4**	**21.5**	**55.1**	<.001
0	52	21.6	33.3	45.1	15.7	27.5	56.9	.008
1	43	39.5	16.3	44.2	39.5	18.6	41.9	<.001
≥2	210	23.0	16.8	60.3	22.0	20.6	57.4	<.001
Vegetables[1]	**All (305)**	**56.1**	**39.6**	**4.3**	**24.8**	**66.7**	**8.6**	<.001
0	52	58.8	41.2	0.0	31.4	58.8	9.8	.01
1	43	58.1	41.9	0.0	30.2	65.1	4.7	.09
≥2	210	55.0	38.8	6.2	22.0	68.9	9.1	<.001

[1] Intake levels based on reported intake in cups/1000 kcal (see Supplementary Table 2)

[2] Differences between distributions at baseline and follow-up, determined by chi-squared test of proportions.

Chapter 5. Factors Affecting Fruit and Vegetable School Lunch Waste in Wisconsin Elementary Schools Participating in Farm to School Programs

Introduction

The prevalence of obesity among children and adolescents has grown over the past three decades, recently reaching 17%,[1–3] over half of the adult obesity prevalence rate, which stood at nearly 36% in 2009-2010.[3] Obesity and related comorbidities have public health as well as economic implications.[4,5] Because of this high prevalence, public health personnel and medical professionals emphasize the importance of consuming a healthy diet.[6] Few children meet FV consumption recommendations.[7] One strategy hypothesized to help achieve this is improving the quality of school meals. These efforts include promoting increased consumption of low-energy-density foods such as fruits and vegetables (FV), which, on the basis of high water and fiber content, alongside their low fat content, collectively yield larger bulk and low energy density. Although the positive effects of low-energy-dense food have been demonstrated in adults,[8] the data are somewhat inconsistent, particularly among children.[9,10] A recent study found trends toward lower rates of BMI gain in children with increasing fruit consumption, but higher rates with increasing vegetable consumption, although both results were nonsignificant.[11]

While many factors influence dietary preferences and habits, encouraging children to consume recommended amounts of FV is often part of programming conducted in schools.[12–18] Schools are common intervention site for studies in children, due to their large, representative populations.[19] Schools have the potential to reach across multiple levels of the socio-ecological model:[20] individual, interpersonal, organizational, and community touchpoints are all feasible within school-based interventions. One specific program, farm to school (F2S), aims to increase children's FV consumption through nutrition and agriculture education and experiential learning activities, and simultaneously to support local farmers by promoting local food purchasing.[21] More importantly, it is one of the specific

strategies cited by the Centers for Disease Control (CDC) as having potential to increase healthy food access and FV consumption.[22]

The potential for schools to impact children's dietary choices has been further enhanced through passage of the Healthy, Hunger-Free Kids Act (HHFKA), which requires increased FV on students' school lunch trays.[23] This law does not directly address, however, strategies to improve consumption, leading to questions of whether increased FV availability for children translates to increased intake, or increased waste. It is possible that increased FV availability will lead to financial losses for school food service authorities due to food waste – certainly an important consideration in the face of tight budgets. Finding ways to serve the required FV that will appeal to students such that they eat them, thereby not wasting the increased federal school meal reimbursement amount, is important.

Few previous studies have investigated waste of FV items specifically; most focus instead on consumption.[16,24–26] Two groups assessed plate waste according to broad factors (food groups) in children, finding that both FV were wasted at high percentages.[27,28] Others have studied school lunch waste and associated costs, or factors associated with children's FV consumption.[29,30] One study assessed the financial implications of food waste throughout the food chain.[31] This study aims to evaluate factors, identifiable either from digital photographs or from communication with food service staff, associated with FV waste from student school lunch trays in schools involved in F2S programs. Moreover, this study examines whether F2S, a nutrition intervention aimed at increasing FV intake, can reduce FV waste over time, and whether implementation of the HHFKA changed waste at F2S sites.

Experimental methods

Recruitment and design.

This study was part of a larger evaluation of Wisconsin F2S programs' effectiveness in improving students' dietary knowledge, attitudes, and behaviors with respect to FV consumption; the complete evaluation protocol was reviewed by the [University of Wisconsin-Madison Institutional Review Board]

and determined to be exempt. This project comprised secondary analysis of lunch trays from third-, fourth-, and fifth-graders in 11 Wisconsin schools. Data was collected in fall 2010 (n=8 schools), spring 2011 (n=8 schools), fall 2011 (n=6 schools), spring 2012 (n=3 schools), and spring 2013 (n=7 schools). A total of 320 third-grade, 1028 fourth-grade, and 529 fifth-grade students were enrolled in the schools at the times of data collection, but student identity was not connected to tray photographs. Each period of data collection contributed to this multi-year cross-sectional observational study.

Data collection.

At each data collection time, digital photographs were taken at lunchtime for four days, which were usually consecutive days, but all schools completed this within a two-week period. Data collection was performed by AmeriCorps members implementing F2S programming at the participating schools and recruited volunteers (fall 2010 through spring 2013, n=8 schools) or by staff from local coalitions working to implement F2S at the school and recruited volunteers (spring 2013 only, n=3 schools). Trays were numbered to permit before- and after-meal pairing for side-by-side comparison. Grade was identifiable from tray numbers if multiple grades within a school had a shared lunch time, with the exception of three schools in fall 2010. At some schools, tray numbers matched de-identified evaluation ID numbers that permitted data linkage with other evaluation measures. The number of trays from each school (each day) varied by the number of children in attendance and taking school lunch, as well as by exclusions of any incomplete data points (such as missing or blurry photographs) applied during analysis, as further described elsewhere.[32] In total, 7,117 trays were analyzed.

Data analysis.

One assessor visually examined each pair of before-/after-meal tray photographs, and recorded the date, tray number, food items, serving sizes, and percent remaining for each item on each tray. Serving sizes were reported in cups; percent remaining was generally estimated in 25% increments.

Amounts wasted were calculated as serving size multiplied by percent remaining. Others have found visual assessments of foods based on digital photographs to be reliable.[33–36]

FV items were excluded if a tray lacked either a before- or after-meal photograph, if the photograph quality was too poor (unfocussed) to ascertain the necessary data, or if the FV item was considered 'masked' (e.g., broccoli in heavy cheese sauce; banana bread; jellied cranberry sauce, or gelatin-based fruit dishes). In total, 1,132 total FV items were excluded from analysis. Following these exclusions, 11,420 FV items remained for waste analysis. FV item waste volume (cups) and percent waste were calculated from the original visual-analysis values of serving size and percent eaten.

Each item was categorized as fully as possible for the following variables: (a) farm to school-related variables: prior years of programming in a school, service line placement (main menu item or salad bar; where known), and purchase source (local or conventional), and (b) item-specific characteristics: item type (fruit or vegetable), preparation method (cooked/canned versus fresh/raw), menu component type (entrée, side dish, or topping [e.g., tomato slice or lettuce on a sandwich]), and whether an item had been reported as tried or not, and (if reported as tried) liked or not. Items' factor-level characterizations were assigned by first using information gleaned directly from the photographs, then verified by examining school lunch menus; this mostly yielded factor information for preparation and item types, service line placement, and menu component. Additional follow-up with food service staff or evaluation site personnel (who had established relationships with school food service staff) was conducted by phone or email to collect information about food procurement sourcing.

For the item-specific tried/liked factor data, data from a student Knowledge and Attitudes survey (KA) also administered in the same semesters as part of the F2S evaluation were incorporated into the analysis. Specifically, on the survey, students were asked whether they had tried 20 (fall 2010 through spring 2012) or 26 (spring 2013) specific FV items, and if they reported having tried an item, whether they liked it. Where the items matched a FV item on school lunch trays, students' survey responses were incorporated as additional categorical variables "tried" (yes/no) and, if tried, "liked" (yes/no). Twenty-one unique items appeared on both the survey and lunch trays. Students' survey responses were

incorporated for analysis when one of those 21 FV items appeared on an individual student's tray in the same semester for which that same individual completed a KA survey (n=783 items).

Statistical analysis.

All statistical analyses were performed using Statistical Analysis Software package version 9.2 (SAS Institute, Inc., Cary, NC, USA) using a significance level of p=0.05. Descriptive statistics were performed to obtain means and standard deviations for each factor overall and by semester. Due to non-normal distributions, statistical significance was determined using the Tobit model (in SAS, the QLIM procedure), which is useful for data sets with differing distributions, in particular data where a high proportion of outcome data is "0" (in this case, the amount of waste for a given item, observed in approximately 55% of item observations).[37] In tables, sample sizes represent individual FV items, rather than the number of trays or students. All models were adjusted for students' grade to account for presumed differences in body sizes (growing children) and their accompanying nutritional/energy needs because the Pearson correlation coefficient between cups wasted and grade trended toward significance (p=0.11, r=0.015). Relationships with waste were investigated according to the factors described above. Grade-adjusted Tobit modeling was also used to assess differences in FV item waste before (fall 2010) and after (spring 2013) implementation of the HHFKA.

Results

Table 5.1 shows overall student and site characteristics, both overall and by semester. For the first academic year (fall 2010, spring 2011), a total of 845 students could have participated based on the number of students in the participating grades from participating schools. This would have yielded 6,760 unique trays had 100% of students participated in the National School Lunch Program (NSLP) and all photographs been accepted. Instead, NSLP participation averaged 73% [32], which would have yielded 4,959 trays; we obtained 4,462 trays, or 90% of those possible based on NSLP participation. Across all

data collection times, we obtained a total of 7,117 trays from 1,877 students. Based on NSLP participation we would have expected 7,508 trays, and thus we obtained 95% of expected trays. Seventeen percent of trays came from third-graders, 43% from fourth-graders, and 21% from fifth-graders. Due to common lunch times, an additional 4% and 14% were indistinguishable between 3^{rd}-4^{th} grades and 4^{th}-5^{th} grades respectively. Overall, 54% of students in participating grades/schools were male and 79% were Caucasian. Schools' prior years of F2S programming ranged from 0 to 5 years; 18% of trays came from schools with no prior programming at the start of the school year in which the LTPO was conducted, 23%, 27%, 18%, 9%, and 5% came from schools with 1, 2, 3, 4, and 5 prior years, respectively.

The mean ± SD FV serving size as items appeared on students' trays was 0.38 ± 0.26 cups (Table 5.2). From this, 0.27 ± 0.23 cups disappeared (and were assumed consumed), leaving an average of 0.11 ± 0.19 cups uneaten, or wasted (27% ± 36%). FV serving size and consumption both significantly correlated with grade ($p \leq 0.02$), and FV cups wasted trended toward a significant correlation ($p=0.11$). For all three of these variables, grade explained less than 1% of the variance.

Farm to School related factors

When examining FV waste according to prior years of F2S programming, there were few significant differences between groups, with the exception of new F2S sites having more FV waste than sites with at least one prior year of programming; the scatter within each prior-year group varied substantially (Figure 5.1; Table 5.3).

Two frequent components for a school F2S program include (a) implementation of a salad bar in the school lunch program, and (b) purchasing foods from local farmers for use in school meals. Therefore, we examined waste outcomes (separately) according to items' classifications as (a) appearing on the main menu versus on the salad bar, and (b) being identified by school food service staff as being purchased locally versus conventionally (Table 5.4). Overall, items from the salad bar were wasted at a higher amount than items from the main menu, but only by 0.01 cups ($p<0.0001$). Following

Table 5.1. Subject Characteristics

Characteristic	N or Percent
N, Trays	7,117
N, Items	11,420
N, students[a]	1,877
3rd grade[b]	17.3%
3 & 4[c] (indistinguishable)	3.7%
4th grade[b]	43.3%
4 & 5[c] (indistinguishable)	14.2%
5th grade[b]	21.4%
Sex, % male[a]	54.0%
Ethnicity, %[a]	
Caucasian	78.7%
Native American	12.0%
African-American	2.7%
Asian-American	2.9%
Hispanic	2.8%
Other	0.9%
Prior years in F2S[a]	
0	18.0%
1	22.9%
2	26.8%
3	18.4%
4	8.9%
5	5.1%
Percent of students eligible for FRPL[d]	49.1%
Percent of students participating in NSLP[d]	65.7%

Abbreviations: FRPL, free/reduced-price lunch; NSLP, National School Lunch Program.

[a] Based on total school level data. Actual participation may have varied slightly.

[b] Based on students known to have at least one tray in the LTPO at collection time (i.e., where tray number matched de-identified student evaluation ID).

[c] In Fall 2010 there were 3 schools (and in Spring 2011 there was 1 school) where two grades ate lunch at the same time and it was not possible to separate the grades.

[d] Based on information available at the district level through the Department of Public Instruction.[32]

Table 5.2. Waste of Fruits and Vegetables According to Grade

Characteristic	N, items	Serving size (cups), Mean ± SD	Cups Eaten, Mean ± SD	Percent Wasted, Mean ± SD	Cups Wasted, Mean ± SD
ALL	**11,420**	0.38 ± 0.26	0.27 ± 0.23	27% ± 36%	0.11 ± 0.19
Grade					
3	2,055	0.35 ± 0.21	0.26 ± 0.21	27% ± 37%	0.10 ± 0.17
3 & 4[a]	597	0.32 ± 0.22	0.24 ± 0.21	22% ± 34%	0.07 ± 0.14
4	5,028	0.39 ± 0.27	0.28 ± 0.24	28% ± 37%	0.12 ± 0.20
4 & 5[a]	993	0.40 ± 0.29	0.27 ± 0.23	27% ± 34%	0.13 ± 0.21
5	2,746	0.37 ± 0.27	0.27 ± 0.25	26% ± 35%	0.10 ± 0.18
Pearson correlation coefficient, column vs grade		0.030	0.022	0.001	0.015
p (correlation)		0.001	0.02	0.91	0.11

[a] In Fall 2010 there were 3 schools (and in Spring 2011 there was 1 school) where two grades ate lunch at the same time and it was not possible to separate the grades.

Figure 5.1. School Lunch Fruit and Vegetable Waste Volume, by Prior Years of Farm to School Programming.

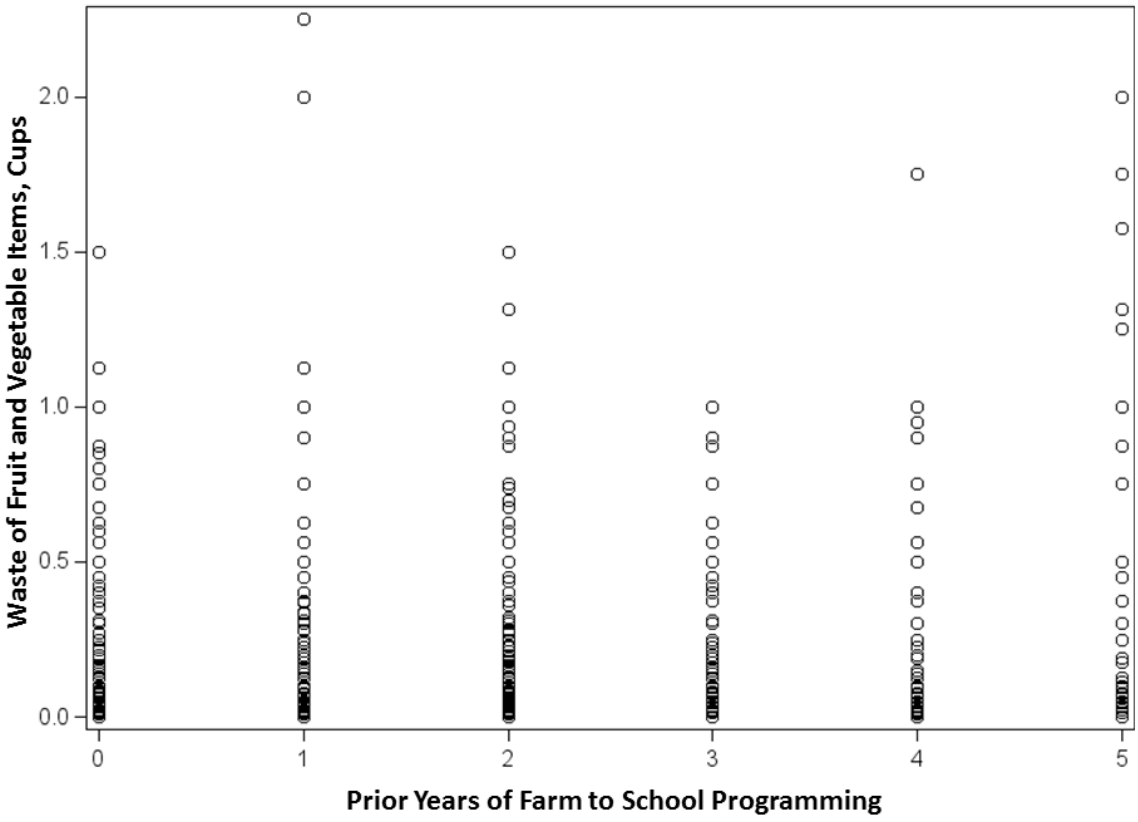


Table 5.3. Waste (Cups) of Fruits and Vegetables According to Prior Years of Farm to School

Characteristic	Number of Items	Serving Size, Cups	Cups Eaten	Percent Wasted	Cups Wasted
Prior F2S years		*mean ± SD*			
0	2,057	0.37 ± 0.27	0.25 ± 0.24	30% ± 37%	0.12 ± 0.20[a]
1	2,618	0.39 ± 0.26	0.28 ± 0.25	28% ± 38%	0.11 ± 0.18
2	3,057	0.36 ± 0.24	0.27 ± 0.22	24% ± 34%	0.09 ± 0.15[†]
3	2,102	0.37 ± 0.24	0.26 ± 0.21	27% ± 36%	0.11 ± 0.19
4	1,016	0.39 ± 0.27	0.26 ± 0.21	26% ± 35%	0.12 ± 0.23
5	578	0.45 ± 0.34	0.35 ± 0.32	21% ± 35%	0.11 ± 0.23[REF]

[a] Mean values within a column with unlike superscript letters were significantly different from reference value ([REF]), $p<0.05$. Significance assessed by Tobit model, adjusted for grade.

[†] Mean values within a column followed by [†] indicates $0.05<p<0.10$ with respect to reference value ([REF]). Significance assessed by Tobit model, adjusted for grade.

Table 5.4. Waste (Cups) of Fruits and Vegetables According to Farm to School-Related Characteristics: Salad bar, Item source

Characteristic	Number of Items	Serving Size, Cups	Waste, Cups			*P*, pre/post HHFKA
			Overall	Fall 2010 (Pre-HHFKA)	Spring 2013 (Post-HHFKA)	
Item Placement		----------*mean ± SD*----------				
Main menu	9608	0.38 ± 0.25	0.11 ± 0.19[a]	0.11 ± 0.17	0.09 ± 0.18	**
Salad bar	1284	0.37 ± 0.34	0.12 ± 0.21[b]	0.07 ± 0.12	0.15 ± 0.25	***
Item Source[1]						
Conventional	6512	0.35 ± 0.21	0.09 ± 0.15[c]	0.09 ± 0.24	0.09 ± 0.16	**
Local	373	0.61 ± 0.42	0.24 ± 0.30[d]	0.24 ± 0.30	0.20 ± 0.31	***

Abbreviations: HHFKA, Healthy, Hunger-Free Kids Act; SD, Standard Deviation.

[a,b,c,d] Mean values within a column (and within a factor) with unlike superscript letters were significantly different ($P<0.05$). Significance assessed by Tobit model, adjusted for grade.

Within-row mean values post-HHFKA were significantly different from pre-HHFKA: * $P<0.05$, ** $P< 0.01$, *** $P<0.001$. Significance assessed by Tobit model, adjusted for grade.

implementation of the HHFKA, waste of main-menu FV items further decreased by 0.02 cups, while waste of salad bar FV items increased by 2-fold ($p<.0001$).

Relatively few items were able to be definitively classified as locally- or conventionally-sourced due to incomplete reporting on this factor in two of the periods. Therefore, only fall 2010, spring 2011, and spring 2013 items were included in this analysis. Of these, an average of 5% of items were identified as locally sourced. Overall, locally-sourced items were wasted at a much higher amount than conventionally-sourced items ($p<0.0001$); however, waste of locally-sourced items decreased after implementation of the HHFKA by 0.04 cups ($p<.0001$); conventionally-sourced items also were statistically different after adjusting for grade.

Item-specific characteristics.

Fruits were wasted at a higher volume than vegetables (0.02 cups, $p=0.0003$; Table 5.5). Following implementation of the HHFKA, vegetable waste changed (no numerical difference, but $p=0.006$), but the observed increase in fruit waste only trended toward significance (+0.08 cups, $p=0.2$).

Because of the observed differences in FV items overall, we examined the next factor, preparation type, separately for fruits and vegetables (Table 5.5). This showed that fresh fruits were wasted at higher amounts than cooked (0.07 cups, $p=0.0008$). The opposite was true for vegetables: raw vegetables were wasted at lower amounts than cooked (-0.02 cups, $p=0.07$). Of these preparation types, only waste of fresh/raw fruit changed after implementation of the HHFKA (+0.04 cups, $p<.0001$).

Another factor of interest, termed 'meal component,' indicated whether FV items appeared within a meal as part of an entrée, as a side dish, or as a topping (e.g., lettuce or tomato on a sandwich) (Table 5.5). FV as entrée components were wasted at a higher amount than both side dishes and toppings (0.16 cups, 0.11 cups, and 0.05 cups respectively, all $p<0.0001$, both without and with adjusting for Grade). Only waste of toppings changed post-HHFKA implementation (-0.03 cups, $p<.0001$).

To provide greater detail for this cohort, we ranked items according to cups wasted (data not shown). Items with the least waste volume were hash browns, onion, green pepper, strawberries,

Table 5.5. Waste of Fruits and Vegetables According to Item Characteristics

Characteristic	Number of Items	Serving size, Cups	Waste, Cups			*P*, pre/post HHFKA
			Overall	Fall 2010 (Pre-HHFKA)	Spring 2013 (Post-HHFKA)	
Item type		----------*mean ± SD*----------				
Fruit	5,253	0.41 ± 0.24	0.12 ± 0.21[a]	0.11 ± 0.18	0.13 ± 0.21	0.19
Vegetable	6,174	0.35 ± 0.27	0.10 ± 0.17[b]	0.09 ± 0.15	0.09 ± 0.17	**
Preparation type						
Fruit – cooked	2,818	0.36 ± 0.14	0.09 ± 0.15[c]	0.10 ± 0.16	0.10 ± 0.15	0.09
Fruit – raw	2,225	0.46 ± 0.32	0.16 ± 0.26[d]	0.13 ± 0.21	0.17 ± 0.28	***
Vegetable – cooked	2,739	0.38 ± 0.24	0.11 ± 0.17[e]	0.12 ± 0.17	0.09 ± 0.13	0.20
Vegetable – raw	2,977	0.30 ± 0.28	0.09 ± 0.17[e†]	0.07 ± 0.12	0.11 ± 0.22	0.85
Meal Component						
Entrée	718	0.57 ± 0.36	0.16 ± 0.24[d]	0.14 ± 0.21	0.09 ± 0.16	0.21
Side dish	9,855	0.38 ± 0.25	0.11 ± 0.19[e]	0.10 ± 0.16	0.11 ± 0.20	0.38
Topping	854	0.23 ± 0.19	0.05 ± 0.11[f]	0.06 ± 0.08	0.03 ± 0.08	***
Among items reported tried:						
Liked	733	0.35 ± 0.30	0.13 ± 0.23	0.10 ± 0.15	0.11 ± 0.20	**
Not liked	30	0.25 ± 0.14	0.10 ± 0.13	0.17 ± 0.16	0.06 ± 0.08	0.20

Abbreviations: HHFKA, Healthy, Hunger-Free Kids Act; SD, Standard Deviation.

[a,b,c,d,e,f] Mean values within a column (and within a characteristic) with unlike superscript letters were significantly different ($P<0.05$).

[†] Mean values within a column followed by [†] indicates $0.05<p<0.10$ relative to the corresponding factor characteristic.

Within-row mean values post-HHFKA were significantly different from pre-HHFKA: * $P<0.05$, ** $P< 0.01$, *** $P<0.001$.

All statistical significances assessed by Tobit model, adjusted for grade.

tomatoes, kohlrabi, radishes, cucumbers, cauliflower, and celery. Although the cups wasted were all less than one tablespoon, the percent wasted varied from nearly 40% (tomatoes) to just 3% (hash browns) because of differences in the amounts placed on the tray. Items with the highest waste volume included mashed potatoes, steamed mixed vegetables, lettuce, roasted potatoes, coleslaw, romaine lettuce, asparagus, unsweetened applesauce, spinach (raw), and canned mixed vegetables. The cups wasted ranged from just under one-eighth to just over one-quarter of a cup, and the percent wasted varied from 20% (mashed potatoes) to just over 50% (asparagus).

For tray items that could be matched to items appearing on the KA survey, we also investigated waste according to whether a student reported having tried the item when it also appeared on their lunch tray, and, if tried, whether the item was reported as liked or not. Twenty-one tray items matched survey items by name, nineteen of which could be matched when appearing on a student's tray in the same semester that the same student also completed the KA survey (n=783 FV items). Too few items were reported as 'not tried' to permit formal analysis (n=17 overall; n=2 fall 2010, n=4 spring 2013) in comparison with items reported as 'tried' (n=763). Among items reported as tried, there was no difference in waste volume between items further differentiated as 'liked' and 'not liked' (Table 5.5). However, liked FV items increased in waste (+0.01 cups) after HHFK, whereas items reported as not liked trended towards decreased waste (-0.11 cups, p=0.2).

Discussion

We found that a variety of characteristics used to describe specific FV items are associated with FV waste volume from students in schools participating in Wisconsin F2S programs. Specifically, we found that a greater volume of fruits were wasted than vegetables, and that FV waste varied according to preparation method (raw/cooked). FV items appearing on the salad bar were wasted more than items from the main menu. FV items sourced conventionally were wasted less than items sourced locally, and entrée and side-dish FV items were wasted at higher volumes than toppings (e.g., on sandwiches,

burritos). Finally, we found that items reported as tried and not liked were not wasted differently from items tried and liked.

The differences in waste volume observed within factors in this study are small, yielding further credit to our previous/separate findings relative to minimal changes in energy intake on the basis of FV energy intake.[38,39] For perspective, 0.0625 cups is equal to 1 tablespoon, estimated at approximately two bites for a child. The greatest within-factor difference observed was 0.15 cups, while the smallest was 0.01 cups. Again, these differences may seem nominal, but their application to the school scale yields potential for substantial financial meaning. It is important to note, however, that a "clear your plate" mentality is not consistent with obesity prevention strategies that are based on children learning to stop eating when sated.[40–42] F2S programming focuses on encouraging a willingness to try new foods, even the unfamiliar, by cultivating experiential knowledge, and it fosters healthy eating by teaching nutritional concepts. F2S programming does not inherently focus on improving waste, although we did observe a slight decrease in waste commensurate with time in program.

If students do not consume what is served, the menu may not be achieving the goals of improving health. The importance of increased FV consumption for overall health benefits are well-documented.[8–10,43–45] Thus, it is important for schools to find ways to encourage increased FV consumption, and this is one goal of F2S programs. In this regard, the findings that canned and other processed fruits were wasted less than fresh, and that fresh/raw vegetables were wasted less than cooked are important to consider when making choices to minimize waste while not using a "clean your plate" approach. This factor alone could be transformative in school lunch programs, since more fresh vegetables could potentially be served and yield less waste; however, short fresh produce shelf-life is a mitigating factor in the feasibility of such an approach. Among the few existing FV waste-related studies in children, other groups have variously found that fruits were wasted less than vegetables,[28] or that both fresh and canned fruits were wasted more than vegetables.[27]

These results may help guide school food service directors as they make decisions about menu items and their preparation, service line placement, and sourcing. Obviously, wasted food translates to

financial loss for the food service authority, an important consideration in a tight economy. As a specific example, replacing cooked mixed vegetables (an item wasted at high volume) with fresh tomatoes (an item with low waste volume) on just one day in a school where 200 students took school lunch, 20 cups (40 half-cup servings) of wasted vegetables could be avoided. The recent HHFKA implementation mandated that students have more FV on their lunch trays in order for meals to qualify as reimbursable.[23] The economic implications, although not addressed in this study, have the potential to warrant consideration when applied at the national level.

A surprising observation was the lack of difference between FV items reported as tried and liked relative to those tried and not liked. Here, we speculate that this may indicate that F2S programming is modulating students' willingness to actively re-try FV previously not liked in the school setting. On the other hand, it is also possible that these results are confounded by differences in serving sizes for both of these cases (tried and liked, 0.35 cups; tried and not liked, 0.25 cups).

FV item sourcing, another F2S-related factor, showed higher waste of locally-sourced than conventionally-sourced items. In the context of F2S programming, this is another surprising result. Anecdotally, it may be related to food preparation or packaging: one food service director reported that many students expect their food to arrive in packages and/or pre-cut forms, which is less likely to be the case for locally-procured produce. It also may be due to serving size differences, as there was nearly a two-fold difference in serving sizes (0.35 cups conventional versus 0.61 cups local). Again in the context of F2S and the idea of a salad bar being an opportunity for student to apply knowledge of healthy dietary behaviors and improved attitudes towards eating FV, the finding of higher FV waste volume for salad bar items than for main menu items was surprising; however, it agrees with previous findings that the presence of a salad bar is not associated with greater FV consumption.[24] As suggested above, the presentation or preparation of salad bar items may be less familiar than items appearing on the main menu. In this case, it is not likely due to differences in serving sizes as main menu and salad bar FV items were not different.

The differences in meal-component factor FV waste were expected, given the differences in serving sizes. They do, however, suggest that "toppings" items could be a valuable way to increase student FV consumption, particularly vegetables, in school lunch. Although "toppings" in this study largely encompassed those for sandwiches or tacos, it could be extended to other ideas, such as create-your-own (veggie) pizza, baked potato bars, or pasta bars.

Results pertaining to HHKFA implementation were mixed across factors. Therefore, our data show uniform evidence for neither increased nor decreased FV waste following HHFKA implementation. Others have found that the HHFKA has yielded healthier school meals,[46,47] but that children's school lunch consumption rarely meets NSLP standards.[27] To our knowledge, no other groups have assessed factors relating to FV waste to this degree, particularly in a pre-/post-HHFKA comparison, nor in a F2S setting.

This study is limited by the inability to fully characterize each FV item according to each factor. Specifically, it was not always possible to ascertain whether items were sourced from a local producer or through conventional purchasing practices due to insufficient details provided from schools at the time of data collection. Data collection times preceded this secondary analysis (with the exception of May 2013) and it was not feasible to collect retrospective procurement records from schools at the time of this study due to limited time on the part of school food service and evaluation staff, and a lack of budget to provide any sort of participation incentive. The ability to relate data from the student survey pertaining to students' exposure ("tried") and liking ("liked") of specific FV items is also limited by the relatively small number (7%) of FV items assessed by the survey that also appeared on lunch trays within the same semester that a student completed the survey. Additional factors may be helpful in further assessing FV waste factors that were not measured here, including consumption/waste of other lunch items, timing of the lunch period (total length of time, average time available after obtaining lunch tray, whether recess is before or after lunch, and what time the lunch period begins), and whether an item was preferentially selected for tray placement or if the child was served the FV item without choice. Nevertheless, this study offers substantial information both in terms of specific factors assessed and in terms of the time-

sensitive assessment of waste before and after HHFKA implementation, as well as waste within the context of F2S programming.

Future studies would be strengthened by adding additional factors to the analysis, or testing the differences specifically of any of these factors by offering both options of one F/V item within a factor in the same meal, such as offering both cooked and raw broccoli, or whole and cut apples. Additional research rigor could be added by weighing a sub-sample of trays. The question of economics in a school food service setting should also be addressed by obtaining cost information for FV items assessed.

Chapter 5 References

1. Ogden CL, Carroll MD, Curtin LR, Lamb MM, Flegal KM. Prevalence of high body mass index in US children and adolescents, 2007-2008. *JAMA*. 2010;303(3):242–249.

2. Ogden CL, Carroll MD, Kit B, Flegal. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *JAMA*. 2012;307(5):483–490.

3. Ogden CL, Carroll MD, Kit BK, Flegal KM. *Prevalence of obesity in the United States, 2009-2010.*; U.S. Department of Health and Human Services,Centers for Disease Control and Prevention, National Center for Health Statistics. 2012:1–8. Available at: http://www.ncbi.nlm.nih.gov/pubmed/22617494.

4. Finkelstein EA, Strombotne KL. The economics of obesity. *Am J Clin Nutr*. 2010;91(Suppl):1520S–1524S.

5. Allison DB, Zannolli R, Narayan KM. The direct health care costs of obesity in the United States. *Am J Public Health*. 1999;89(8):1194–1199.

6. Gortmaker SL, Story M. Nutrition policy research that can lead to reduced childhood obesity in the U.S. *Am J Prev Med*. 2012;43(3 Suppl 2):S149–S151.

7. Kimmons J, Gillespie C, Seymour J, Serdula M, Blanck HM. Fruit and vegetable intake among adolescents and adults in the United States: Percentage meeting individualized recommendations. *Medscape J Med*. 2009;11(1):26–36.

8. Pérez-Escamilla R, Obbagy JE, Altman JM, et al. Dietary energy density and body weight in adults and children: a systematic review. *J Acad Nutr Diet*. 2012;112(5):671–684.

9. Tohill BC, Seymour J, Serdula M, Kettel-khan L, Rolls BJ. What epidemiologic studies tell us about the relationship between fruit and vegetable consumption and body weight. *Nutr Rev*. 2004;62(10):365–374.

10. Ledoux TA, Hingle MD, Baranowski T. Relationship of fruit and vegetable intake with adiposity: a systematic review. *Obes Rev*. 2011;12(5):e143–e150.

11. Bayer O, Nehring I, Bolte G, von Kries R. Fruit and vegetable consumption and BMI change in primary school-age children: a cohort study. *Eur J Clin Nutr*. 2014;68(2):265–270.

12. Tuuri G, Zanovec M, Silverman L, et al. "Smart Bodies" school wellness program increased children's knowledge of healthy nutrition practices and self-efficacy to consume fruit and vegetables. *Appetite*. 2009;52(2):445–451.

13. Wang MC, Rauzon S, Studer N, et al. Exposure to a comprehensive school intervention increases vegetable consumption. *J Adolesc Health*. 2010;47(1):74–82.

14. Jones M, Dailami N, Weitkamp E, et al. Food sustainability education as a route to healthier eating: evaluation of a multi-component school programme in English primary schools. *Health Educ Res*. 2012;27(3):448–458.

15. Parmer SM, Salisbury-Glennon J, Shannon D, Struempler B. School gardens: An experiential learning approach for a nutrition education program to increase fruit and vegetable knowledge, preference, and consumption among second-grade students. *J Nutr Educ Behav*. 2009;41(3):212–217.

16. Hoffman JA, Franko DL, Thompson DR, Power TJ, Stallings VA. Longitudinal behavioral effects of a school-based fruit and vegetable promotion program. *J Pediatr Psychol*. 2010;35(1):61–71.

17. Siega-Riz AM, El Ghormli L, Mobley C, et al. The effects of the HEALTHY study intervention on middle school student dietary intakes. *Int J Behav Nutr Phys Act*. 2011;8:7.

18. Reinaerts E, Crutzen R, Candel M, De Vries NK, De Nooijer J. Increasing fruit and vegetable intake among children: comparing long-term effects of a free distribution and a multicomponent program. *Health Educ Res*. 2008;23(6):987–996.

19. Story M, Kaphingst KM, French S. The role of schools in obesity prevention. *Future Child*. 2006;16(1, Childhood Obesity):109–142.

20. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Educ Q*. 1988;15(4):351–377.

21. National Farm to School Network. The Benefits of Farm to School. 2013. Available at: http://www.farmtoschool.org. Accessed January 2, 2014.

22. Centers for Disease Control and Prevention. Recommended Community Strategies and Measurements to Prevent Obesity in the United States. *MMWR*. 2009;58(No. RR-07):1–26.

23. *Pub L No. 111-296, 124 Stat. 3183*. Congress; 2010:1–84. Available at http://www.gpo.gov/fdsys/pkg/PLAW-111publ296/pdf/PLAW-111publ296.pdf

24. Adams MA, Pelletier RL, Zive MM, Sallis JF. Salad bars and fruit and vegetable consumption in elementary schools: a plate waste study. *J Am Diet Assoc*. 2005;105(11):1789–92.

25. Hakim SM, Meissen G. Increasing consumption of fruits and vegetables in the school cafeteria: the influence of active choice. *J Health Care Poor Underserved*. 2013;24(2 Suppl):145–57.

26. Hoffman JA, Thompson DR, Franko DL, Power TJ, Stallings VA. Decaying behavioral effects in a randomized, multi-year fruit and vegetable intake intervention. *Prev Med (Baltim)*. 2012;52(5):370–375.

27. Smith SL, Cunningham-Sabo L. Food choice, plate waste and nutrient intake of elementary- and middle-school students participating in the US National School Lunch Program. *Public Health Nutr*. 2013;2004(7):1–9.

28. Nicklas T, Liu Y, Stuff J, Fisher J, Mendoza J, O'Neil C. Characterizing lunch meals served and consumed by pre-school children in Head Start. *Public Health Nutr*. 2013;16(12):2169–2177.

29. Cohen JFW, Richardson S, Austin SB, Economos CD, Rimm EB. School lunch waste among middle school students: nutrients consumed and costs. *Am J Prev Med*. 2013;44(2):114–21.

30. Krølner R, Rasmussen M, Brug J, Klepp K-I, Wind M, Due P. Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part II: qualitative studies. *Int J Behav Nutr Phys Act*. 2011;8(1):112.

31. Nahman A, de Lange W. Costs of food waste along the value chain: evidence from South Africa. *Waste Manag*. 2013;33(11):2493–500.

32. Wisconsin Department of Public Instruction. Program Statistics. Available at: http://fns.dpi.wi.gov/fns_progstat. Accessed February 17, 2014.

33. Swanson M. Digital photography as a tool to measure school cafeteria consumption. *J Sch Health*. 2008;78(8):432–437.

34. Martin CK, Nicklas T, Gunturk B, Correa JB, Allen HR, Champagne C. Measuring food intake with digital photography. *J Hum Nutr Diet*. 2014;27(Suppl 1):72-81.

35. Williamson DA, Allen R, Martin PD, Alfonso AJ, Gerald B, Hunt A. Comparison of digital photography to weighed and visual estimation of portion sizes. *J Am Diet Assoc*. 2003;103(9):1139–1145.

36. Martins Rodrigues AG, da Costa Proenca RP. Use of food images for evaluating food intake. *Revista de Nutrição – Brazilian Journal of Nutrition*. 2011;24(5):765–776.

37. Tobin J. Estimation of Relationships for Limited Dependent Variables. *Econometrica*. 1958;26(1):24–36.

38. Bontrager Yoder AB, Liebhart JL, McCarty DJ, et al. Farm to elementary school programming increases access to fruits and vegetables and increases their consumption among those with low intake. *J Nutr Educ Behav*. 2014;(in press).

39. Bontrager Yoder AB, Schoeller DA. Fruits and Vegetables Displace, but do not Decrease, Total Energy in School Lunches. *Child Obes*. 2014;(in press).

40. Carnell S, Wardle J. Appetitive traits and child obesity: measurement, origins and implications for intervention. *Proc Nutr Soc*. 2008;67(4):343–55.

41. Ho M, Gow M, Halim J, et al. Effect of a prescriptive dietary intervention on psychological dimensions of eating behavior in obese adolescents. *Int J Behav Nutr Phys Act*. 2013;10:119.

42. Dattilo AM, Birch L, Krebs NF, Lake A, Taveras EM, Saavedra JM. Need for early interventions in the prevention of pediatric overweight: a review and upcoming directions. *J Obes*. 2012;2012:123023.

43. Vernarelli JA, Mitchell DC, Hartman TJ, Rolls BJ. Dietary energy density is associated with body weight status and vegetable intake in U.S. children. *J Nutr*. 2011;141:2204–2210.

44. Angelopoulos PD, Milionis HJ, Grammatikaki E, Moschonis G, Manios Y. Changes in BMI and blood pressure after a school based intervention: the CHILDREN study. *Eur J Public Health*. 2009;19(3):319–325.

45. Prentice RL, Willett WC, Greenwald P, et al. Nutrition and physical activity and chronic disease prevention: research strategies and recommendations. *J Natl Cancer Inst*. 2004;96(17):1276–87.

46. Baxter SD, Paxton-Aiken AE, Tebbs JM, Royer JA, Guinn CH, Finney CJ. Secondary analyses of data from 4 studies with fourth-grade children show that sex, race, amounts eaten of standardized portions, and energy content given in trades explain the positive relationship between body mass index and energy intake at school-prov. *Nutr Res*. 2012;32(9):659–668.

47. Ohri-Vachaspati P, Turner L, Chaloupka FJ. Elementary school participation in the United States Department of Agriculture's Team Nutrition program is associated with more healthful school lunches. *J Nutr Educ Behav*. 2013;45(6):733–8.

Chapter 6. Fruits and Vegetables Displace, but do not Decrease, Total Energy in School Lunches

Introduction

The high prevalence of pediatric obesity in the United States and its resultant comorbidities are well-documented.[1–4] Obesity's causes are multifaceted, but diet is generally accepted to play a major role.[5,6] Consumption of fruits and vegetables (FV), known to be sub-optimal among most of the US population,[7–9] is often hypothesized to be a dietary factor that, if increased to recommended levels, will help ameliorate the prevalence of overweight and obesity.[10,11] It is well-demonstrated that FV contain micronutrients important for health, but the primary reason that increased FV intake is suggested within the context of the obesity epidemic is their low energy density and high fiber and water content.[12–14] This is based on the presumption that increased intake of FV displaces energy intake from energy-dense foods.[15–17]

Although the energy density hypothesis is well documented in the laboratory setting,[18,19] there is less evidence that an increase in FV consumption actually displaces consumption of other foods in a free-living situation such that it reduces total energy intake. In addition, most such evidence is based on self-reported dietary data and thus there is limitation in measuring dietary intake due to the inaccuracies of self-report.[12–14,20,21] Moreover, the relationships between FV intake and adiposity or body weight are documented epidemiologically in adults, but not in children.[12,13]

In 2009, Farm to school (F2S) programs were named by the Centers for Disease Control and Prevention (CDC) as a strategy to facilitate children's increased access to FV in the school setting.[10] These programs combine nutrition and agricultural education through traditional classroom lesson formats and experiential learning alongside procurement of locally-grown foods (particularly produce) for use in school lunches, with simultaneous goals of improving students' FV consumption and supporting

smaller-scale, local farmers through the learning experiences and intentional purchasing.[22,23] The experiential learning activities are selected by each community to build on the strengths and resources available within their community; typical strategies include FV taste-testing, farmer or chef classroom presentations, field trips to farms, cooking activities, or school gardens.

This study aimed to objectively measure energy intake in a free-living population to assess total-energy and FV-sourced energy intake during one meal (school lunch), to better understand the relationship of FV intake to total-meal energy intake. Assessing this relationship in a cohort involved in F2S programming facilitated assessment in a population undergoing a broad intervention aimed at increasing FV consumption. Although it was not expected that all students would attain recommended FV intake, the assumption was that more students would reach higher levels of FV energy intake than may be observed in populations not involved in some intervention to increase intake, thus providing a wider range of FV energy intakes for analysis.

Methods

Participation and recruitment. Participants attended schools (n=9) participating in a Wisconsin AmeriCorps Farm to School (F2S) program evaluation, which evaluated changes in dietary knowledge, attitudes, and behaviors (FV intake). The Wisconsin AmeriCorps F2S program evaluation was reviewed by the University of Wisconsin-Madison Institutional Review Board, and determined to be exempt. All third- through-fifth grade students participated in de-identified evaluation activities unless their parents submitted an opt-out form.

The data described here were generated from the Fall 2010 iteration of the Lunch Tray Photo Observation (LTPO) Study, which used digital photography to assess third- through fifth-grade children's dietary intake at school lunch over a period of four days in eight schools. (The ninth school was a large district that did not permit this evaluation activity.) Briefly, AmeriCorps members were trained during a two-hour face-to-face session. They, along with volunteers at each school (recruited and trained by

AmeriCorps members), took pictures using digital cameras of students' school lunch trays before and after students ate. All AmeriCorps members were given a written document describing the LTPO protocol to use for training volunteers, which included a recommended height and angle from which to take photographs. AmeriCorps members received ongoing technical assistance from the evaluation coordinating center team by email and telephone upon request; clarifications offered to a single school were promptly communicated to all schools. Tripods were not used in order to facilitate the least obstructive presence possible in the school cafeterias. Digital cameras were available upon request, but all AmeriCorps members used school-owned or personal digital cameras. Students were told that the AmeriCorps members wanted to learn about which foods they liked, and that it was important to not discard any food before having the photograph of their tray taken after they had finished eating.

Trays were numbered to enable before/after meal pairing; side-by-side tray pictures were assessed visually by one reader (trained in visually estimating food volumes) to document the food items and their amounts (in cups) on the tray, and the amounts disappeared (assumed to have been consumed; in increments of 0, 25, 50, 75, 100%); the amount consumed was calculated by difference. Foods identified visually were verified against school menus, and usual serving sizes were reported through phone or electronic communications with food service directors.

Nutrient analysis. The U.S. Department of Agriculture (USDA) Nutrient Database[24] was used to conduct an analysis of energy values of all foods on individual school lunch trays, both as available on the tray (before eating) and as disappeared (after eating). The amounts disappeared were assumed to have been consumed. FV energy was separated from total energy for each tray[1] to enable comparison of total

[1] Fruits and vegetables included all fresh and cooked FV items including applesauce, whole or canned fruit, vegetable sides, salad bar items, and excluding juice and "extras" (olives, salsa, marinara sauce). Fried-like potato items (hash brown triangles, visually-heavily oiled potato wedges, French fries) also were not included. The full list of FV items included is as follows: apples (fresh, or baked with cinnamon), applesauce, bananas, cranberries (dried), canned mixed fruit/fruit cocktail, grapes, kiwi, melon, orange (fresh, or canned mandarin oranges), pineapple (fresh slices, or canned chunks), pineapple/mandarin oranges (canned mix), peaches (canned slices or chunks), pear (canned slices or chunks); vegetables – broccoli (mostly raw, some cooked), cabbage (raw, shredded) carrots (raw sticks or baby carrots, raw grated on salads, or cooked), cauliflower (raw), celery (raw), corn (cooked), cucumber (raw slices), green beans (cooked), green pepper (raw slices), kohlrabi (raw slices), lettuce/salad greens/spinach, onions (raw), peas (cooked alone or mixed with carrots), potatoes (mashed), radishes (raw), succotash/other cooked vegetable blends (cooked), tomatoes (cherry/grape or sliced raw, or as soup),and vegetable soup.

to FV-only energy intake. Furthermore, the energy density of the FV on each tray was calculated, weighted according to the volume consumed, and trays were grouped according to "low" (≤80 kcal/cup) or "high" (>80 kcal/cup) FV energy density based on the median energy density value of FV items appearing on trays.

Statistical analysis. All statistical operations were performed using SAS 9.2 (SAS Institute Inc., Cary, NC). No data transformations were used. Data were examined for distribution normality and homogeneity of variances; no transformations were required and assumptions were met for analysis by linear regression. The data were grouped into levels of intake: no FV consumption, and by quartiles of FV energy intake among the remaining trays. Between-group differences were assessed by generalized linear modeling, controlling for grade (to serve as proxy for body size differences), and also mixed modeling, additionally treating school as a random effect to account for differences in school culture: different menus, different qualities of school meals, overall acceptability of eating FV among peers, and different health- and nutrition-related programming. Differences in energy availability and intake were calculated between groups of average weighted FV energy density, evaluating energy outcomes (total kcal available/disappeared; FV kcal, non-FV kcal disappeared) as continuous variables (unadjusted). Additionally, energy availability and intake were assessed according to prior years of F2S programming. Tukey's adjustment was applied to correct for multiple comparisons, and significance levels were set at 0.05.

Results

Subject/School Characteristics.

Table 6.1 depicts subject and school characteristics. Subject characteristics were determined according to grade-aggregate information available from the grades specific to schools participating in the LTPO, since it was not possible to identify which individual students participated in school lunches at most schools (tray numbers did not include student IDs). Students were distributed across grades 3, 4,

Table 6.1. Student, School, and Food Service Environment Characteristics

Characteristic	N; Mean ± SD; or Percent (N)
Students (n^a)	845
Sex: Male, Percent (n^a)	53.9% (455)
Trays (n^b)	2292
Grade: Percent (n^a)	
3rd	17.7% (405)
3rd/4th (indistinguishable)	11.6% (266)
4th	30.8% (705)
4th/5th (indistinguishable)	22.8% (522)
5th	17.2% (394)
Ethnicity:[c] Percent (n^a)	
African-American	3.2% (27)
Asian-American	0.7% (6)
Caucasian	88.3% (744)
Hispanic	2.7% (23)
Native American	3.6% (30)
Other	1.5% (13)
Weight status[d]	
BMI *z*-score, mean ± SD	0.8 ± 1.1
BMI-for-age-and-sex percentile, mean ± SD	69.5 ± 28.0
Under weight, Percent (*n*)	1.7% (11)
Healthy weight, Percent (*n*)	57.8% (372)
Overweight, Percent (*n*)	15.5% (100)
Obese, Percent (*n*)	25.0% (161)
Estimated Daily Energy Requirement,[d] kcal, mean ± SD	2293 ± 575
1/3 of EER, kcal, mean ± SD	764 ± 192
FV disappeared, cups, mean ± SD	0.40 ± 0.35
Schools (N)	8
Students eligible (%) for FRPL,[e] mean ± SD	48.7 ± 14.6
Participation rate (%) in National School Lunch Program,[e] mean ± S	71.8 ± 6.3
Prior years of farm to school programming, % (n^b)	
0 prior years (2 schools)	25.8% (591)
1 prior year (2 schools)	23.3% (535)
≥2 prior years (4 schools)	50.9% (1166)

Table 6.1 ***continued.***

School Food Service Characteristics:	
Select/Serve: Students select, percent	72.2%
Students are served, percent	16.6%
Both	11.2%
Fruit Serving Size	0.5 cups or a piece of fruit
Vegetable Serving Size	0.5 cups
Salad bar in the cafeteria	79.0%
Students serve themselves	84.9%
Combination of Staff serves students + students serve themselve	15.1%
Salad bar use education:[f] Minimal/in previous years	7.7%
Current/ongoing	54.9%
Not reported	37.4%
Peanut butter & jelly bar in the cafeteria (self-service)	4.5%
Bread bar in the cafeteria	6.1%
Students serve themselves / Staff serves	49.3% / 50.7%
Spreads: Butter / Peanut butter	50.7% / 49.3%

Abbreviations: N, Number of observations; SD, Standard Deviation; EER, Estimated (Daily) Energy Requirement; BMI, Body Mass Index; FRPL, Free or Reduced-Price Lunch.

[a] Based on number of students from the participating grades within participating schools

[b] Number of lunch trays

[c] Ethnicity was not available for two students

[d] Based on a subset of students for whom height and weight information was collected (n=644)

[e] Obtained from Department of Public Instruction at the school level

[f] From among trays from schools where there was a salad bar

and 5 relatively evenly. Only 12% of trays were indistinguishable between 3rd and 4th grades, and 23% of trays were indistinguishable between 4th and 5th grades: these cases were due to common lunch times. Most students (88%) were Caucasian, half (49%) were eligible for free or reduced-price lunches, and most (72%) participated in the National School Lunch program. Student heights and weights were reported for six of the eight schools (n=644 students), from which BMI-for-age-and-sex *z*-scores were calculated (mean 0.75±1.09). Furthermore, 36% of students were classified as overweight or obese per CDC guidelines (BMI ≥85th percentile).[25] For comparison, daily estimated energy requirements, using Daily Reference Intake equations specific to age and sex, were calculated and the average for those students was 2293±575 kcal. As these schools were part of a broader evaluation of F2S programs, prior years in F2S was reported: 26% of trays came from schools new to F2S in the 2010-2011 school year, 23% were from schools with one prior year, and 51% were from schools with two or three prior years of programming.

Brief interviews (by phone or e-mail) with food service directors or staff indicated that 72% of trays were from schools where students were allowed to select which FV items were placed on their trays, whereas 17% of trays came from schools where food service staff served students largely uniform lunch trays. The remaining 11% of trays came from two schools that used a combination of students selecting some items and portions while being served others, with menu variance from day to day. FV serving sizes were reported to be one-half cup, except for certain fruits, such as a banana or an apple, which were offered as whole items. Reported serving sizes were not used as definitive volumes; instead they were used as a lens through which to consider food items on trays of known size in context of all items for volume estimations. 79% of trays came from schools that had a salad bar, all of which included the salad bar in the cost of the school meal. Among those that had a salad bar, 85% of trays came from schools where students served themselves from the salad bar, and the rest came from schools that involved some degree of staff supervision at the salad bar. Education on use of the salad bar as a strategy for increasing FV consumption (e.g., through posters, signage, staff supervision and assistance) was reported as 'current/ongoing' for 55% of trays, and as 'minimal/in previous years' for 8% of trays. Additional self-

serve (or staff-assisted service) food items included a peanut butter and jelly bar (4.5% of trays) and a bread bar (6% of trays) with accompanying spreads (butter, peanut butter).

Table 6.2 presents the results for energy content of school lunches, expressed as available and consumed (disappeared) energy for total lunch, FV only, and non-FV energy, each adjusted for grade. Total energy did not decrease across groups of increasing FV energy intake; in fact, trays representing the most FV energy had the highest total energy consumed. Students with moderate FV consumption (approximately one-third cup FV, group 2) at lunch trended towards consuming less total energy, but not significantly less, than those with very little or slightly more FV (groups 0, 1, 3). Non-FV energy, however, significantly decreased across FV energy intake groups (p for trend <0.0001), from 536 kcal (trays with no FV) to 460 kcal (trays with the most FV energy intake), indicating some displacement of non-FV energy by FV energy. When school was entered as a random effect, the pattern of differences across FV energy intake groups remained in total energy intake and the differences were statistically stronger. For non-FV energy, however, the pattern was less clear and results were no longer statistically significant. An interesting observation relative to energy intake in this cohort stems from calculated EER among a cohort where heights and weights were provided (Table 6.1). Across all FV energy intake groups, total energy intake was less than one-third of calculated EER, which is the target energy provision set by the National School Lunch Program. It is possible that body size is not as important in determining how much children actually eat during the school lunch, particularly since this data uses visual estimations of food, and subsequently energy intake, rather than self-reported dietary intake measures.

To test for an effect of consumption of low-energy-dense FV, the trays were segregated into three groups: no FV, weighted sum of consumed FV energy densities <80 kcal/cup, and weighted sum of consumed FV energy densities >80 kcal/cup. Table 6.3 presents the energy in school lunches according to these groups, for total energy available and for total, FV, and non-FV energy disappeared. The total energy available was significantly different according to the weighted energy density of FV items, with no-FV and low-FV-energy density trays showing significantly higher total energy available than high-FV-energy density trays by 20-30 kcal (p for trend, 0.0172) and the same trays showing higher non-FV

Table 6.2. Adjusted Mean Total and FV Energy (kcal) According to Groups[a] of FV kcal Consumed in School Lunches

Group	Range of FV kcal consumed	FV Cups Mean ± SD	N	Total kcal		FV kcal	Non-FV kcal	
				LS Mean (SE)[b]	(95% CI)	LS Mean (SE)[b]	LS Mean (SE)[b]	(95% CI)
0	0	0.00	595	536 (13)[d]	(520, 553)	-0 (1.0)[d]	536 (13)[d]	(520, 553)
1	≥0 to <15.9375	0.22 ± 0.15	410	547 (14)[de]	(527, 567)	0 (2.0)[e]	540 (14)[d]	(520, 559)
2	≥15.9375 to <38.6125	0.36 ± 0.18	432	525 (14)[d]	(506, 544)	26 (2.0)[f]	499 (14)[e]	(480, 518)
3	≥38.6125 to <77.0000	0.53 ± 0.22	406	544 (14)[d]	(524, 563)	55 (2.0)[g]	489 (14)[ef]	(469, 508)
4	≥77.0000	0.81 ± 0.35	449	583 (14)[e]	(561, 602)	123 (2.0)[h]	460 (14)[f]	(441, 478)
***p* for model[b]**				***		***	***	
Cohen's *d*, group 0 vs group 4[c]				**-0.15**		**-3.68**	**0.42**	

Abbreviations: FV, fruits and vegetables; SD, Standard Deviation; LS (Mean), Least Squares (Mean); SE, Standard Error; CI, Confidence Interval.

[a] Groups represent trays with no fruits and vegetables (group 0), and quartiles of the remaining trays.

[b] Values are LS Means (SE, 95% Confidence Intervals), adjusted for grade, using generalized linear modeling, with Tukey's adjustment for multiple comparisons. *p* for model, *** <0.0001

[c] Cohen's *d* calculated from simple means and standard deviations (rather than LS Means and standard errors).

[d,e,f,g,h] Total, non-FV, and FV energy were analyzed by mixed modeling, adjusting for grade and treating school as a random effect. Group values with different bolded superscript letters indicate significant differences ($p<0.05$).

Table 6.3. Mean School Lunch Energy (kcal) Available and Disappeared According to Average Weighted FV Energy Density

Average Weighted FV Energy Density Group	N	Available	Disappeared		
		Total kcal, Mean (SD)	Total kcal, Mean (SD)	FV kcal Mean (SD)	Non-FV kcal Mean (SD)
No FV	595	739 (227)	541 (238)	0 (0)	541 (238)
Low-energy-dense (≤ 80 kcal/cup)	652	730 (218)	555 (218)	21 (18)	534 (219)
High-energy-dense (>80 kcal/cup)	1045	711 (178)	545 (183)	75 (56)	470 (179)
p for between-group differences[a]		*	NS	***	***
Cohen's *d*, no FV vs high FV energy density[b]		**0.41**	-0.02	**-1.68**	**0.35**
Cohen's *d*, low- vs high-FV energy density[b]		**0.10**	0.05	**-1.19**	**0.33**

Abbreviations: FV, fruits and vegetables; SD, Standard Deviation; NS, non-significant.

[a] Calculated using generalized linear modeling, with column name treated as a continuous variable. *, $p<0.05$; ***, $p<0.0001$.

[b] Cohen's *d* calculated from simple means and standard deviations.

energy consumed by 60-70 kcal (p for trend<0.0001). There were, however, no differences in the total energy consumed. The non-FV energy consumed was much higher in no-FV and low-FV-energy density trays than high-FV-energy density trays (541, 534, 470 kcal, respectively; p for trend <0.0001). Collectively, these data indicate that FV provided a higher proportion of energy intake for high-FV-energy dense trays without changing total energy intake, suggesting calorie displacement rather than volume displacement.

Finally, to examine potential associations of F2S programs with total- and FV-energy intake, trays were grouped according to schools' prior years of F2S programming (Table 6.4). Although there were significant trends (treating the outcome as a continuous variable; p<0.0001 for each) for lower total energy available on and consumed from trays with more prior years of F2S programming, adjustments for grade and school (random effect) removed that significance. The same was observed for cups of, and energy from, FV. However, non-FV energy consumed was significantly lower among trays from schools with one or more prior years of F2S programming, by nearly 200 kcal, even after adjustments.

Discussion

This article represents estimations of energy intake at school lunches in a free-living setting, using an objective assessment based on digital photographs. Intake of energy from FV displaced non-FV energy, but total energy did not decrease across groups of FV energy intake. Non-FV energy consumption, however, did decrease as energy consumed from FV increased. When categorized based on the weighted average energy density of the FV as consumed, trays with a high average weighted energy density of FV items showed no difference in total energy consumption than trays with low average weighted FV energy density despite high-FV-energy density trays having lower total energy available than low- and no-FV-energy density trays initially. In addition, prior F2S programming was associated with reduced intake of energy from non-FV items at school lunch. Thus, these findings demonstrate that FV consumption reduces the intake of non-FV food items, but do not support the hypothesis that

Table 6.4. Mean School Lunch Energy (kcal) Available and Disappeared According to Prior Years of Farm to School Programming

Prior years of Farm to School programming	N	Available		Disappeared					
		Total kcal		Total kcal		FV kcal	Non-FV kcal		FV cups
		Mean (SD)	(95% CI)	Mean (SD)	(95% CI)	Mean (SD)	Mean (SD)	(95% CI)	Mean (SD)
0	591	872 (238)[c#]	(585, 887)	665 (247)[d#]	(649, 680)	22 (31)[e#]	643 (238)[f]	(627, 658)	0.26 (0.30)[h]
1	535	694 (172)[c]	(678, 709)	494 (203)[d]	(477, 510)	48 (43)[e]	446 (194)[g]	(430, 463)	0.44 (0.35)[h]
≥2	1166	662 (154)[c#]	(651, 672)	511 (161)[d#]	(500, 522)	46 (59)[e#]	465 (159)[g]	(454, 476)	0.38 (0.37)[h]
p for trend[a]		***		***		***	***		***
Cohen's *d*, 0 vs ≥2 prior years[b]		**1.13**		**0.79**		**-0.47**	**0.94**		**-0.34**

Abbreviations: SD, Standard Deviation; CI, Confidence Interval.

[a] Assessed by generalized linear modeling, adjusted for grade with Tukey's adjustment for multiple comparisons, with column name treated as a continuous variable. ***, $p<.0001$.

[b] Cohen's *d* calculated from simple means and standard deviations.

[c,d,e,f,g,h,#] Total and non-FV energy were assessed by mixed modeling, adjusting for grade and treating school as a random effect. Values with different superscripts indicate significant differences ($p<0.05$). [#] indicates a trend of significance, $0.05<p<0.10$.

consumption of FV, especially low energy dense FV, reduces energy consumption during school lunch; furthermore, F2S programming may favorably reduce consumption of non-FV energy.

The differences in mean total energy consumed ranged from 10 kcal to 40 kcal, which, within a single meal, has the potential for biological significance if sustained over time: an increase in weight of even just one pound over the course of a year equates to just 10 kcal per day. However, the wide confidence intervals (approximately 40 kcal around each group's average) made it nearly impossible to detect statistical significance between the observed means with the exception of the lowest and highest total energy means (groups 2 and 4, respectively). Given the nature of the estimations and the variance expected in children's eating habits, even when grouped by intake levels, this is not entirely surprising.

Our finding that higher FV energy intake displaced non-FV energy intake is novel. In the National School Lunch Program, one meal should provide approximately one-third of a child's daily energy needs (550-650 kcal at the elementary level), excluding a la carte items and condiments.[26,27] School food service directors must develop menus that simultaneously satisfy various nutrient and food group requirements (fluid milk, a meat/meat alternate, bread/grain product, and two servings of different FV – for a total of five items), with the goal of lunches providing 33% of the RDA for calories, protein, vitamins A and C, calcium, and iron, without exceeding recommendations for total or saturated fat, in accordance with the Dietary Guidelines for Americans.[28] Under the regulations in place in 2010 when these data were collected, elementary (3^{rd}-5^{th} grades) school lunches were not required to offer a specific *amount* of FV, but to offer two different FV item servings as well as meet nutrient requirements; however, the offer versus serve guideline, employed by many schools, permits students to select three of five items offered to decrease food wastage.[26,27] Because non-FV-energy intake decreases across FV energy intake groups, it appears that when students consume FV as part of their school lunch, at least some of the total energy they consume from non-FV items decreases. However, trays with the greatest observed FV energy consumption actually showed greater total energy intake at lunch. It is possible that this may have been influenced by factors for which it was not possible to adjust (at the item level) in this

study, such as student BMI or economic status, which may have influenced food availability at home and students' subsequent consumption choices in school lunch.

Previous work has suggested that high-energy-density foods contribute to high caloric intake.[29,30] In this study, high-FV-energy-density lunch trays show lower non-FV energy consumption than no-FV and low-FV-energy-density trays, but the same total energy intake. By contrast, the volumetric displacement hypothesis would expect that bulky FV with lower energy density contribute to satiety and, consequently, lower energy intake. A recent longitudinal study in elementary-aged children also did not support increased FV consumption as displacing high-energy foods in the diet, although the measurement tool used was self-report rather than measured.[14] Again, limited menu offerings of school cafeteria meals do not offer insight into completely free-ranging eating habits, but the data are from photographs, and thus are more objective than recall or food frequency questionnaire tools. Since children eat relatively little FV at school,[29] perhaps the displacement hypothesis is not a reasonable assumption for a school lunch setting. However, if schools are to offer meals that align with the Dietary Guidelines, it does not seem unreasonable to expect that adequate volumes of FV are available to satiate children in a way that lowers total caloric intake such that even the hungriest of children are satisfied in the context of the total meal. Additionally, although not explored in this study, students who eat more FV volume and more FV calories may have healthier overall diets: if students consume a more-satisfying school lunch meal, they may eat fewer unhealthy snacks during the rest of the day due to increased satiety.

The third School Nutrition Dietary Assessment Study (academic year 2004-2005) reported that vegetables contributed to 9.7% (SE 0.58) of total calories offered, and fruits contributed to 8.7% (SE 0.32) of total calories.[31] These data show that students consumed 0%, 1.4%, 5.0%, 10.1%, and 21.1% of energy from FV (across the FV kcal intake groups). This indicates a discrepancy between what schools offer and what students consume, since 80% of trays assessed here are categorized as consuming an average of $\leq$10% of energy from FV – 8 percentage points lower than reported in the SNDA-III.

A limitation of this study is that these data come from program evaluation rather than from a formal research design. Various health-promotion programs take place in schools, to differing degrees:

all schools were part of F2S, which aims to increase students' access to, and consumption of, FV, and presumably were receiving at least similar messaging, but in differing formats and doses due to the grassroots nature of F2S programs. It is possible, then, that the true answers to our questions are lost in the "noise" of the total school environment. Treating school as a random effect variable in our statistical analyses was one way to account for such noise. A further limitation is that our measures are of school lunches only; the photographs did not measure how FV consumption impacts total daily consumption, thus missing the home environment completely. Therefore, it is possible that FV consumption at lunch influenced energy consumption in snacks or meals consumed in later meals. A third limitation is that food quantities were generally assessed in 25% increments of the food initially available on the tray; this may have obscured some small differences. It is also possible that some food item trading occurred between students, or that some items were discarded prior to capturing the photograph. A fourth important limitation is that the average serving sizes reported by food service directors were not verified with actual measurements of specific menu items served on the days of data collection, nor were any food items weighed; instead, our estimations are based on visual estimations by a trained assessor. Finally, trays were not matched to individual students and their characteristics because most of the schools did not wish to provide this detail.

A major strength of this study is that the data on foods consumed were collected using an objective measure of food consumption. Other recent reports have also used digital photography to assess food intake in cafeteria or free-living settings, and have found it to be a reliable estimation.[32–34] None of those studies have evaluated the relationship of FV to total energy, although one reported 43% average waste of fruit and 31% of vegetables among middle school students, and 37% and 34% (respectively) among elementary students, with total energy consumed lower than recommendations by the Child Nutrition and WIC Reauthorization Act of 2004.[33] For comparison, third- through fifth-graders in this study, currently participating in a F2S program, wasted an average of 26% of fruit and 27% of vegetable by volume (data not shown).

Future investigations should include factors that influence what and how much of FV students consume at school lunches, characterizations of school culture, and further comparisons of FV intake in children to total energy, particularly given the recent legislation accompanying the Healthy, Hunger-Free Kids Act of 2010.[35] In addition, total-diet comparisons of FV energy to total energy intake would be a valuable addition to the literature; however, this is difficult given the limited ability to capture unbiased dietary intake.

Conclusions

Total energy intake was higher among students with the highest energy intake from FV in school lunches, and also that trays with high-FV-energy-density showed no difference in total energy intake than trays with low-FV-energy-density; rather, they showed that high-FV-energy-density trays yielded lower non-FV energy intake within the same total energy intake levels. These results do not support the volumetric displacement hypothesis, but suggest that calorie displacement occurs within the school lunch setting. Future studies should further examine factors affecting the relationship between total, FV, and non-FV energy intake.

Chapter 6 References

1. Ogden CL, Carroll MD, Kit B, Flegal. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *JAMA* 2012;307:483–490.

2. Raghuveer G. Lifetime cardiovascular risk of childhood obesity. *Am J Clin Nutr* 2010;91:1514S–1519S.

3. Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: Systematic review. *Int J Obes* 2011;35:891–898.

4. Baker JL, Olsen LW, Sorensen TIA. Childhood body-mass index and the risk of coronary heart disease in adulthood. *N Engl J Med* 2007;357:2329–2337.

5. Roblin L. Childhood obesity: Food, nutrient, and eating-habit trends and influences. *Appl Physiol Nutr Metab Appl Nutr Metab* 2007;32:635–645.

6. l'Allemand-Jander D. Clinical diagnosis of metabolic and cardiovascular risks in overweight children: Early development of chronic diseases in the obese child. *Int J Obes* 2010;34:S32–S36.

7. Resnicow K, Smith M, Baranowski T, et al. 2-Year tracking of children's fruit and vegetable intake. *J Am Diet Assoc* 1998;98:785–789.

8. Guenther PM, Dodd KW, Reedy J, et al. Most Americans eat much less than recommended amounts of fruits and vegetables. *J Am Diet Assoc* 2006;106:1371–1379.

9. Kimmons J, Gillespie C, Seymour J, et al. Fruit and vegetable intake among adolescents and adults in the United States: Percentage meeting individualized recommendations. *Medscape J Med* 2009;11:26–36.

10. Centers for Disease Control and Prevention. Recommended Community Strategies and Measurements to Prevent Obesity in the United States. *MMWR*. 2009;58(No. RR-07):1–26.

11. Donnelly JE, Jacobsen DJ, Whatley JE, et al. Nutrition and physical activity program to attenuate obesity and promote physical and metabolic fitness in elementary school children. *Obes Res* 1996;4:229–243.

12. Tohill BC, Seymour J, Serdula M, et al. What epidemiologic studies tell us about the relationship between fruit and vegetable consumption and body weight. *Nutr Rev* 2004;62:365–374.

13. Ledoux T a, Hingle MD, Baranowski T. Relationship of fruit and vegetable intake with adiposity: A systematic review. *Obes Rev* 2011;12:e143–e150.

14. Bayer O, Nehring I, Bolte G, et al. Fruit and vegetable consumption and BMI change in primary school-age children: A cohort study. *Eur J Clin Nutr* 2014;68:265-270

15. Drewnowski A, Almiron-Roig E, Marmonier C, et al. Dietary energy density and body weight : Is there a relationship? *Nutr Rev* 2004;62:403–413.

16. Sabate J, Wien M. Vegetarian diets and childhood obesity prevention. *Am J Clin Nutr* 2010;91:1525S–1529S.

17. Pérez-Escamilla R, Obbagy JE, Altman JM, et al. Dietary energy density and body weight in adults and children: A systematic review. *J Acad Nutr Diet* 2012;112:671–684.

18. Bell EA, Castellanos VH, Pelkman CL, et al. Energy density of foods affects energy intake in normal-weight women. *Am J Clin Nutr* 1998;67:412–20.

19. Rolls BJ, Roe LS, Meengs JS. Reductions in portion size and energy density of foods are additive and lead to sustained decreases in energy intake. *Am J Clin Nutr* 2006;83:11–17.

20. Kristal AR, Vizenor NC, Patterson RE, et al. Precision and bias of food frequency-based measures of fruit and vegetable intakes. *Cancer Epidemiol Biomarkers Prev* 2000;9:939–944.

21. Burrows TL, Martin RJ, Collins CE. A systematic review of the validity of dietary assessment methods in children when compared with the method of doubly labeled water. *J Am Diet Assoc* 2010;110:1501–1510.

22. Feenstra G, Ohmart J. The evolution of the school food and farm to school movement in the United States: Connecting childhood health, farms, and communities. *Child Obes* 2012;8:280–289.

23. National Farm to School Network. The Benefits of Farm to School. 2013. Available at: www.farmtoschool.org. Last accessed January 2, 2014.

24. U.S. Department of Agriculture, Agricultural Research Service. 2012. USDA National Nutrient Database for Standard Reference, Release 25. Nutrient Data Laboratory Home Page. Available at: www.ars.usda.gov/ba/bhnrc/ndl. Last accessed March 25, 2013.

25. Centers for Disease Control and Prevention, National Center for Health Statistics. CDC Growth Charts: United States. 2000. Available at: www.cdc.gov/growthcharts/. Last accessed July 17, 2011.

26. Burghardt JA, Devaney BL. Background of the School Nutrition Dietary Assessment Study. *Am J Clin Nutr* 1995;61:S178–S181.

27. IOM (Institute of Medicine). *School Meals: Building Blocks for Healthy Children*. Washington, DC: The National Academies Press; 2010.

28. Gordon AR, Cohen R, Crepinsek MK, et al. The third School Nutrition Dietary Assessment Study: Background and study design. *J Am Diet Assoc* 2009;109:S20–S30.

29. Briefel RR, Crepinsek MK, Cabili C, et al. School food environments and practices affect dietary behaviors of US public school children. *J Am Diet Assoc* 2009;109:S91–S107.

30. Briefel RR, Wilson A, Gleason PM. Consumption of low-nutrient, energy-dense foods and beverages at school, home, and other locations among school lunch participants and nonparticipants. *J Am Diet Assoc* 2009;109:S79–S90.

31. Crepinsek MK, Gordon AR, McKinney PM, et al. Meals offered and served in US public schools: Do they meet nutrient standards? *J Am Diet Assoc* 2009;109:S31–S43.

32. Swanson M. Digital photography as a tool to measure school cafeteria consumption. *J Sch Health*. 2008;78:432–437.

33. Smith SL, Cunningham-Sabo L. Food choice, plate waste and nutrient intake of elementary- and middle-school students participating in the US National School Lunch Program. *Public Health Nutr* 2013;2004:1–9.

34. Williamson DA, Allen R, Martin PD, et al. Comparison of digital photography to weighed and visual estimation of portion sizes. *J Am Diet Assoc* 2003;103:1139–1145.

35. 111th Congress. Healthy, Hunger-Free Kids Act of 2010. *Public Law 111-296, 124 Stat. 3183*. 2010:1–84. Available at: www.gpo.gov/fdsys/pkg/PLAW-111publ296/pdf/PLAW-111publ296.pdf. Accessed April 29, 2014.

Chapter 7. Effect of Wisconsin Farm to School Programs on BMI *z*-score in Elementary Students

Introduction

Overweight and obesity exist at high prevalence in the United States for all age groups and have increased over the past half-century.[1–4] This high prevalence is of public concern due to the associated comorbidities such as increased risk for cardiovascular disease,[5–7] metabolic disease,[8] and diabetes.[9] These conditions present a substantial economic burden to the US health care system.[10] In Wisconsin, the Department of Health Services has reported high overweight and obesity prevalence for all age groups, including 29% of two- to four-year-olds, 33% of third-graders, 25% of high-schoolers, and 65% of adults.[11,12]

In this context of high prevalence, many obesity prevention programs have been implemented in a range of settings and ages. Evidence demonstrates that money spent on evidence-based interventions to increase physical activity and improve dietary choices can yield substantial savings in health care spending within just five years [13]. Because overweight and obese children are more likely to be so as adults,[14–16] prevention at an early age is an important goal. The school setting is often selected for interventions due to the ability to reach large numbers of children representative of the general population.

A program gaining momentum currently is farm to school. Farm to school (F2S) programs seek to connect schools to small-scale, local farmers to accomplish two broad goals: first, to improve the nutritional value of meals consumed by students, and second, to support small- and mid-scale local farmers.[17,18] This is accomplished through a variety of learning activities, including nutrition and agricultural lessons, and experiential learning such as taste-testing, cooking, and gardening.[17–20] Pairing

these activities with local economic goals is proposed to increase sustainability and to improve long-term health.[17,18]

Little peer-reviewed literature exists to support the proposed benefits of F2S, particularly with respect to documenting F2S program impacts on children's body mass index (BMI) outcomes in either the short-term or the long-term. As part of the Wisconsin F2S Evaluation,[21] the opportunity to collect students BMI data arose. The goal of this study is to document early associations of F2S programs with students' BMI *z*-scores, comparing students participating in F2S with grade-matched students from schools not participating in F2S.

Materials and Methods

This study was part of a larger evaluation of Wisconsin F2S Programs conducted in 2010-2013.[21] The project, reviewed by the University of Wisconsin-Madison's Institutional Review Board, was determined to be exempt. Briefly, four Wisconsin AmeriCorps F2S sites (elementary schools) submitted de-identified height and weight data of third- and fourth-grade students to the central evaluation processing center for calculation of BMI-for-age- and sex-*z*-scores. AmeriCorps members worked with school personnel to conduct the height and weight measurements in accordance with the protocols for measuring and privacy described by the Wisconsin Department of Health Services.[22] Students were measured in fall 2010 (at the beginning of the school year), spring 2011 (end of the school year), and fall 2011 (beginning of the school year).

All students were included unless parents returned an opt-out form. The schools were at differing stages of F2S program implementation: one school had no prior experience with the program (0 prior years; 18% of the total F2S cohort), and the remaining three schools began in fall 2008 (2 prior years; 82% of the total F2S cohort). These four schools were part of a larger cohort reported on elsewhere,[21,23] but were the only four schools from that cohort that reported BMI in each of the selected data collection times.

De-identified BMI data collected by the Wisconsin Department of Public Instruction was obtained for a comparison cohort. Subjects included students in third, fourth, and fifth grades who were measured in the same semesters as the F2S cohort as part of school-initiated FitnessGram (The Cooper Institute, Dallas, TX) fitness and activity level assessments.[24] These comparison schools were not indicated as implementing F2S programs as assessed at the school district level by a Wisconsin survey of food service directors and by the United States Department of Agriculture's F2S Census survey (complied by the Wisconsin Department of Agriculture, Trade, and Consumer Protection and the University of Wisconsin-Madison's Center for Integrated Agricultural Studies, both of which coordinate and monitor statewide F2S efforts).[25] Whole-number age (years) and sex were known for all students; age was adjusted to x+0.25 years for fall measurements and x+0.75 years for spring to account for age change across the year based on observed fractional ages in these grades in our prior studies. Ethnicity was reported for some students in this database, but was unknown for 72%, 43%, and 87% of students by semester (fall 2010, spring 2011, and fall 2011, respectively), and thus additional school-level ethnicity distributions were obtained from Wisconsin's Department of Public Instruction.[26] Because subjects were de-identified, it was not feasible to ascertain whether any of the students were the same in each semester.

Students' heights, weights, sex, and age were used to calculate BMI-for-age-and-sex *z*-score and percentile using a program from the Centers for Disease Control (CDC).[27] From the percentile values, students were classified into CDC-defined weight status categories: underweight, BMI $<5^{th}$ percentile; healthy weight, BMI $\geq 5^{th}$ and $<85^{th}$ percentile; overweight, BMI $\geq 85^{th}$ and $<95^{th}$ percentile; obese, BMI $\geq 95^{th}$ percentile.[28]

Statistical analysis. All statistical analyses were performed using SAS 9.2 (SAS Institute Inc., Cary, NC). Two primary analyses were conducted: first, all students, and secondly, students with three measurements. In the full cohort, the data were examined by comparing F2S students with non-F2S students. F2S cohort data were examined without adjustments, as well as after adjusting for ethnicity and for the percent of students eligible for free or reduced-price lunches (%FRPL; district-level data),[29] including logistic regression to calculate the odds ratios for the likelihood of being overweight or obese

for non-F2S students as compared with F2S students. Similarly, students with all three measurements were assessed. Finally, students in each of the three cohorts were examined according to baseline weight status category (healthy-weight vs overweight/obese, per CDC definitions[28]). Analyses were performed using student's *t*-tests or generalized linear modeling, using Tukey's adjustment for multiple comparisons. Significance was defined at a level of $p<0.05$.

Results

Participant Characteristics

At the start of this study, AmeriCorps members submitted de-identified, but ID-coded, data for 474 students in the third, fourth, or fifth grade at F2S schools. Of these students, 97%, 96 %, and 96% were measured in fall 2010, spring 2011, and fall 2011 respectively. The grade-matched comparison cohort comprised 347, 105, and 755 students in the same respective semesters. Tables 7.1 and 7.2 show participant characteristics for the total cohort of students overall (Table 7.1), as well as for the within-student paired cohort (students with three measurements, n=249; Table 7.2). Comparison students were slightly older than F2S students; slightly taller in fall 2010 and fall 2011; and slightly heavier in fall 2011. There was a lower proportion of male students in the comparison cohort in fall 2011 relative to the F2S cohort. Most F2S cohort students were Caucasian; the next largest ethnic group represented was Native Americans. Based on publicly-available school-level data,[26] comparison students were 36% Caucasian, 28% African-American, 33% Hispanic, and remaining students of Asian, Native American, or Other (Pacific Islander and multiple ethnicities) descent, with some variation by semester (particularly for Caucasians and African-Americans). Characteristics among students in the paired cohort were similar to the F2S cohort for heights and weights, as well as for ethnicity and sex distribution (Table 7.2). All groups were similar with respect to BMI status to national data of measured heights and weights for boys and girls ages 8 to 11 years (Table 7.1b).[30]

Table 7.1. Participant Characteristics, Total Cohort

	F2S Cohort			Comparison Cohort		
Characteristic	**Fall 2010**	**Spring 2011**	**Fall 2011**	**Fall 2010**	**Spring 2011**	**Fall 2011**
***N*, overall**	**461**	**457**	**453**	**347**	**105**	**755**
	---------- *mean ± SD* ----------					
Age, years,	9.2 ± 0.6	9.9 ± 0.6	9.7 ± 0.8	9.4 ± 0.6*	10.1 ± 0.7*	9.9 ± 0.7*
Height, cm	136.2 ± 7.4	139.4 ± 7.9	139.5 ± 7.9	138.1 ± 8.4*	142.3 ± 8.7	142.6 ± 8.1*
Weight, kg	36.4 ± 11.0	39.5 ± 12.8	39.8 ± 13.5	39.3 ± 11.8	40.4 ± 12.0	41.7 ± 12.8*
BMI	19.7 ± 4.7	20.1 ± 4.7	20.0 ± 5.2	20.4 ± 4.8*	19.7 ± 4.3	20.3 ± 4.7
	---------- *%* ----------					
Sex, % male	56.1	56.5	54.8	50.1	47.6	49.7*
Ethnicity[1]				*	*	*
Caucasian	78.4	78.3	79.1	37.4	18.4	44.0
African-American	1.3	1.3	2.1	29.1	48.9	17.0
Asian-American	0.9	0.9	1.1	0.5	0.5	1.2
Hispanic	1.7	2.0	1.3	31.9	31.1	35.5
Native American	15.6	15.1	14.9	0.7	0.9	1.2
Other	2.2	2.4	1.6	0.4	0.3	1.1

[1] Ethnicity for F2S cohort determined by demographic parameters submitted for F2S evaluation data. Ethnicity for Comparison cohort was unknown for 72%, 43%, and 87% of students (fall 2010, spring 2011, and fall 2011 respectively), so school-level data were obtained from Wisconsin Department of Public Instruction.[26]

* Comparison group is significantly different ($p<0.05$, determined by student's *t*-test for comparisons of means or by Chi-squared test of proportions) from F2S group at the given data collection time.

Table 7.1b. National Anthropometric Reference Data[30]

Characteristic	8 years	9 years	10 years	11 years
	---------- *mean ± SE* ----------			
Girls				
Height, cm	131.3 ± 0.84	137.0 ± 0.47	144.5 ± 0.52	150.4 ± 0.54
Weight, kg	31.9 ± 1.01	35.5 ± 0.98	41.1 ± 0.74	47.5 ± 1.28
BMI	18.5	18.9	19.7	21.0
Boys				
Height, cm	132.0 ± 0.66	137.9 ± 0.88	142.3 ± 0.64	149.9 ± 0.62
Weight, kg	31.3 ± 0.70	36.6 ± 1.17	40.0 ± 0.93	46.6 ± 1.13
BMI	18.0	19.2	19.8	20.7
Overall mean BMI, all ages and sexes combined	19.5			

Table 7.2. Participant Characteristics, Longitudinal F2S Cohort

	F2S Cohort		
Characteristic	**Fall 2010**	**Spring 2011**	**Fall 2011**
***N*, paired**	**249**	**249**	**249**
	---------- *mean* ± *SD* ----------		
Age, years	9.2 ± 0.6	9.9 ± 0.6	10.3 ± 0.6
Height, cm	136.0 ± 7.3	138.8 ± 7.5	142.1 ± 7.6
Weight, kg	36.0 ± 11.6	38.4 ± 13.0	41.4 ± 14.5
BMI	19.2 ± 4.7	19.6 ± 4.9	20.2 ± 5.4
	---------- *%* ----------		
Sex, % male	56.2		
Ethnicity			
Caucasian	84.3		
African-American	0.4		
Asian-American	1.2		
Hispanic	1.2		
Native American	12.9		
Other	0.0		
Prior F2S years, %			
0 prior years	14.9		
2 prior years	85.1		

Weight Status Classifications and Changes in BMI z-score Over Time

The highest proportion of students in both the F2S (total) and comparison cohorts were classified as having healthy weight per CDC definitions (≥5th BMI-for-age-and-sex percentile and <85th) [28], but approximately one-quarter of the F2S cohort were obese (≥95th BMI-for-age-and-sex percentile) at all measurement times (Table 7.3). There were no differences in the proportion of students' weight status classification in spring or fall 2011, but 10% more comparison-cohort students were classified as overweight or obese in fall 2010 relative to the F2S cohort. The odds of being overweight/obese were higher for students without F2S (odds ratio 1.26 [95% confidence interval 1.09-1.46], p=0.0002). After adjusting for the percent of students classified as ethnic minority, however, this was no longer significant (OR 1.06 [95% CI 0.90-1.25], p=0.49). The difference observed overall was driven by that in fall 2010.

BMI *z*-scores of F2S and comparison cohorts overall were compared at each measurement time (between groups) and across time (within groups) (Table 7.3). Comparison students had higher BMI *z*-scores in fall 2010 (+0.23 ± 1.16, p=0.005) than F2S students, but remaining semesters were not different. As compared to baseline, BMI *z*-score of comparison cohort students were lower at the end of the school year relative to the start (-0.24 ± 1.17, p=0.06), but they did not differ at the start of the next school year. The total F2S cohort BMI *z*-scores did not differ from baseline at either follow-up measurement.

A subset of the F2S cohort had BMI data at all three time points. More than one-fifth of this longitudinal F2S cohort were obese at all measurement times, but most (57% to 62%) of students were classified as healthy weight (Table 7.4). There was no change in BMI *z*-scores for the longitudinal cohort across the school year, nor during the summer months (Table 7.4). Moreover, the paired F2S cohort *z*-scores (Table 7.4) were similar to those observed in the unpaired F2S cohort (Table 7.3). Preliminary data indicates that the odds of being obese were higher for students from new F2S sites, relative to established ones (odds ratio 2.84 (95% CI 1.88-4.30, p<.0001), and the trend was maintained after adjusting for the percent of students classified as minority ethnicity (odds ratio 16.02 [0.65-396.6], p=0.09) (data not shown). It is important to note, however, that this is based on a very small number of

Table 7.3. BMI Weight Status and *z*-scores, F2S Cohort versus Comparison Cohort

	F2S Cohort			Comparison Cohort		
Characteristic	**Fall 2010**	**Spring 2011**	**Fall 2011**	**Fall 2010**	**Spring 2011**	**Fall 2011**
***N*, overall**	**461**	**457**	**453**	**347**	**105**	**755**
	---------- *%* ----------					
Weight Status[1]				*		
Underweight	1.8	1.2	1.3	2.9	1.9	2.7
Healthy Weight	58.8	58.3	54.0	45.2	61.0	51.8
Overweight	14.5	16.5	17.0	17.9	17.1	18.2
Obese	24.9	24.1	27.7	31.0	20.0	27.4
	---------- *mean ± SD* ----------					
BMIz-score	0.67 ± 1.12	0.67 ± 1.08	0.74 ± 1.13	0.91 ± 1.21*	0.66 ± 1.05	0.77 ± 1.33
P[2]		0.47	0.33		0.06	0.32

[1] Determined by the Centers for Disease Control definitions.[28]

[*] Comparison group is significantly different ($p<0.05$) from F2S group at specified data collection time, determined by student's *t*-test for comparisons of means or by Chi-squared test of proportions.

[2] Within-group time-related analysis by student's T-test (unpaired), indicating a change in BMI *z*-score from the previous data collection of time (i.e., Fall 2010 versus Spring 2011; Fall 2011 versus Spring 2011).

Table 7.4. Weight status and BMI *z*-scores, Longitudinal F2S Cohort

Group	Fall 2010	Spring 2011	Fall 2011	F10 vs S11 *P*[1]	S11 vs F11 *P*[1]
Weight Status,[2] %	---------- *%* ----------				
Underweight	2.4	0.8	1.6		
Healthy Weight	61.0	61.5	56.6		
Overweight	15.3	17.3	16.5		
Obese	21.3	20.5	25.3		
	---------- *mean ± SD* ----------				
BMI *z*-score	0.64 ± 1.15	0.64 ± 1.11	0.66 ± 1.16	0.97	0.31

[1] Determined by paired *t*-test.

[2] Determined by the CDC definitions.[28]

observations (n=249 students at 3 measurement times) with quite different distributions of ethnicities between new and established sites.

Time-related BMI z-score Change within Weight Status Groups

Total F2S and comparison cohort students were compared, independently, for change across time within baseline (fall 2010) weight status groups (Table 7.5). Grouped as 'underweight/healthy weight' and 'overweight/obese,' neither the F2S nor the comparison cohort significantly changed mean BMI *z*-score across time. In the paired F2S cohort, students classified initially as overweight/obese decreased from fall 2010 to spring 2011 (-0.06 ± 0.20, p=0.003), but these same students trended toward a BMI *z*-score increase from spring to fall 2011 (+0.05 ± 0.26, p=0.07).

Discussion

We found that students participating in F2S programs demonstrated no change in BMI *z*-scores across a single program year, whereas students not participating in F2S programming trended toward decreasing BMI *z*-scores in the same time frame. After adjusting for the percent of students categorized as minority ethnicity, students participating in F2S were no more or less likely to be overweight or obese than were students not participating in F2S at the end of one program year. The same time-related patterns were observed in the longitudinal F2S cohort as the total F2S cohort. To our knowledge, this is the first student health data specifically associated with F2S programs.

Few programs involving facets of F2S programming that included BMI outcomes exist in the literature. Those that have measured BMI were multi-component interventions and demonstrated small, but significant, favorable impacts on children's BMI outcomes.[31–33] Programs comprised at least two of the following: gardening, nutrition education, cooking, improved school meal offerings, family and/or community components, or physical activity components. The programs represented by schools in this study were more limited in scope, in that they lacked formal family, community, and physical activity

Table 7.5. BMI *z*-scores Over Time, Grouped by Baseline Weight Status

Group	Fall 2010 mean ± SD	Spring 2011 mean ± SD	Fall 2011 mean ± SD	F10 vs S11[1] *P*	S11 vs F11[1] *P*
Comparison cohort, N	**167[H] 180[O]**	**66[H] 39[O]**	**411[H] 344[O]**		
Under/Healthy weight	-0.10 ± 0.93	0.02 ± 0.71	-0.09 ± 1.19	0.28	0.28
Overweight/Obese	1.84 ± 0.45	1.78 ± 0.45	1.81 ± 0.46	0.25	0.40
F2S cohort, N	**281[H] 180[O]**	**275[H] 182[O]**	**259[H] 194[O]**		
Under/Healthy weight	-0.04 ± 0.78	-0.04 ± 0.72	-0.07 ± 0.71	0.96	0.62
Overweight/Obese	1.78 ± 0.47	1.75 ± 0.46	1.82 ± 0.51	0.47	0.67
Paired F2S cohort, N	**158[H] 91[O]**	**158[H] 91[O]**	**158[H] 91[O]**		
Under/Healthy weight	-0.05 ± 0.79	-0.01 ± 0.77	0.00 ± 0.84	0.27	0.76
Overweight/Obese	1.83 ± 0.51	1.77 ± 0.50	1.82 ± 0.56	0.003	0.07

[1] Within-group change assessed by student's *t*-test.

[H] Students classified as underweight or healthy weight per CDC definitions (BMI-for-age-and-sex <85th percentile).

[O] Students classified as overweight or obese per CDC definitions (BMI-for-age-and-sex ≥85th percentile).

components. However, F2S programs typically involve some form of nutrition education as well as some degree of fresh, locally-grown produce in school meals or snacks, and parents often receive information sent home (usually a monthly newsletter with information and/or recipes to try). Additional common experiential learning activities include cooking or gardening.

As described elsewhere, programs similar to F2S (i.e., those incorporating one facet often incorporated in F2S) have indicated favorable potential to improve mediators of FV consumption: increased FV access,[34] dietary knowledge,[21,35–43] attitudes toward eating FV,[21,37,41,43–47] as well as actual FV consumption, particularly in the school lunch setting.[21,36,40,42,45,48–51] These are all proposed to be important for reducing obesity,[52] although the relationship of FV consumption to obesity outcomes is unclear in children.[53–55]

In this evaluation of F2S programs overall, we expected limited ability to detect changes in BMI given the short evaluation period. The lack of differences between the F2S and comparison cohorts may reflect the variety of public health initiatives taking place simultaneously in many communities across the country, which yields a growing awareness of the importance of healthy lifestyle behaviors, or that the extent of the F2S intervention was insufficient to result in substantial change. More likely, however, is that the evaluation period assessed for this study is too short a time to reasonably expect to observe meaningful change in BMI outcomes. It is interesting to note, however, that the longitudinal F2S cohort showed a decrease in BMI *z*-score of 0.04 units across a single program year among students from established F2S program schools (data not shown). This is a relative change of 0.3 kg less than no *z*-score change. For students in new F2S program schools, the observed BMI *z*-score change of 0.26 units translates to 1.6 kg excess weight increase over the same period. Changes of this magnitude have yielded clinical improvements in cardiovascular risk factors.[56] Given the small degree of change, however, we recommend longer-term F2S evaluation to better assess health outcomes.

BMI has limitations as a measure of health outcomes. While there are documented associations between overweight and obesity and various chronic disease outcomes,[5–9] it is known that an individual's percent body fat can vary quite widely within the healthy-weight BMI range[57] and that the risks of

overweight and obesity are on different scales for different ethnic groups.[57–59] For children, especially individual children, its most appropriate use is that of a screening tool to further investigate the child's complete healthy, including cardiovascular fitness, and to encourage clinicians and key adults figures in a child's life to encourage healthy lifestyle behaviors.[60,61] The use of BMI *z*-scores and percentiles, rather than the index values of kg/m^2 that are used for adults, improve its usefulness in growing children, but it is still important to interpret the measures in their complete context.

This analysis has limitations. It was not possible to conduct paired analyses with Comparison cohort students since it was not possible to pair these students across time. Our knowledge of Comparison cohort students' exact ages and school environments (for example, other health-related programs taking place at similar times to this study that potentially could have influenced BMI outcomes) is also limited. However, including the comparison cohort suggests at a minimum that F2S programs did not negatively impact students' BMI outcomes relative to similar schools on the basis of two points: first, there was no overall change in BMI *z*-scores for comparison cohort students, and second, there was no difference in *z*-scores between F2S and comparison cohorts. By contrast, it seems promising that our paired F2S cohort showed small BMI *z*-score decreases across one program year for students who were initially overweight/obese. Finally, this study was not able to conduct an analysis of the duration of F2S programming at the various sites. Because neither the total F2S nor the comparison cohort showed this, longer-term future studies that include longitudinal comparison or control students are warranted.

We acknowledge that many other factors impact children's BMI outcomes: physical activity time, sedentary time, screen time, parental dietary and activity habits, the home and community food and built environments, family genetics, and socioeconomic status, to name a few. This study was limited significantly in that we lacked measures of these factors; they were outside the scope of our limited-budget F2S program evaluation. Other promising outcomes are being reported for F2S programs, including improved knowledge of nutrition and agricultural concepts, attitudes towards eating fruits and vegetables, and measured consumption of fruits and vegetables in school lunch.[21,23,62,63] Thus, it is important to consider that the long-term benefits of F2S programming are likely yet to be observed, and

therefore F2S programs ought not be discounted for the lack of impact on children's BMI described in this short-term evaluation. Although F2S programs have the potential to impact students across multiple levels of the social-ecological model, they are unlikely to provide the sole answer to the widespread prevalence of overweight and obesity due to the vast complexity of influences leading to obesity; further study is needed to better ascertain the effects of F2S on children's long-term health and BMI outcomes.

Conclusion

In Wisconsin, F2S programs did not have a demonstrable impact on children's short-term BMI outcomes. The authors' previous observations suggest that F2S programming does impact mediators of BMI,[21,23] but longer-term studies that include a wider variety of measures to account for the complex nature of overweight and obesity are needed to better understand the relationship between F2S programs and BMI.

Chapter 7 References

1. Ogden C, Carroll M. Prevalence of Obesity Among Children and Adolescents: United States , Trends 1963 – 1965 Through 2007 – 2008. *Natl Cent Heal Stat E-Stat*. 2010;(June). Available at: http://www.cdc.gov/nchs/data/hestat/obesity_child_07_08/obesity_child_07_08.htm. Accessed February 4, 2014.

2. Ogden CL, Carroll MD, Kit BK, Flegal KM. *Prevalence of obesity in the United States, 2009-2010.* U.S. Department of Health and Human Services,Centers for Disease Control and Prevention, National Center for Health Statistics; 2012:1–8.

3. Ogden CL, Carroll MD, Curtin LR, Lamb MM, Flegal KM. Prevalence of high body mass index in US children and adolescents, 2007-2008. *JAMA*. 2010;303(3):242–249.

4. Ogden CL, Carroll MD, Kit B, Flegal. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *JAMA*. 2012;307(5):483–490.

5. Gunnell DJ, Frankel SJ, Nanchahal K, Peters TJ, Smith GD. Childhood obesity and adult cardiovascular mortality: a 57-y follow-up study based on the Boyd Orr cohort. *Am J Clin Nutr*. 1998;67(6):1111–1118.

6. Must A, Jacques PF, Dallal GE, Bajema CJ, Dietz WH. Long-term Morbidity and Mortality of Overweight Adolescents: A Follow-up of the Harvard Growth Study of 1922 to 1935. *N Engl J Med*. 1992;327(19):1350–1355.

7. Raghuveer G. Lifetime cardiovascular risk of childhood obesity. *Am J Clin Nutr*. 2010;91(Suppl):1514S–1519S.

8. l'Allemand-Jander D. Clinical diagnosis of metabolic and cardiovascular risks in overweight children: early development of chronic diseases in the obese child. *Int J Obes*. 2010;34(2):S32–S36.

9. Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review. *Int J Obes*. 2011;35(7):891–898.

10. Finkelstein EA, Trogdon JG, Cohen JW, Dietz W. Annual medical spending attributable to obesity: payer-and service-specific estimates. *Health Aff*. 2009;28(5):w822–w831.

11. Olson MA, Chaffin JG, Chudy N, Yang A. *Healthy Smiles / Healthy Body: Wisconsin's Third Grade Children, 2013*. Wisconsin Oral Health Program, Wisconsin Department of Health Services. Madison, WI: 2013. Available at: http://www.dhs.wisconsin.gov/publications/P0/p00589.pdf. Accessed March 12, 2014.

12. Wisconsin Department of Health Services, Division of Public Health, Nutrition, Physical Activity and Obesity Prevention, Wisconsin Partnership for Activity and Nutrition. *Obesity , Nutrition , and Physical Activity in Wisconsin*. Madison, WI: 2008. Available at: http://www.dhs.wisconsin.gov/publications/P0/P00009.pdf. Accessed March 12, 2014.

13. Trust for America's Health. *Prevention for a Healthier America: Investments in Disease Prevention Yield Significant Savings, Stronger Communities*. Washington, DC; 2009. Available at: http://healthyamericans.org/reports/prevention08/Prevention08.pdf. Accessed March 16, 2014.

14. Freedman DS, Khan LK, Serdula MK, Dietz WH, Srinivasan SR, Berenson GS. The relation of childhood BMI to adult adiposity: The Bogalusa Heart Study. *Pediatrics*. 2005;115(1):22–27.

15. Guo SS, Chumlea WC. Tracking of body mass index in children in relation to overweight in adulthood. *Am J Clin Nutr*. 1999;70(1):145S–148S.

16. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med*. 1997;337(13):869–873.

17. Feenstra G, Ohmart J. The evolution of the school food and farm to school movement in the United States: Connecting childhood health, farms, and communities. *Child Obes*. 2012;8(4):280–289.

18. National Farm to School Network. The Benefits of Farm to School. 2013. Available at: http://www.farmtoschool.org. Accessed January 2, 2014.

19. Joshi A, Ratcliffe MM. Causal pathways linking Farm to School to childhood obesity prevention. *Child Obes*. 2012;8(4):305–314.

20. Bagdonis JM, Hinrichs CC, Schafft KA. The emergence and framing of farm-to-school initiatives: civic engagement, health and local agriculture. Walsh-Dilley E. Pfeffer,M.J. ME, ed. *Agric Human Values*. 2009;26(1-2):107–119.

21. Bontrager Yoder AB, Liebhart JL, McCarty DJ, et al. Farm to elementary school programming increases access to fruits and vegetables and increases their consumption among those with low intake. *J Nutr Educ Behav*. 2014;(in press).

22. *To Weigh and Measure*. Department of Health and Family Services, Division of Public Health, Wisconsin Nutrition and Physical Activity Program. Madison, WI: 2008. Available at: http://www.dhs.wisconsin.gov/health/physicalactivity/Sites/School/To_Weigh_Measure.pdf. Accessed August 28, 2010.

23. Bontrager Yoder AB, Schoeller DA. Fruits and vegetables displace, but do not decrease, total energy in school lunches. *Child Obes*. 2014;(in press).

24. Carrel A, Wisconsin Department of Public Instruction. Personal communication. 2013.

25. Elliott SJ. Personal communication, April 30, 2014.

26. Wisconsin Department of Public Instruction. Wisconsin Information System for Education Data Dashboard. Available at: http://wisedash.dpi.wi.gov/Dashboard/Page/Home/Topic Area/Attendance/. Accessed March 17, 2014.

27. Centers for Disease Control and Prevention. A SAS Program for the 2000 CDC Growth Charts (ages 0 to <20 y). Available at: http://www.cdc.gov/nccdphp/dnpao/growthcharts/resources/sas.htm. Accessed October 28, 2010.

28. Centers for Disease Control and Prevention, National Center for Health Statistics. CDC Growth Charts: United States. 2000.

29. Wisconsin Department of Public Instruction. Program Statistics. Available at: http://fns.dpi.wi.gov/fns_progstat. Accessed February 17, 2014.

30. Fryar C, Gu Q, Ogden C. *Anthropometric Reference Data for Children and Adults: United States, 2007–2010*. National Center for Health Statistics. Vital Health Stat 11(252). 2012. Available at: http://www.cdc.gov/nchs/data/series/sr_11/sr11_252.pdf. Accessed March 23, 2014.

31. Gatto NM, Ventura EE, Cook LT, Gyllenhammer LE, Davis JN,. LA Sprouts: A Gardening, Nutrition, and Cooking Intervention for Latino Youth Improves Diet and Reduces Obesity. *J Am Diet Assoc*. 2011;111(8):1224–1230.

32. Hollar D, Messiah SE, Lopez-Mitnik G, Hollar TL, Almon M, Agatston AS. Healthier options for public schoolchildren program improves weight and blood pressure in 6- to 13-year-olds. *J Am Diet Assoc*. 2010;110(2):261–267.

33. Chomitz VR, McGowan RJ, Wendel JM, et al. Healthy Living Cambridge Kids: A Community-based participatory effort to promote healthy weight and fitness. *Obesity*. 2010;18(Supplement 1):S45–S53.

34. Slusser WM, Cumberland WG, Browdy BL, Lange L, Neumann C. A school salad bar increases frequency of fruit and vegetable consumption among children living in low-income households. *Public Health Nutr*. 2007;10(12):1490–1496.

35. Contento IR, Manning AD, Shannon B. Research perspective on school-based nutrition education. *J Nutr Educ*. 1992;24(5):247–260.

36. Liquori T, Koch PD, Contento IR, Castle J. The cookshop program: Outcome evaluation of a nutrition education program linking lunchroom food experiences with classroom cooking experiences. *J Nutr Educ*. 1998;30(5):302–313.

37. Bevan S, Vitale T, Wengreen H. Farm field trips provide sensory-based experiences with fresh, local produce. *J Nutr Educ Behav*. 2012;44(3):278–9.

38. Morris JL, Zidenberg-Cherr S. Garden-enhanced nutrition curriculum improves fourth-grade school children's knowledge of nutrition and preferences for some vegetables. *J Am Diet Assoc*. 2002;102(1):91–93.

39. Blair D. The child in the garden: An evaluative review of the benefits of school gardening. *J Environ Educ*. 2009;40(2):15–38.

40. Parmer SM, Salisbury-Glennon J, Shannon D, Struempler B. School gardens: An experiential learning approach for a nutrition education program to increase fruit and vegetable knowledge, preference, and consumption among second-grade students. *J Nutr Educ Behav*. 2009;41(3):212–217.

41. Somerset S, Markwell K. Impact of a school-based food garden on attitudes and identification skills regarding vegetables and fruit: a 12-month intervention trial. *Public Health Nutr*. 2009;12(2):214–221.

42. Morgan PJ, Warren JM, Lubans DR, Saunders KL, Quick GI, Collins CE. The impact of nutrition education with and without a school garden on knowledge, vegetable intake and preferences and quality of school life among primary-school students. *Public Health Nutr*. 2010;13(11):1–10.

43. Nolan GA, McFarland AL, Zajicek JM, Waliczek TM. The effects of nutrition education and gardening on attitudes, preferences, and knowledge of minority second to fifth graders in the Rio Grande Valley toward fruit and vegetables. *Horttechnology*. 2012;22(3):299–304.

44. Lakkakula A, Geaghan JP, Wong W-P, Zanovec M, Pierce SH, Tuuri G. A cafeteria-based tasting program increased liking of fruits and vegetables by lower, middle and upper elementary school-age children. *Appetite*. 2011;57(1):299–302.

45. Anzman-Frasca S, Savag JS, Marini ME, Al E. Repeated exposure and associated conditioning promote preschool children's liking of vegetables. *Appetite*. 2012;58(2):543–553.

46. Cullen KW, Watson KB, Konarik M. Differences in fruit and vegetable exposure and preferences among adolescents receiving free fruit and vegetable snacks at school. *Appetite*. 2009;52(3):740–744.

47. Cunningham-Sabo L, Lohse B. Cooking with kids positively affects fourth graders' vegetable preferences and attitudes and self-efficacy for food and cooking. *Child Obes*. 2013;9(6):549–556.

48. Cotugna N, Manning CK, DiDomenico J. Impact of the use of produce grown in an elementary school garden on consumption of vegetables at school lunch. *J Hunger Environ Nutr*. 2012;7(1):11–19.

49. McAleese JD, Rankin LL. Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents. *J Am Diet Assoc*. 2007;107(4):662–665.

50. Heim S, Stang J, Ireland M. A garden pilot project enhances fruit and vegetable consumption among children. *J Am Diet Assoc*. 2009;109(7):1220–1226.

51. Meinen A, Friese B, Wright W, Carrel A. Youth gardens increase healthy behaviors in young children. *J Hunger Environ Nutr*. 2012;7(2-3):192–204.

52. Centers for Disease Control and Prevention. Recommended Community Strategies and Measurements to Prevent Obesity in the United States. *MMWR*. 2009;58(No. RR-07):1–26.

53. Ledoux TA, Hingle MD, Baranowski T. Relationship of fruit and vegetable intake with adiposity: a systematic review. *Obes Rev*. 2011;12(5):e143–e150.

54. Tohill BC, Seymour J, Serdula M, Kettel-khan L, Rolls BJ. What epidemiologic studies tell us about the relationship between fruit and vegetable consumption and body weight. *Nutr Rev*. 2004;62(10):365–374.

55. Bayer O, Nehring I, Bolte G, von Kries R. Fruit and vegetable consumption and BMI change in primary school-age children: a cohort study. *Eur J Clin Nutr*. 2014;68(2):265–270.

56. Kolsgaard MLP, Joner G, Brunborg C, Anderssen SA, Tonstad S, Andersen LF. Reduction in BMI z-score and improvement in cardiometabolic risk factors in obese children and adolescents. The Oslo adiposity intervention study - a hospital/public health nurse combined treatment. *BMC Pediatr*. 2011;11:47.

57. Abernathy R, Black D. Healthy body weights: an alternative perspective. *Am J Clin Nutr*. 1996;63(supplement):448S–451S.

58. Mascie-Taylor CGN, Goto R. Human Variation and Body Mass Index: A Review of the Universality of BMI Cut-offs, Gender and Urban-rural Differences, and Secular Changes. *J Physiol Anthropol*. 2007;26(2):109–112.

59. Norgan N. Population differences in body composition in relation to the body mass index. *Eur J Clin Nutr*. 1994;48(Supplement 3):S10–S25.

60. Krebs NF, Himes JH, Jacobson D, Nicklas T a, Guilday P, Styne D. Assessment of child and adolescent overweight and obesity. *Pediatrics*. 2007;120(Suppl 4):S193–S228.

61. Nihiser AJ, Lee SM, Wechsler H, et al. BMI measurement in schools. *Pediatrics*. 2009;124 Suppl :S89–97.

62. Moss A, Smith S, Null D, Roth SL, Tragoudas U. Farm to School and Nutrition Education: Positively Affecting Elementary School-Aged Children's Nutrition Knowledge and Consumption Behavior. *Child Obes*. 2013;9(1):51–56.

63. Taylor JC, Johnson RK. Farm to School as a strategy to increase children's fruit and vegetable consumption in the United States: Research and recommendations. *Nutr Bull*. 2013;38:70–79.

Chapter 8. Overall Conclusions and Future Directions

Overall Conclusions

The central hypothesis of this dissertation was that farm to school programs serve as a viable strategy to reduce the prevalence of overweight and obesity among elementary-aged children through improved mediators of, and measured, fruit and vegetable consumption. The results described in the preceding chapters suggest that farm to school programs have promising potential to be a meaningful strategy for obesity prevention, but they fall short of fully testing this hypothesis. The stated specific aims involved (1) evaluation of farm to school program effectiveness as a strategy to improve children's dietary knowledge, attitudes, and fruit and vegetable consumption; (2) examining the relationship of total energy intake to energy from fruits and vegetables in school lunch; (3) examining factors associated with fruit and vegetable waste in the school lunch setting, within the context of farm to school programs; and (4) examining short-term longitudinal BMI *z*-score outcomes in children participating in farm to school programs.

With respect to the first aim, these data show that farm to school programs were effective in making small, significant improvements in:

- knowledge of nutrition and agricultural concepts, *as evidenced by longitudinal improvements in knowledge scores (chapter 4)*
- attitudes toward eating new fruits and vegetables, *as evidenced by (a) baseline cross-sectional increases in attitudes scores commensurate with prior farm to school program years, and (b) further longitudinal improvements in attitudes scores (chapter 4)*
- access to fruits and vegetables in school lunch, *as evidenced by (a) increases in the number of fruit and vegetable items on students' school lunch trays commensurate with increasing years of*

prior farm to school programming, and (b) decreases in the percent of student school lunch trays containing no fruit or vegetable items (chapter 4)

- consumption of fruits and vegetables in school lunch, *as evidenced by (a) increases in the amount of fruits and vegetables that disappeared from students' school lunch trays commensurate with prior farm to school program years, and (b) decreases in the percent of student school lunch trays showing no fruit or vegetable consumption (chapter 4)*

The above factors (access, knowledge, attitudes), as presumed mediators of fruit and vegetable consumption, are presumed to indicate their potential for obesity prevention and lead to the second aim for the reasons described in chapter 1.

The second aim, assessing the relationship between children's fruit and vegetable consumption and total energy intake, grew out of an unclear relationship in the peer-reviewed literature to date, as described in chapter 1. A frequent explanation for the proposed mechanism between increased fruit and vegetable consumption and decreased obesity is that of volume displacement: consuming energy-dilute fruits and vegetables (with bulky volume due to high water and fiber contents) leads to displacing energy-dense foods from the diet, resulting in an overall decrease in total energy intake, thus yielding the potential for decreased obesity. These data do not support this hypothesis (chapter 6), suggesting instead the phenomenon of *calorie* displacement: higher energy from fruits and vegetables within a single (school lunch) meal was associated with higher total energy, but containing a larger proportion of calories from fruits and vegetables. Thus, it remains conceivable that dietary increases in fruits and vegetables could lead to a multitude of health benefits and may, in the long term, favorably impact weight status outcomes.[1–6] As alluded above, we were unable to fully test the weight-outcomes hypothesis.

The third aim involved examining factors of school lunch fruit and vegetable waste in the context of farm to school programs. We were assess correlates of fruit and vegetable consumption at school lunches by examining waste of fruit and vegetable items (chapter 5). Although many factors were significantly correlated with differences in waste volume both overall and across time, perhaps the most important finding is that some students participating in Wisconsin farm to school programs put fruit and

vegetable items on their school lunch trays that they reported having previously tried and not liked, and wasted those items at a volume that was no different from items students reported having tried and liked. This achievement – getting students to try, and to actually eat, fruits and vegetables they have never tried, or have previously tried and not liked – is certainly a favorable outcome for farm to school programs. Other studies have shown that decreased food neophobia improves liking of new foods, particularly fruits and vegetables to which children are exposed during interventions designed to reduce neophobia, and may have the potential to favorably impact diet quality.[7–12]

The fourth aim, assessing longitudinal BMI *z*-score outcomes, indicate that farm to school programming yields no measurable short-term impact, whether considered as a total cohort or in comparison with students not participating in farm to school (chapter 7). However, we lacked statistical power to compare students in new farm to school sites with those in established programs (particularly after accounting for the differences in students' ethnicities in the two groups); moreover, the comparison cohort data organization did not permit longitudinal analysis among specific individuals with three measurements. As described in chapter seven, BMI is best used as a screening tool rather than an ultimate health indicator; it should be considered in the entire context of a child's health, including their attitudes toward healthy behaviors, demonstrated health-related behaviors, and cardiovascular fitness. It is important to note that this evaluation scope was limited to assessing farm to school program effects, and thus did not include measures of physical activity, the home and community food environments, parental diet or activity habits, screen time, or individual-level measures of socioeconomic status, all of which are known to contribute an individual's energy balance and resultant weight status.[13–21]

Considered all together, our data show small, significant changes in both mediators of and measured fruit and vegetable consumption. Although there is not substantial evidence suggesting the potential for farm to school programs to favorably impact BMI outcomes, the small, measurable improvements demonstrated in knowledge, attitudes, access, and consumption are important achievements. The improvements demonstrated in this dissertation ought to be viewed as precursors to long-term healthy habit formation, and the lack of BMI changes are not wholly unexpected given the

relatively short evaluation time frame. The small changes observed suggest that farm to school programming may not be the juggernaut that so many laypeople search for in obesity prevention (or resolution), but that it is promising as part of a series of strategies and policies to improve access to, knowledge of, attitudes toward, and actual decisions to make healthy food behavior choices for all people.

Future evaluations of farm to school programs are unlikely to be on the level of randomized, controlled trials, though those are the gold standard for delineating the effects of a therapy or intervention. The environment in the United States is such that attitudes toward healthy eating are improving, thanks in part to high-profile public health messaging and federal initiatives such as Michelle Obama's active involvement in planting and harvesting from a vegetable garden in the White House yard, the USDA's *MyPlate* corresponding to the 2010 Dietary Guidelines for Americans, the USDA's *Know Your Farmer, Know Your Food* initiative to strengthen local and regional food systems, and the increases in fruit and vegetable requirements within the National School Lunch Program as part of the Healthy, Hunger-Free Kids Act. In the current socio-environmental context, finding communities uninfluenced by these initiatives are highly unlikely and thus a true case-control prospective study will be tainted by the general populations' awareness of such programs and goals. That does not diminish the need for further study, but future studies need to be carefully considered and necessarily must include a larger variety of measures to better delineate the effects of the program itself from the effects of a constantly changing society and evolving public attitudes toward, and actions to improve, individual- and public-level health. Examples of additional measures that would strengthen future farm to school analyses include physical activity, screen time, total dietary habits, parental/familial activity and diet habits, or community characteristics. Additionally, more work should be done to elucidate the potential effects of specific farm to school program activities on student outcomes.

Original Research Question Not Addressed

Despite the above findings, we did not fully address all of our original ambitious aims. The original research plan included an examination of Wisconsin F2S program activities, documented

quantitatively and qualitatively by AmeriCorps Members during the 2010-2011 program year, to integrate into an analysis of student outcomes. We hypothesized that (a) higher total F2S program activity (more activities) across a program year would yield greater improvements in student outcomes for mediators of and measured FV intake, and (b) specific F2S program activities may be associated with greater improvements in student outcomes than other activities. However, this proved to be a larger task than could be accomplished by one person. There were some seventeen different activities reported by AmeriCorps members over the course of the program year, each happening variously within three grades within each school. Eventually, we determined that we lacked sufficient schools and participating students to offer adequate statistical power to conduct these analyses with integrity and thus did not include it in the final dissertation work.

Future Directions: New Directions in Dietary Assessment

A significant difficulty in understanding the effects of farm to school programming on dietary outcomes is the limitations of traditional dietary measures. Food frequency questionnaires, 24-hour recalls, and food records are each prone to significant errors of underreporting, omission, and misremembering, and these errors are not uniform across all sociodemographic or anthropometric characteristics.[22–27] An additional challenge with measuring dietary intake is that of burden placed on research or evaluation participants: the best self-reported dietary measures may be weighed and measured food records, but this requires subjects to have access to, and actually use, measuring utensils, scales, and write down all foods and beverages consumed during the requested study period. This often leads participants to change their dietary choices in order to simplify this task, or to appear to have healthier habits than they typically have. The gold standard for measuring energy expenditure in humans, the doubly-labeled water method by Schoeller and Van Santen (1982),[28] has demonstrated the phenomenon of under-reporting.[25,29,30]

Recently, other researchers have sought to find a way to measure dietary intake in ways that are less burdensome for study participants but provide better information than is garnered from lower-subject-burden methods. A method that has been gaining traction involves the use of digital photography. Some groups have approached this method to capture assumed intake – that is, capturing a person's meal only before it has been consumed.[31] Others, including this study, have captured before- and after-meal images to enable pre- and post-meal comparison.[32–34] In general, comparisons of this method with weighed measures of consumption have demonstrated reliability/accuracy when photos are analyzed by trained assessors.[35–37]

Digital photographs offer a wealth of information, particularly when before- and after-meal photos are considered: items consumed (or not), portion sizes and consumption amount, preparation, and more. However, assessing digital photographs require significant input of time on the part of researchers. For this study, organizing and analyzing photographs took approximately 5 minutes per before-/after-meal tray pair; which amounts to 593 hours for the more than 7000 tray pairs that appeared in this study (nearly 15 full work weeks). In order to make better use of the informational capacity of photographs as a dietary assessment, method, determining a method for reducing researcher burden is important.

An emerging method for mining data from large volumes of digital photographs is "crowd sourcing," a method that has been used effectively in tobacco prevention research.[38] A Washington, D.C.,-based company, Survos, LLC, has expertise in developing methods for high-volume digital data analysis (including photographs) by engaging a "crowd-based workforce" to complete compartmentalized tasks designed to not overwhelm non-professionals (www.survos.com). Specifically, they design a series of simple, survey-based tasks that are applied collectively to a photograph to obtain the desired information. The surveys and photographs are uploaded Amazon's Mechanical Turk platform, which offers an on-demand, scalable workforce to complete the surveys (www.mturk.com/mturk/welcome). The surveys are called *Human Intelligence Tasks*, or HITs, by the Mechanical Turk platform. By completing HITs, the 'Turk Workers' earn money by working from home at the hours they choose for HITs they find interesting. Survos (and any other business choosing to use this platform) administrators

pay for satisfactory results. The Turk Worker crowd base is located around the world, making the workforce available any time an individual chooses to spend time online searching for HITs of interest to them. The global workforce facilitates swift processing of large volumes of data.

Under the Survos model, each survey is completed by multiple workers in order to verify agreement and to serve as measure of data reliability. The surveys can be programmed to be completed by as many Turk Workers as is desired, and the percent agreement between workers can be set to the desired agreement rate, before accepting workers' answers. Although optimal data fidelity is not standardized by Survos at this time, data are emerging to describe the relationship between number of surveys and percent agreement to help businesses choose the best parameters for their work and desired output.

Preliminary work for food-related photograph analysis is underway. First, photograph files are uploaded to the Survos server from the free file-sharing platform Dropbox (www.dropbox.com) directly from participating farm to school sites. As long as the date and time function are set correctly on the cameras used, the photographs' metadata is readable by the Survos server, thus automatically labeling photos with date and time. On the programming end, each set of photos (one day at one school) has a corresponding set of survey questions to match the menu for the day, and a series of reference photos are selected to assist Turk Workers in correctly identifying items and sizes.

We have identified and discussed multiple approaches for the analysis of photos coming from the school cafeteria setting. One approach is to analyze the photos in two distinct phases. The first phase asks the work force to identify (a) whether the tray appears to contain food before or after the meal was consumed, (b) the number written on the tray label (typed answer), and (c) whether there are any potential issues with the photo, such as it looks unused, brought from home, the ID label is difficult to read, or there are other issues with the photo. Preliminary trials of this approach to the data mining were tasked at $0.02 per photo, with a minimum question-level agreement (i.e., for a specific item answer within a photo) of 65% between at least two, and no more than five, Turk Workers. If HIT agreement (total

answers between multiple Turk workers pertaining to all answers concerning a single photo) is less than 80%, the HIT will be offered to another Worker, up to five workers, to achieve consensus.

The second phase is a lengthier set of tasks, and it obtains information about which items and how much of each appear in the photo. Reference photos are available for each item, in varying amounts, to assist Turk Workers' selection of items and their corresponding amounts. Turk workers select from among a set of standardized answers, usually ranging from "none" to "more than [a standard amount]." Preliminary runs of this data were tasked at $0.07 per photo, with a minimum question-level agreement threshold (i.e., for a specific item within a photo) of 70% between 2 and 6 Turk workers (for example, 100% agreement between two Turk workers will stop further HITs being generated for a given photograph). If HIT agreement (total answers between multiple Turk workers) is less than 90%, the HIT will be extended to another Turk Worker, up to six workers, to achieve consensus.

We have discussed many additional approaches to the photo analysis process. A goal under discussion is to change the assessment model from consensus to average, for example by using a slider bar for workers (again with reference photos). Another goal is to move from menu-specific food question generation to building a library of foods and typical amounts, with associated reference photos, which could be used for any school including a given item. Given the vast data bank of photos already available, this generates the potential to create a very usable and marketable system that would make photo analysis of school cafeteria lunch trays an efficient, affordable means of dietary assessment. At this point, we estimate that each tray will cost approximately $1 to process through the Turk method; by comparison, the Block Kids 2004 Food Frequency Questionnaire has a per-student fee of $6 when administered online.[39] (Both methods have associated administrative fees, which vary by length of study.)

Post-Turk Worker visual assessment, this information can be used in many ways. First, at a macro-level, it can be used to calculate the overall cups of fruits and vegetables available on and disappeared from lunch trays, as was performed for the current study. Secondly, at a more micro-level, this data can be linked to the USDA Nutrient Database (SR 26) for calculation of tray-specific energy

availability and consumption, both in total and for fruits and/or vegetables separately. Because of the automatic nature of linkage to the USDA Nutrient Database, it is also feasible to obtain tray-level nutrient availability and intake for virtually any nutrient of interest.

Additional applications for this technology are conceivable. Any intervention that contains a component that makes dietary behaviors an outcome of interest could tweak the questions about the photographs, or the corresponding analyses, to meet their needs. Studying characteristics of foods not eaten (wasted) in various settings, such as cafeterias or schools could be important economic or environmental studies, such as cafeterias exploring the potential to implement a composting program or schools looking to improve fruit and vegetable consumption through tweaking characteristics of items offered on the school meal menu. Individual-level studies are also feasible; personal technology device applications (such as for a smartphone or table) are also a feasible method of collecting photographic information that could be analyzed by Turk workers to obtain food group and nutrient consumption information. Conceivably, this could be marketed commercially to individuals seeking to improve their diets through real-time feedback from a dietitian following large-volume submission of dietary photographic data.

Another group previously described a method for using crowdsourcing technology to analyze digital photographs for nutrition analysis.[40] That group, inspired by the Remote Food Photography Method of Corby Martin[34] (which employed expert nutritionists for image analysis), proposed a series of small tasks to completed by a crowd-based workforce to tag items (draw a box around), identify items (using entries from a nutrition database), and measure items (numeric estimation of item size according to crowd-worker's selection from among a pre-set list of units).[40] Survos aims to improve on this model by providing more standardization of measurement units and reference photos to assist the crowd-based workforce in estimating sizes, and by eliminating the need for workers to identify nuanced items within a vast database (instead, the item's identification within the database will be preselected by a trained expert and described in simple enough terms for identification distinctly from other items on a tray). These

improvements are particularly applicable to the school cafeteria setting, where serving sizes are fairly standardized and menus are limited.

Importantly, this technology makes it feasible to more objectively measure dietary intake than traditional self-report methods that place lower burden on participants. This is particularly important in assessing children's diets, especially in settings where timely data collection is critical to minimize disruptions to the school day. Moreover, this technology places much less burden on the researcher for raw analysis but still provides excellent opportunity for thorough review of large volumes of data.

Chapter 8 References

1. Vernarelli JA, Mitchell DC, Hartman TJ, Rolls BJ. Dietary energy density is associated with body weight status and vegetable intake in U.S. children. *J Nutr*. 2011;141:2204-2210.

2. Tohill BC, Seymour J, Serdula M, Kettel-khan L, Rolls BJ. What epidemiologic studies tell us about the relationship between fruit and vegetable consumption and body weight. *Nutr Rev*. 2004;62(10):365-374.

3. Ledoux TA, Hingle MD, Baranowski T. Relationship of fruit and vegetable intake with adiposity: a systematic review. *Obes Rev*. 2011;12(5):e143-50.

4. Pérez-Escamilla R, Obbagy JE, Altman JM, et al. Dietary energy density and body weight in adults and children: a systematic review. *J Acad Nutr Diet*. 2012;112(5):671-84.

5. Angelopoulos PD, Milionis HJ, Grammatikaki E, Moschonis G, Manios Y. Changes in BMI and blood pressure after a school based intervention: the CHILDREN study. *Eur J Public Health*. 2009;19(3):319-325.

6. Prentice RL, Willett WC, Greenwald P, et al. Nutrition and physical activity and chronic disease prevention: research strategies and recommendations. *J Natl Cancer Inst*. 2004;96(17):1276-87.

7. Kalich KA, Bauer D, McPartlin D. "Early Sprouts" – Establishing healthy food choices for young children. *Young Child*. 2009;64(4):49-55. Available at: http://www.naeyc.org/yc/pastissues/2009/july.

8. Russell CG, Worsley A. A population-based study of preschoolers' food neophobia and its associations with food preferences. *J Nutr Educ Behav*. 2008;40(1):11-19.

9. Gibbs L, Staiger PK, Johnson B, et al. Expanding children's food experiences: the impact of a school-based kitchen garden program. *J Nutr Educ Behav*. 2013;45(2):137-46.

10. Anzman-Frasca S, Savag JS, Marini ME, Al E. Repeated exposure and associated conditioning promote preschool children's liking of vegetables. *Appetite*. 2012;58(2):543-553.

11. Lakkakula A, Geaghan JP, Wong W-P, Zanovec M, Pierce SH, Tuuri G. A cafeteria-based tasting program increased liking of fruits and vegetables by lower, middle and upper elementary school-age children. *Appetite*. 2011;57(1):299-302.

12. Gatto NM, Ventura EE, Cook LT, Gyllenhammer LE, Davis JN. LA Sprouts: A garden-based nutrition intervention pilot program influences motivation and preferences for fruits and vegetables in Latino youth. *J Acad Nutr Diet*. 2012;112(6):913-920.

13. Vos MB, Welsh J. Childhood obesity: update on predisposing factors and prevention strategies. *Curr Gastroenterol Rep*. 2010;12(4):280-287.

14. Lee H. The role of local food availability in explaining obesity risk among young school-aged children. *Soc Sci Med*. 2012;74(8):1193-203.

15. Hopper CA, Munoz KD, Gruber MB, Nguyen KP. The effects of a family fitness program on the physical activity and nutrition behaviors of third-grade children. *Res Q Exerc Sport.* 2005;76(2):130-139.

16. Gubbels JS, Kremers SP, Stafleu A, et al. Clustering of dietary intake and sedentary behavior in 2-year-old children. *J Pediatr*. 2009;155(2):194-198.

17. Cutler GJ, Flood A, Hannan P, Neumark-Sztainer D. Multiple sociodemographic and socioenvironmental characteristics are correlated with major patterns of dietary intake in adolescents. *J Am Diet Assoc*. 2011;111(2):230-40.

18. Fox MK, Dodd AH, Wilson A, Gleason PM. Association between School Food Environment and Practices and Body Mass Index of US Public School Children. *J Am Diet Assoc*. 2009;109(Supplement 2):S108-S117.

19. De Craemer M, De Decker E, De Bourdeaudhuij I, et al. Correlates of energy balance-related behaviours in preschool children: a systematic review. *Obes Rev*. 2012;13(Suppl 1):13-28.

20. Verloigne M, Van Lippevelde W, Maes L, Brug J, De Bourdeaudhuij I. Family- and school-based correlates of energy balance-related behaviours in 10-12-year-old children: a systematic review within the ENERGY (EuropeaN Energy balance Research to prevent excessive weight Gain among Youth) project. *Public Health Nutr*. 2012;15(8):1380-1395.

21. Popkin BM, Paeratakul S, Zhai F, Ge K. A review of dietary and environmental correlates of obesity with emphasis on developing countries. *Obes Res*. 1995;3(Supplement 2):145s-153s.

22. Thompson FE, Kipnis V, Subar AF, et al. Evaluation of 2 brief instruments and a food-frequency questionnaire to estimate daily number of servings of fruit and vegetables. *Am J Clin Nutr*. 2000;71(6):1503-1510.

23. Horner NK, Patterson RE, Neuhouser ML, Lampe JW, Beresford SA, Prentice RL. Participant characteristics associated with errors in self-reported energy intake from the Women's Health Initiative food-frequency questionnaire. *Am J Clin Nutr*. 2002;76(4):766-773.

24. Burrows TL, Martin RJ, Collins CE. A systematic review of the validity of dietary assessment methods in children when compared with the method of doubly labeled water. *J Am Diet Assoc*. 2010;110(10):1501-1510.

25. Subar AF, Kipnis V, Troiano RP, et al. Using intake biomarkers to evaluate the extent of dietary misreporting in a large sample of adults: The OPEN Study. *Am J Epidemiol*. 2003;158(1):1-13.

26. Livingstone MBE, Robson PJ, Wallace JMW. Issues in dietary intake assessment of children and adolescents. *Br J Nutr*. 2004;92(2):S213-S222.

27. Schoeller DA. Limitations in the assessment of dietary energy intake by self-report. *Metabolism*. 1995;44(Supplement 2):18-22.

28. Schoeller DA, van Santen E. Measurement of energy expenditure in humans by doubly labeled water method. *J Appl Physiol*. 1982;53(4):955-959.

29. Schoeller DA. Validation of habitual energy intake. *Public Health Nutr*. 2002;5(6A):883-888.

30. Trabulsi J, Schoeller DA. Evaluation of dietary assessment instruments against doubly labeled water, a biomarker of habitual energy intake. *Am J Physiol Endocrinol Metab*. 2001;281(5):E891-E899.

31. Sabinsky MS, Toft U, Andersen KK, Tetens I. Validation of a digital photographic method for assessment of dietary quality of school lunch sandwiches brought from home. *Food Nutr Res*. 2013;57.

32. Williamson DA, Allen HR, Davis Martin P, Alfonso A, Gerald B, Hunt A. Digital photography: a new method for estimating food intake in cafeteria settings. *Eat Weight Disord*. 2004;9:24-28.

33. Swanson M. Digital photography as a tool to measure school cafeteria consumption. *J Sch Health*. 2008;78(8):432-437.

34. Martin CK, Han H, Coulon SM, Allen HR, Champagne CM, Anton SD. A novel method to remotely measure food intake of free-living individuals in real time: the remote food photography method. *Br J Nutr*. 2009;101:446-456.

35. Williamson DA, Allen R, Martin PD, Alfonso AJ, Gerald B, Hunt A. Comparison of digital photography to weighed and visual estimation of portion sizes. *J Am Diet Assoc*. 2003;103(9):1139-1145.

36. Martin CK, Nicklas T, Gunturk B, Correa JB, Allen HR, Champagne C. Measuring food intake with digital photography. *J Hum Nutr Diet*. 2013:1-10.

37. Martins Rodrigues AG, da Costa Proenca RP. Use of food images for evaluating food intake. *Revista de Nutroção - Brazlian Journal of Nutrition*. 2011;24(5):765-776.

38. Ilakkuvan V, Tacelosky M, Ivey K, et al. Cameras for public health surveillance: Crowdsourced annotation of point-of-sale photographs. *JMIR Res Protoc*. 2014;(in press).

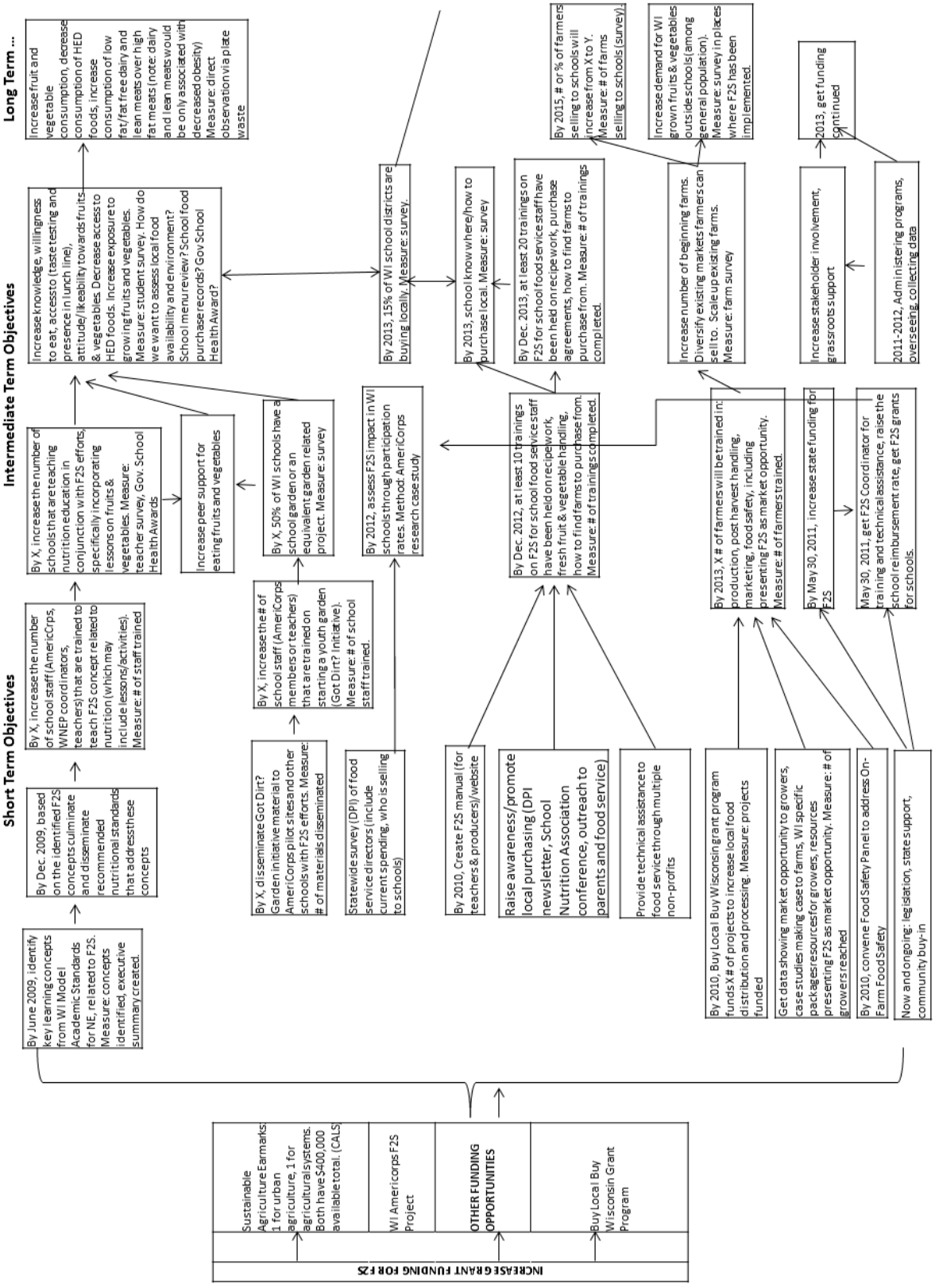
39. NutritionQuest. NutritionQuest Assessment & Analysis Services: Pricing and Ordering. 2014. Available at: http://nutritionquest.com/assessment/pricing-and-ordering/.

40. Noronha J, Hysen E, Zhang H, Gajos KZ. PlateMate: Crowdsourcing Nutrition Analysis from Food Photographs. In: *Proceedings of the 24th Annual ACM Symposium on User Interface Software and Technology* (pp. 1-12). ACM. Santa Barbara, CA; 2011.

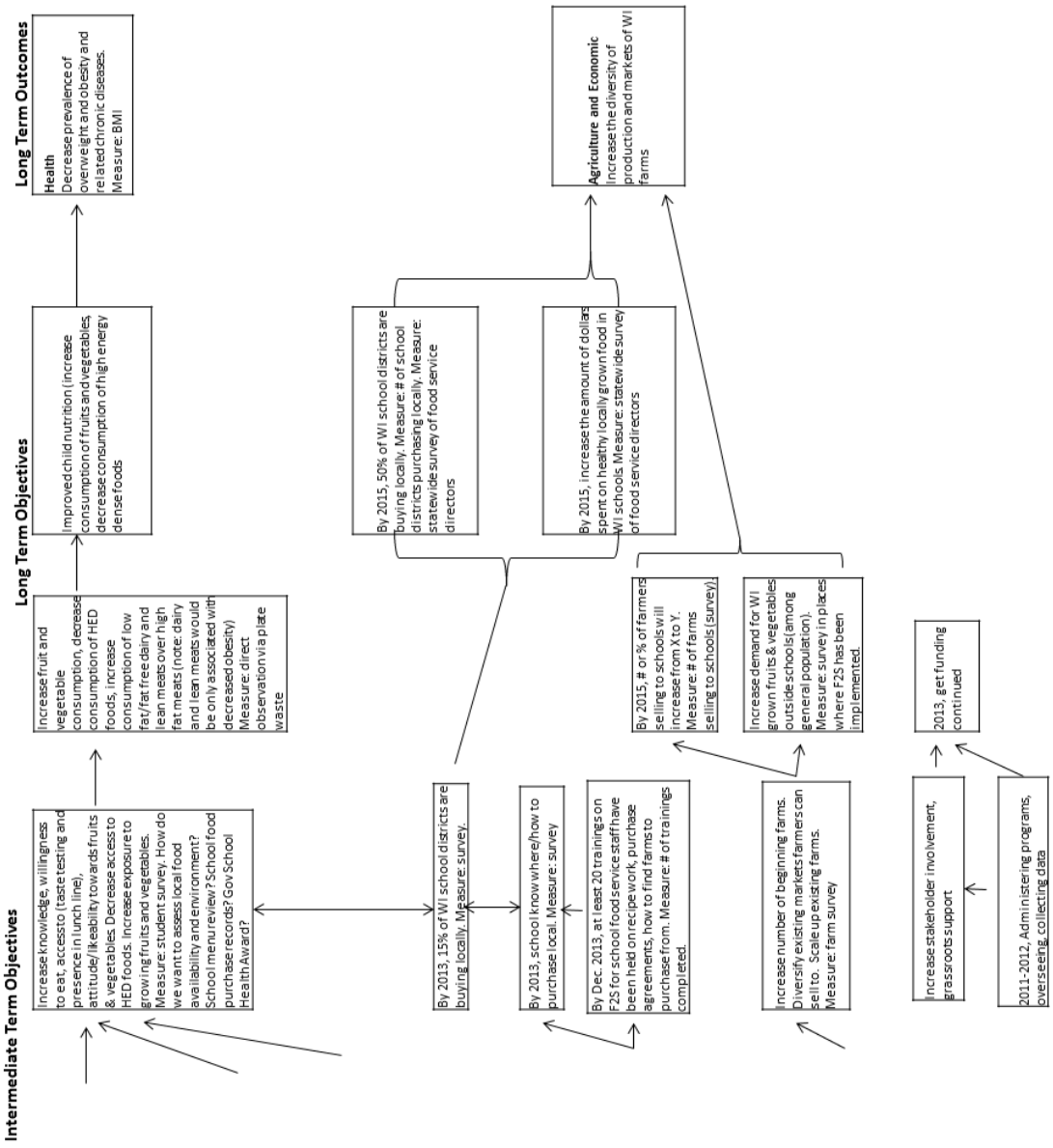
APPENDICES

Detailed Appendices Contents

APPENDIX 1. Wisconsin Farm to School Logic Model (September 2009)



Wisconsin Farm to School Logic Model (2009), Continued.



APPENDIX 2. Wisconsin Farm to School Evaluation Manual, 2010-2011

Note: Page numbers have been updated to match pagination in this document

Wisconsin Farm to School

Evaluation Manual

2010-2011

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Overview

The Department of Health Services (DHS) subgroup Nutrition, Physical Activity and Obesity (NPAO) Program submitted 3 grant applications as part of the American Recovery and Reinvestment Act (ARRA) – Communities Putting Prevention to Work (CPPW) funding. All three grants were awarded with funds from the Centers for Disease Control and Prevention (CDC) to promote state-wide policy and environmental changes with a focus on healthy behaviors related to nutrition, physical activity, and tobacco use. One focus is to increase access to fruits and vegetables in schools through the use of comprehensive farm-to-school strategies. The grants require strong program evaluation, and DHS has contracted evaluation services with UW-Madison College of Agriculture and Life Sciences (CALS). This is an opportunity for the DHS, Department of Public Instruction (DPI), and the Department of Agriculture, Trade, and Consumer Protection (DATCP), and UW-Madison to build a strong collaborative relationship. Increasing access to fruits and vegetables and improving eating behaviors through comprehensive farm-to-school efforts are goals of public health agencies, and rigorous evaluation is necessary in a culture increasingly focused on evidence-based practice.

Partnerships between schools, public health and human service agencies, and institutions of higher learning are vital to the success of improving children's long-term health. Schools provide an environment that is conducive to effective nutrition education delivery, and many children consume meals at school. The disease risks from poor nutrition and obesity have significant effects on lifetime health, and children are at greater risk for chronic disease such as Type II Diabetes Mellitus (T2DM). Overweight and obesity also is associated with lower cognitive and academic performance. As such, schools ought to teach and model optimal eating patterns in order to positively influence children's ideas and behaviors relating to their own health. Eating local food may positively influence the local economy. Schools are one setting where community agencies can collaborate with schools and parents to address critical health behaviors and provide needed services to guide all residents of a community toward improvements in health. This evaluation aims to engage all partners (schools, state agencies, and the university evaluation team) in student-focused health issues that will ultimately lead to building better systems in the state to enable and establish conditions in which students, their families, and their communities can be healthy.

It is important that information about Farm to School program activities be collected throughout the 2010-2011 academic year in order to provide the UW-Madison evaluation team with de-identified quantitative and qualitative data. The data will be used to measure the programs' impact on students' knowledge, attitudes, and behavior, as well as adult perceptions of the programs' opportunities and challenges. Schools and AmeriCorps members are expected to comply with the following data collection procedures to ensure optimal evaluation data collection by following the guidelines in this manual.

All organizations are committed to an open and cooperative relationship that will be maintained by the program staff and administration who are directly involved in the Farm to School program. In addition, DHS is committed to supporting to schools, school food services, and AmeriCorps through the Statewide Farm to School Coordinator position and the Evaluation Coordinator for CPPW projects.

School Responsibilities

Please refer to the Memorandum of Agreement signed by schools and the Farm to School Coordinator for more details. Schools have agreed to the following:

- Assign all third- to fifth-graders a 3-digit evaluation ID number, which will be maintained throughout the evaluation and given to students for using during surveys.
- Provide time for student surveys:
    - Student Knowledge/Attitudes Survey (online, unless paper copies are requested)
    - Block Kid's Food Frequency Questionnaire (online, unless paper copies are requested)
        - Students need their evaluation ID to take these surveys.
        - AmeriCorps member or teachers may administer these surveys.
- Provide access to FitnessGram data (height, weight, birth date, gender, and ethnicity) for third through fifth graders.
    - If the school does not use FitnessGram, height and weight measurements will be taken by the school nurse or other qualified person, following guidelines in the DHS publication *To Weigh and Measure* (2008).
    - Tanita scales and Handi-Stat Right Angle Device and measuring tape are available if needed.
- Permit Plate Waste Observation in the cafeteria for two sets of 4 consecutive days.
- Participation in interviews at the end of the school year: school administrator(s), teacher(s), food service director (and staff, if time allows and individuals are willing). AmeriCorps member will conduct the interviews.
- Provide guidance to AmeriCorps member for choosing parent(s) and community member(s) to invite to be interviewed. AmeriCorps member will conduct the interviews.
- Provide 2009-2010 monthly data from School Food Services (meal participation rates, menus, food expenditures (total and locally-grown/produced), percent of the student body eligible for free/reduced price lunches, and revenue).
    - This should be the data submitted to DPI to obtain federal and state reimbursements, and will be used to compare with 2010-2011 data.
- Provide 2010-2011 monthly data from School Food Services (submit on DPI Claim Form and Supplemental Claim form, or in whatever manner it is submitted to the district for DPI purposes):
    - Percent of student body eligible for free/reduced-price meals
    - School meal participation rates
    - School meal revenue (separated by reimbursements and student fees)
    - Total food expenditures
    - Local food expenditures, including itemized list of locally grown/produced foods purchased
    - School meal menus, with local foods identified.
- Provide annual data for 2009-2010 and 2010-2011 academic years:
    - School absentee rates
    - Volunteer hours logged (including the capacity of volunteering; dates if possible)
    - Academic records (aggregated by grade; any standardized exam scores that would be sent to DPI for district-level public reporting)

AmeriCorps Member Responsibilities

Per contracts, AmeriCorps Members must participate in evaluation of Farm to School programs and activities. Members are responsible for the following:

- Obtain and keep a record of the paired student names and student evaluation ID numbers assigned by schools as a back-up. (The evaluation team will never see this paired list.)
- Complete baseline program survey (online)
- Conduct interviews, according to guidelines (page 10) with:
    - Farmers working with the school
    - School Food Service Director
    - Stakeholders:
        - School administrator
        - Parent
        - Teacher
        - Community member
    - Student focus groups
- Administer student surveys:
    - Student Knowledge/Attitudes Survey (online; paper available if requested)
    - Block Kids Food Frequency Questionnaire
- Organize and administer Plate Waste Observation using digital photography, per protocol (see pages 8-9)
- Monthly reports:
    - Farm to School program activity reports (online)
    - School menu analysis (obtain a copy of school meal menus for the entire month; identify local foods)
    - Assist as needed with school food service reporting (revenue, participation, local vs total food expenditures, itemized list of local foods purchased)
- End-of-year program survey (online)

Evaluation Tools

1. **Student evaluation ID number** – *due ASAP*
   Schools will assign all third- to fifth-graders a 3-digit evaluation ID number. This will be combined with a 2-digit school ID and 2-digit grade ID, resulting in a 7-digit evaluation ID, i.e. 0103005). This record must be maintained throughout the evaluation, and students must be told their number at appropriate times.

   A Microsoft Excel file template will be provided to all schools to create and maintain this information. School administrators should give a copy of the names paired with evaluation ID numbers to the AmeriCorps member/program implementer as an extra copy. The evaluation team will never see this paired list, but using the same number throughout the evaluation enables within-student change in knowledge, attitudes, and behavior as well as between-grade and between-school changes to be assessed. It may be helpful to give each classroom teacher a copy with their students' names and evaluation ID numbers.

2. **Dropbox**
   A series of Dropbox folders have been created to assist with submitting de-identified data and files to the Evaluation Team. AmeriCorps Members will receive personal invitations to "share" these folders as soon as possible. To download Dropbox, go to www.dropbox.com .

   To begin to learn how to use dropbox, take the tour available at: https://www.dropbox.com/tour or see https://www.dropbox.com/help/ for more information.
   If there are problems downloading the desktop application to a school-based computer, there is a web version available. See https://www.dropbox.com/help/90 to learn how to add files using the website (the second box on the page gives details).

3. **FitnessGram or Student Health Indicators** – *due Sept 30 2010, June 10 2011, Sept 30 2010*
   If the school uses FitnessGram already, schools must provide the evaluation team with access to data collected in FitnessGram assessments (height, weight, birth date, gender, and ethnicity) for third through fifth graders. Students should be identified with their 7-digit evaluation IDs.

   If the school does not use FitnessGram, height and weight measurements should be taken by the school nurse or another person trained according to the guidelines in the DHS publication *To Weigh and Measure* (2008). Tanita scales and Handi-Stat Right Angle Device and measuring tape are available if needed. A sample data collection sheet is provided in this manual (see page 17) and an electronic version will be in Dropbox.

4. **Baseline AmeriCorps Member Survey** – *due Sept 25*
   This survey can be found online. Program Implementers will be sent a link to their email by September 1, 2010. Each Member should complete this independently. This survey must be completed in one sitting. You will be given the opportunity to print a copy for your records at the completion of the survey.

5. **Student Knowledge & Attitudes Survey** – *due Sept 30 2010, June 10 2011, Sept 30 2011*
   The link to this survey will be sent to AmeriCorps Members/Program Implementers at the beginning of September and again at the beginning of May. Students must enter their correct 7-digit evaluation ID number both times. If teachers are administering the survey instead of the AmeriCorps Member, the link will be sent to school administrators to be distributed to teachers. Students may ask questions during the survey. A paper version of this survey is available upon request (see page 18 to preview the survey).

   Survey password: **gofruitveg**
   Expected time for online survey completion: 10-20 minutes

6. **Block Kids 2004 Food Frequency Questionnaire** - *due Sept 30, June 10*
   The link to this survey will be sent to AmeriCorps Members/Program Implementers at the beginning of September and again at the beginning of May. Students must enter their correct evaluation ID number both times. If teachers are administering the survey instead of the Farm to School Program Implementer, the link will be sent to school administrators to be distributed to teachers. Students may ask questions during the survey. (See Appendix B for a paper version of this survey.)

   Student usernames: Fall: [evaluation ID]1 (i.e., 01030051)
   Spring: [evaluation ID]2 (i.e., 01030052)
   Survey password: **gofruitveg**
   Expected time for online survey completion: 25-30 minutes

7. **School Menu Analysis –** *due the 5th of each month following the month being reported*
   AmeriCorps Members/Program Implementers and School Food Service Directors dealing with food procurement and menus should work together to identify the local foods featured in the school meal menus for an entire month. The entire month's menu, with local foods identified, should be submitted to the UW Evaluation Team electronically, either by scanning and sending an image or by creating a document that identifies the local foods.

   This information must be submitted each month.
   For example, September menus are due October 5; October menus are due November 5; etc.

8. **Plate Waste Observation** – *due Oct 8 2010, June 10 2011*
   Per protocol, complete 4 consecutive days of digital photography observation of school lunches in the fall and in the spring. Digital photographs must be uploaded to the "Plate Waste Digital Photos – Shared" DropBox folder, being sure to upload to the folder specific to the school and day. See page 8 for more information.

9. **Monthly Activity Report** – *due the 5th of each month following the month being reported*
   This survey can be found online. AmeriCorps Members will be sent a link to their email by the 25th of each month. Community Outreach and Nutrition Education Members should each complete this report, independently, answering as the questions pertain to their own work with Farm to School programs. A sample report is included in this manual (see Appendix A). An activity log, found in

the Dropbox folder, will be provided to help track details for each activity (see page 27). By accessing the survey from the email link on the same computer and using the same browser as the first time it is accessed, the survey will be able to be completed over the course of one week from the first day the survey is accessed.

10. Interview Guides:

Electronic copies of all interview guides can be found in the Dropbox folder "F2S\Interview Guides." Conduct according to the *Guidelines for Selecting Interviewees* (see page 10). Plan to spend 30-60 minutes for each interview, and please audio-record each interview. Submit to the evaluation team either by email or via Dropbox. See the timelines (beginning on pages 11 and 15) for deadlines. The interview guides are included in this manual for your reference (with small font and minimized spacing to preserve paper) on pages 28-37.

11. School Food Service Data Collection

On a monthly basis, school food services must submit:

- Participation rates
- Percent of students eligible for free/reduced price meals
- Total food expenditures ($)
- Local food expenditures, itemized (and $)
- Revenue (student fees, state reimbursements, federal reimbursements)

Schools may submit this information to the evaluation team using any of the following:

- DPI Claim and Supplemental Claim forms
- Evaluation Team-provided summary Excel File
- Send the evaluation team a copy of what they send to their district to satisfy DPI reporting requirements.

Electronic submission to the evaluation team is preferred. Electronic files are available in the Dropbox folder, "F2S/Food Services" and examples are found in this manual (see pages 38-39). If the School Food Service Director/Staff would like assistance from the AmeriCorps Member in gathering and submitting this information to the evaluation team, it is up for negotiation between the School Food Service Director and AmeriCorps Member. These reports are due at the end of the month following the month being reported (see timelines beginning page 14 for more details).

12. End-of-year AmeriCorps Member/Program Implementer Survey – *due July 31*

This survey will be online. Program Implementers will be sent a link to their email by July 1, 2010.

Plate Waste Observation – Protocol

We will use digital photography to assess fruit and vegetable consumption in third- through fifth-grade students at schools participating in Farm to School, both at the beginning and the end of the 2010-2011 school year, for four consecutive days each time (Tuesday through Friday) in order to obtain a wide variety of menus and consistency. If possible, the menus should be the same in the fall and spring to reduce variability, but it is not mandatory.

AmeriCorps Members should engage 1-3 volunteers (depending on the number of students being observed) to help take photographs of "before" and "after" school lunch trays each day (preferably the same volunteers each day, but that is not mandatory). Each volunteer should use their own digital camera that has the capability to directly upload to a computer immediately following the observation day (a total of 4 digital cameras are likely to be needed, depending on the size of the memory card; batteries should be new or freshly charged, and extras should be available just in case). At least one previous study has found this method to not disrupt the school cafeteria setting, and analysts' estimations of consumption levels agreed with each other well (1).

On site – each day:

1. AmeriCorps Members provide stickers ahead of time:
   -color-coded by grade: 3rd grade = red, 4th grade = blue, 5th grade = yellow
   -pre-numbered (1 through xx) so that there is one for each student eating a school lunch
   -Ideally, each child would have the same number each day (perhaps using alphabetical order) but it is **not** mandatory. (If you manage it, please indicate this to the evaluation team - especially if you can link it specifically to student evaluation ID numbers both in the fall and in the spring!)

2. **Either (a)** In classrooms prior to lunch, teachers will place stickers on students' wrists, palm-side *and instruct all students to be sure they dump their own trays when they have finished eating.*
   or **(b)** Trays will be labeled in advance by the AmeriCorps member and/or volunteers with numbered, color-coded dots or tape (labeled as described in #1 above) that dissolve in water.

3. Digital photographs should be taken from a height of approximately 16 inches above the tray and at approximately a 45° angle.
   a) As students exit the lunch line, volunteers will take a digital photograph of each "before" tray, with the student's wrist and sticker showing (no faces).
   b) Just before students dump their tray at the end of the meal, volunteers will take a digital photograph of the "after" tray with the student's wrist and sticker showing (no faces).
      (i) Adjustments may need to be made to differentiate between eaten and uneaten portions, for example orange peels remaining versus uneaten orange slices ought to be clearly distinguishable. The photographers may ask the children to move the food themselves, or the photographers may wear gloves and adjust the layout themselves.

(ii) If time constraints do not allow for "after" photos ***and*** if lunch trays are disposable (stickers can be placed directly on the trays), students may leave trays on the table for photographs to be taken after children have left the cafeteria.

4. Volunteers and AmeriCorps Member will upload digital photos to computer (or directly to Dropbox – see # 5) to clear cameras for the next day.

5. The AmeriCorps Member will subsequently upload all photos to the appropriate Dropbox folder (specific to school and day; separate by camera if possible) to submit to the evaluation team.

6. AmeriCorps Member will provide notes and observations to the evaluation team, such as:
   a) any problems that arose during data collection (photography slowing the serving line, or students disposing of trays prior to photography)
   b) cameras used (make, model, year)
   c) whether or not students received same numbers for ID sticker each day
   d) whether or not sticker numbers correspond exactly to an evaluation ID each day
   e) any other observations that you think may be helpful for analysis and interpretation.

Evaluation:

1. Evaluation team will receive school menus as part of monthly data collection from school food service directors.
2. Evaluation team will match "before" and "after" trays according to grade color and number, and compare to visually estimate the percent of each fruit and vegetable consumed (to the nearest 10% increment), and enter data into the appropriate spreadsheet.

The ideal data collection is for each participating school to take "before" and "after" photographs of school lunch trays:

-for all third through fifth graders
-on four consecutive days (see timeline)
-by AmeriCorps member plus 3 volunteers each day, with volunteer/borrowed digital cameras.

If volunteers are not available, we will leave it up to the AmeriCorps member to decide how many grades are possible (target 5th grade first, then add 4th grade, then add 3rd grade). It is intended that the same groups are photographed both in the fall and in the spring.

Reference

Swanson, M. (2008) Digital Photography as a Tool to Measure School Cafeteria Consumption. *J School Health*, 78(8): 432-437.

Selecting Interviewees – Guidelines

****PLEASE AUDIO RECORD ALL INTERVIEWS. IF THE INTERVIEWEE DOES NOT GRANT PERMISSION, TAKE DETAILED NOTES.****

Farmers – ***Interview Guide for Farmers/Suppliers*** *Due Sept 30 2010, June 30 2011*
If your district/schools is connected with more than one farmer/cooperative for Farm-to-School food procurement and other activities, it would be ideal to interview one farmer from each farm or cooperative in order to give a broad scope of data for this evaluation. If several interviews are not possible, please choose to interview farmers who are most actively involved, who have a unique approach/involvement, who are new to F2S this year, and/or are most enthusiastic about promoting F2S in the community. Of course, we know you're asking for a rather significant piece time from busy people, so choose the farmers who are *willing* to be interviewed. Interview the number that time ultimately allows.

Stakeholders – ***Interview Guide for Stakeholders*** *Due June 30 2011*
We have identified four broad categories of stakeholders: parents, teachers, school administrators, and community members. We need 1-2 people included from each category. If time allows and individuals are willing, additional interviews are welcome. The interview questions are geared toward persons who are more involved in F2S efforts rather than not.
***Parents*:** Select parents by asking school administrators or teachers to learn what parents are involved in or supportive of F2S efforts at the school.
***Teachers*:** Select teachers by asking school administrators (or food service staff) which teachers are involved in or supportive of F2S efforts at the school. If your own activities indicate to you which teachers fall into those categories, we trust you to choose wisely without consulting school administrators.
School administrators: Ideally, this would be the principal or vice principal. In smaller districts, a superintendent who is directly involved in the day-to-day running of the school would also be a candidate. Please choose the administrator with the most direct involvement in F2S activities/programs and, of course, a willingness to be interviewed.
Community members: These interviewees may be persons volunteering in the schools (non-parents), or local business leaders partnering with the school to support F2S activities, or other community members who are working to implement local food systems with some direct involvement in F2S efforts.

School Food Service Directors – ***Interview Guide for School Food Professional*** *Due June 30 2011*
Please choose from among the food service staff the person who is, above all, most willing to be interviewed and with the most direct involvement in engaging and implementing F2S in the school cafeteria. If time allows and are multiple staff members willing, additional interviews are welcome. Please interview the person most in charge first, and follow that with staff members directly involved with food preparation and serving.

Students Focus groups – ***Student Interview Guide*** *Due June 15 2011*
Interview one to three groups of 5-10 students, starting with fifth-graders and following with fourth-, then third-graders. Audio record the sessions. Either you may randomly select students, or the teachers or school administrators may randomly select students to participate. Another possibility would be to interview an entire class if you are provided with class time during the spring semester. This interview would be performed as a large focus group.

Timeline – AmeriCorps Member

Month	Tool	Due date	Objective
September 2010	1. Obtain from school and keep records of students' school evaluation ID numbers	1. ASAP ***(not distributed)***	1. Organization of data, to enable comparisons of individual student change through the year.
	2. Baseline AmeriCorps survey online **(Both)**	2. Sept 25	2. Baseline assessment: perceived opportunities and challenges for working with Farm to School.
	3. Farmer interview(s) **(Community Outreach)**	3. Sept 30	3. Baseline records: farmer's involvement in, and perceived opportunities and challenges for participating with Farm to School.
	4. Student Knowledge/Attitudes Survey **(Nutrition Educator)**	4. Sept 30	4. Baseline assessment: children's attitudes toward trying new fruits and vegetables, and knowledge.
	5. Block Kids Food Frequency Questionnaire **(Nutrition Educator)**	5. Sept 30	5. Baseline assessment: children's overall dietary patterns.
	6. School Menu analysis: obtain a copy of school meal menus for the entire month; identify local foods **(Community Outreach)**	6. Oct 5	6. Ongoing records: local foods served in school cafeteria.
	7. Monthly activity report – online survey **(Both)**	7. Oct 5	7. Accurate records of program activities.
	8. Plate Waste Observation (4 consecutive days, between Sept 20 and Oct 8) in cafeteria **(Community Outreach)**	8. Oct 8	8. Baseline quantitative observation: what fruits and vegetables students eat in school lunch, and how much.
	9. Where needed – assist School Food Services with reporting: revenue, participation, local vs total food expenditures, itemized list of local foods purchased	9. Oct 30	9. Assessment of economic impact of Farm to School in the cafeteria.
October 2010	1. Monthly activity report – online survey **(Both)**	1. Nov 5	1. Accurate records of program activities.
	2. School Menu analysis: obtain a copy of school meal menus for the entire month; identify local foods **(Community Outreach)**	2. Nov 5	2. Ongoing records of local foods served in school cafeteria.
	3. Where needed – assist School Food Services with reporting: revenue, participation, local vs total food expenditures, itemized list of local foods purchased	3. Nov 30	3. Assessment of economic impact of Farm to School in the cafeteria.
November 2010	1. Monthly activity report – online survey **(Both)**	1. Dec 5	1. Accurate records of program activities.
	2. School Menu analysis: obtain a copy of school meal menus for the entire month; identify local foods **(Community Outreach)**	2. Dec 5	2. Ongoing records of local foods served in school cafeteria.
	3. Where needed – assist School Food Services with reporting: revenue, participation, local vs total food expenditures, itemized list of local foods purchased	3. Dec 30	3. Assessment of economic impact of Farm to School in the cafeteria.
December	1. Monthly activity report – online survey **(Both)**	1. Jan5	1. Accurate records of program activities.

2010 ***(December 2010 cont'd)***	2. School Menu analysis: obtain a copy of school meal menus for the entire month; identify local foods **(Community Outreach)**	2. Jan 5	2. Ongoing records of local foods served in school cafeteria.
	3. Where needed – assist School Food Services with reporting: revenue, participation, local vs total food expenditures, itemized list of local foods purchased	3. Jan 30	3. Assessment of economic impact of Farm to School in the cafeteria.
January 2011	1. Monthly activity report – online survey **(Both)**	1. Feb 5	1. Accurate records of program activities.
	2. School Menu analysis: obtain a copy of school meal menus for the entire month; identify local foods **(Community Outreach)**	2. Feb 5	2. Ongoing records of local foods served in school cafeteria.
	3. Where needed – assist School Food Services with reporting: revenue, participation, local vs total food expenditures, itemized list of local foods purchased	3.Feb 28	3. Assessment of economic impact of Farm to School in the cafeteria.
February 2011	1. Monthly report of activities – online survey **(Both)**	1. March 5	1. Accurate records of program activities.
	2. School Menu analysis: obtain a copy of school meal menus for the entire month; identify local foods **(Community Outreach)**	2. March 5	2. Ongoing records of local foods served in school cafeteria.
	3. Where needed – assist School Food Services with reporting: revenue, participation, local vs total food expenditures, itemized list of local foods purchased	3. March 31	3. Assessment of economic impact of Farm to School in the cafeteria.
March 2011	1. Monthly activity report – online survey **(Both)**	1. April 5	1. Accurate records of program activities.
	2. School Menu analysis: obtain a copy of school meal menus for the entire month; identify local foods **(Community Outreach)**	2. April 5	2. Ongoing records of local foods served in school cafeteria.
	3. Where needed – assist School Food Services with reporting: revenue, participation, local vs total food expenditures, itemized list of local foods purchased	3. April 30	3. Assessment of economic impact of Farm to School in the cafeteria.
April 2011	1. Monthly activity report – online survey **(Both)**	1. May 5	1. Accurate records of program activities.
	2. School Menu analysis: obtain a copy of school meal menus for the entire month; identify local foods **(Community Outreach)**	2. May 5	2. Ongoing records of local foods served in school cafeteria.
	3. Where needed – assist School Food Services with reporting: revenue, participation, local vs total food expenditures, itemized list of local foods purchased	3. May 31	3. Assessment of economic impact of Farm to School in the cafeteria.
May 2011	1. Monthly activity report – online survey **(Both)**	1. June 5	1. Accurate records of program activities.
	2. School Menu analysis: obtain a copy of school meal menus for the entire month; identify local foods **(Community Outreach)**	2. June 5	2. Ongoing records of local foods served in school cafeteria.
(May 2011 cont'd)	3. Student Knowledge/Attitudes Survey (administer between May 23 and June 10) **(Nutrition Educator)**	3. June 10	3. End-of-year assessment of children's attitudes toward trying new fruits and vegetables, and knowledge.

	4. Block Kids Food Frequency Questionnaire (administer between May 23 and June 10) **(Nutrition Educator)**	4. June 10	4. End-of-year assessment of children's overall dietary patterns.
	5. Plate Waste Observation (4 consecutive days, between May 23 and June 10) in cafeteria **(Community Outreach)**	5. June 10	5. End-of-year quantitative observation of what fruits and vegetables students eat in school lunch.
	6. Student focus groups (between May 15 and June 15) **(Nutrition Educator)**	6. June 15	6. End-of-year qualitative data/story collection.
	7. Where needed – assist School Food Services with reporting: revenue, participation, local vs total food expenditures, itemized list of local foods purchased	7. June 30	7. Assessment of economic impact of Farm to School in the cafeteria.
	8. Stakeholder interviews (between May 15 and June 30) **(Community Outreach + Nutrition Educator)**	8. June 30	8. End-of-year assessment of perceived challenges and opportunities working with Farm to School; qualitative data/story collection.
	9. Farmer interviews (between May 15 and June 30) **(Community Outreach)**	9. June 30	9. End-of-year assessment of perceived challenges and opportunities working with Farm to School; qualitative data/story collection.
	10. School Food Service Director (or manager) interview (between May 15 and June 30) **(Community Outreach or Nutrition Educator)**	10. June 30	10. End-of-year assessment of perceived challenges and opportunities working with Farm to School; qualitative data/story collection.
June 2011	1. Monthly activity report – online survey **(Both)**	1. July 5	1. Accurate records of program activities.
	2. School Menu analysis: obtain a copy of school meal menus for the entire month; identify local foods **(Community Outreach)**	2. July 5	2. Ongoing records of local foods served in school cafeteria.
	3. Where needed – assist School Food Services with reporting: revenue, participation, local vs total food expenditures, itemized list of local foods purchased	3. July 31	3. Assessment of economic impact of Farm to School in the cafeteria.
	4. End of year AmeriCorps survey online **(Both)**	4. July 31	4. End of year assessment: perceived opportunities and challenges for working with Farm to School.
September 2011	1. Student Knowledge/Attitudes Survey **(Nutrition Educator)**	1. Sept 30	1. Follow-up assessment of children's attitudes toward trying new fruits and vegetables, and knowledge.

Timeline – School Food Services

ASAP:

- Please provide a summary for 2009-2010 academic year, including monthly participation rates, revenue, % of student body eligible for free/reduced-price lunches, and expenditures (total, plus amount spent on local products if available).
- If 2009-2010 school menus are available, please provide a copy of those. If any local foods were incorporated, please indicate this.

Monthly, 2010-2011 academic year:

- May submit using DPI forms, or using Excel Spreadsheet from Evaluation team **(due on the last day of the month following the month being reported; i.e., September data is due October 31)**:
  - School meal participation data
  - School meal revenue
  - % of student body eligible for free/reduced price lunches
  - Itemized list of foods purchased/grown locally, with costs
  - Total food expenditures
- School meal menus – identify which foods are local (AmeriCorps will assist with collection and submission) **(due the 5th of the month following the month being reported, i.e., September menus are due October 5)**

Fall 2010:

- Between September 20 and October 8, the AmeriCorps member assigned to your school will conduct four (4) consecutive days of observation in the cafeteria, taking digital photographs of students' lunch trays prior to eating and prior to students dumping their trays. They will recruit volunteers with the community so that photos are taken quickly and do not interfere with the limited time available to students in the cafeteria.

Spring 2011:

- Between May 23 and June 10, the AmeriCorps member assigned to your school will conduct four (4) consecutive days of observation in the cafeteria, taking digital photographs of students' lunch trays prior to students eating and prior to students dumping their trays. They will recruit volunteers with the community so that photos are taken quickly and do not interfere with the limited time available to students in the cafeteria.
- Between May 15 and June 30, the AmeriCorps member assigned to your school will interview at least one member of the SFS staff to collect perspectives on your perceived challenges and opportunities for working within a Farm to School framework in the cafeteria.

DUE DATE	ACTION: OVERALL TIMELINE	TOOL/FILE
ASAP	**School administrator and AmeriCorps Members:** Obtain and keep records of students' school evaluation ID numbers. ***Do not distribute this list****	Template for schools – assign ID numbers (Excel spreadsheet)
25 Sept 2010	**AmeriCorps Members:** Baseline AmeriCorps survey	Online –link will be sent via email
30 Sept 2010	**AmeriCorps Community Outreach Member:** Farmer interview(s)	Farmer interview guide (*need recording device*). See also: Guidelines for selecting interviewees
30 Sept 2010	**AmeriCorps Nutrition Education Member or Teacher:** Student Knowledge & Attitudes Survey (15-30 minutes)	Online –link will be sent via email *(Paper copies available per request)* Password (for all students): **gofruitveg**
30 Sept 2010	**AmeriCorps Nutrition Education Member or Teacher:** Block Kids Food Frequency Questionnaire (25-30 minutes)	Online –link will be sent via email
30 Sept 2010	**School Nurse or PE Teacher:** FitnessGram assessment *or* Height/weight measurements	FitnessGram software *or* "Student Height-Weight-Demographics" (Word document). See "To Weigh and Measure" by DHS, 2008
5 Oct 2010	**School Food Service Staff, with AmeriCorps Community Outreach Member:** School menu analysis (Sept)	Obtain a copy of school meal menus for month of September; identify local foods. Submit to Evaluation team (scan and email, type a document, or mail).
5 Oct 2010	**AmeriCorps Members:** Monthly activity report (Sept)	Online –link will be sent via email
20 Sept-8 Oct 2010	**AmeriCorps Community Outreach Member:** Plate Waste Observation (4 consecutive days) in cafeteria	*Recruit volunteers + cameras.* See Plate Waste Observation – Data Collection protocol
15 Oct 2010	**School Administrator:** 2009-2010 school data, aggregated by grade level (student absence/attendance rates; student standardized test scores; log of volunteer hours)	Direct from school administration to Evaluation Team.
30 Oct 2010	**School Food Services** monthly reporting: revenue, participation, local vs total food expenditures, itemized list of local foods purchased (Sept)	Excel documents available for data collection in Dropbox.
5 Nov 2010	**School Food Service Staff, with AmeriCorps Community Outreach Member:** School menu analysis (Oct)	Obtain a copy of school meal menus for month of October; identify local foods. Submit to Evaluation team (scan and email, type a document, or mail).
5 Nov 2010	**AmeriCorps Members:** Monthly activity report (Oct)	Online –link will be sent via email
30 Nov 2010	**School Food Services** monthly reporting: *as before* (Oct)	Excel documents available for data collection in Dropbox.
5 Dec 2010	**School Food Service Staff, with AmeriCorps Community Outreach Member:** School menu analysis (Nov)	Obtain a copy of school meal menus for month of November; identify local foods. Submit to Evaluation team (scan and email, type a document, or mail).
5 Dec 2010	**AmeriCorps Members:** Monthly activity report (Nov)	Online –link will be sent via email
30 Dec 2010	**School Food Services** monthly reporting: *as before* (Nov)	Excel documents available for data collection in Dropbox.
5 Jan 2011	**School Food Service Staff, with AmeriCorps Community Outreach Member:** School menu analysis (Dec)	Obtain a copy of school meal menus for month of December; identify local foods. Submit to Evaluation team (scan and email, type a document, or mail).

5 Jan 2011	**AmeriCorps Members:** Monthly activity report (Dec)	Online –link will be sent via email
30 Jan 2011	**School Food Services** monthly reporting: *as before* (Dec)	Excel documents available for data collection in Dropbox.
5 Feb 2011	**School Food Service Staff, with AmeriCorps Community Outreach Member:** School menu analysis (Jan)	Obtain a copy of school meal menus for month of January; identify local foods. Submit to Evaluation team (scan and email, type a document, or mail).
5 Feb 2011	**AmeriCorps Members:** Monthly activity report (Jan)	Online –link will be sent via email
28 Feb 2011	**School Food Services** monthly reporting: *as before* (Jan)	Excel documents available for data collection in Dropbox.
5 Mar 2011	**School Food Service Staff, with AmeriCorps Community Outreach Member:** School menu analysis (Feb)	Obtain a copy of school meal menus for month of February; identify local foods. Submit to Evaluation team (scan and email, type a document, or mail).
5 Mar 2011	**AmeriCorps Members:** Monthly activity report (Feb)	Online –link will be sent via email
31 Mar 2011	**School Food Services** monthly reporting: *as before* (Feb)	Excel documents available for data collection in Dropbox.
5 Apr 2011	**School Food Service Staff, with AmeriCorps Community Outreach Member:** School menu analysis (March)	Obtain a copy of school meal menus for month of March; identify local foods. Submit to Evaluation team (scan and email, type a document, or mail).
5 Apr 2011	**AmeriCorps Members:** Monthly activity report (March)	Online –link will be sent via email
30 Apr 2011	**School Food Services** monthly reporting: *as before* (March)	Excel documents available for data collection in Dropbox.
5 May 2011	**School Food Service Staff, with AmeriCorps Community Outreach Member:** School menu analysis (April)	Obtain a copy of school meal menus for month of April; identify local foods. Submit to Evaluation team (scan and email, type a document, or mail).
5 May 2011	**AmeriCorps Members:** Monthly activity report (April)	Online –link will be sent via email
31 May 2011	**School Food Services** monthly reporting: *as before* (April)	Excel documents available for data collection in Dropbox.
23 May-10 June 2011	**AmeriCorps Nutrition Education Member or Teacher:** Student Knowledge & Attitudes Survey (15-30 minutes)	Online –link will be sent via email *(Paper copies available per request)* Password (for all students): **gofruitveg**
23 May-10 June 2011	**AmeriCorps Nutrition Education Member or Teacher:** Block Kids Food Frequency Questionnaire (25-30 minutes)	Online –link will be sent via email
23 May-10 June 2011	**AmeriCorps Community Outreach Member:** Plate Waste Observation (4 consecutive days) in cafeteria	*Recruit volunteers + cameras*. See Plate Waste Observation – Data Collection protocol (Word document in Dropbox)

15 May-15 June 2011	**AmeriCorps Nutrition Education Member or Teacher:** Student Focus Groups	Student Focus Group interview guide (need recording device) See also: Guidelines for selecting interviewees
15 June 2011	**School Nurse or PE Teacher:** FitnessGram assessment *or* Height/weight measurements	FitnessGram software *or* "Student Height-Weight-Demographics" (Word document in Dropbox; see "To Weigh and Measure" by DHS, 2008)
15 May-30 June 2011	**AmeriCorps Members:** Stakeholder interviews (school administrator, teacher, parent community member)	Stakeholder interview guide (need recording device) See also: Guidelines for selecting interviewees
15 May-30 June 2011	**AmeriCorps Members:** School Food Service Director (or manager) interview(s)	School Food Service Professional Interview Guide Need recording device See also: Guidelines for selecting interviewees
15 May-30 June 2011	**AmeriCorps Community Outreach Member:** Farmer interview(s)	Farmer interview guide (need recording device) See also: Guidelines for selecting interviewees
5 June 2011	**School Food Service Staff, with AmeriCorps Community Outreach Member:** School menu analysis (May)	Obtain a copy of school meal menus for month of May; identify local foods. Submit to Evaluation team (scan and email, type a document, or mail).
5 June 2011	**AmeriCorps Members:** Monthly activity report (May)	Online –link will be sent via email
30 June 2011	**School Food Services** monthly reporting: *as before* (May)	Excel documents available for data collection in Dropbox.
30 June 2011	**School Administrator:** 2010-2011 school data, aggregated by grade level (student absence/attendance rates; student standardized test scores; log of volunteer hours)	Direct from school administration to Evaluation Team
5 Jul 2011	**School Food Service Staff, with AmeriCorps Community Outreach Member:** School menu analysis (June)	Obtain a copy of school meal menus for month of June; identify local foods. Submit to Evaluation team (scan and email, type a document, or mail).
5 Jul 2011	**AmeriCorps Members:** Monthly activity report (June)	Online –link will be sent via email
31 Jul 2011	**School Food Services** monthly reporting: *as before* (June)	Excel documents available for data collection in Dropbox.
31 Jul 2011	**AmeriCorps Members:** End of Year survey	Online –link will be sent via email
30 Sept 2011	**AmeriCorps Nutrition Education Member or Teacher:** Student Knowledge & Attitudes Survey (15-30 minutes)	Online –link will be sent via email *(Paper copies available per request)* Password (for all students): **gofruitveg**
30 Sept 2011	**School Nurse or PE Teacher:** FitnessGram assessment *or* Height/weight measurements	FitnessGram software *or* "Student Height-Weight-Demographics" (Word document in Dropbox; see "To Weigh and Measure" by DHS, 2008)

Wisconsin Farm-to-School Evaluation
2010-2011

Student Demographics and Measurement

**Please be sure to have read and reviewed To Weigh and Measure prior to collecting this data.*

Student Evaluation ID

Date of birth _____ *mm/dd/yyyy* **Today's date** _____ *mm/dd/yyyy*

Gender ☐ Male ☐ Female

Ethnicity
☐ African-American
☐ Asian-American
☐ Caucasian
☐ Hispanic
☐ Other – please describe: _____

Measurement data:

Note: Clearly indicate if you are using measurements other than pounds and inches.
If the difference between height measurements 1 and 2 is greater than ¼ inch, re-measure.
If the difference between weight measurements is greater than ¼ pound, re-measure.

1st height: _____&____/8th inches 2nd height: ____&___/8th inches

1st weight: _____.____pounds 2nd weight: ____.____pounds

Unable to assess:

Check a reason below if measurement or student data cannot be obtained:

- ☐ Parent refused
- ☐ Physical disability
- ☐ No longer at this school
- ☐ Student refused
- ☐ Could not get two height measurements within ¼ inch or two weight measurements within ¼ pound
- ☐ Other: _____

School information: Scale make/model: _____

Last calibration date: _____

Stadiometer make/model: _____

Wisconsin Farm-to-School

2010-2011

Student Survey

Welcome to the Wisconsin Farm to School Student Survey. We want to hear what you think about fruits and vegetables - thank you for helping us!

This is not a test and it will not affect your grades. Please answer every question, telling us what you really think. If you have questions you may ask your teacher or AmeriCorps member.

Student Evaluation ID:

Today's date: _____
month / day / year

What is your gender? ☐ **Male** ☐ **Female**

What ethnic group do you belong to?

- ☐ **African-American**
- ☐ **Asian-American**
- ☐ **Caucasian**
- ☐ **Hispanic**
- ☐ **Other – please describe:** _____

What is your birthdate?

Month: _____

Day: _____

Year: _____

	Please tell how you feel about fruit.	**a lot**	**a little**	**not very much**	**not at all**
1	How much do you like **fruit**?	☐	☐	☐	☐
2	When you try a new fruit for the first time, how much do you usually like it?	☐	☐	☐	☐
3	How much do you like tasting new **fruits**?	☐	☐	☐	☐

	Please tell how you feel about tasting new fruit.	**definitely**	**probably**	**probably not**	**definitely not**
4	Will you taste a **fruit** if you don't know what it is?	☐	☐	☐	☐
5	Will you taste a **fruit** if it looks strange?	☐	☐	☐	☐
6	Will you taste a **fruit** if you have never tasted it before?	☐	☐	☐	☐
7	When you are at a **friend's house**, will you try a new **fruit**?	☐	☐	☐	☐
8	When you are at **school**, will you try a new **fruit**?	☐	☐	☐	☐
9	When you are at **home**, will you try a new **fruit**?	☐	☐	☐	☐

		Never	**1 time**	**2 times**	**3 times**	**at least 4 times**
10	How many times have you tried a new **fruit** since school started this year?	☐	☐	☐	☐	☐

	Please tell how you feel about vegetables.	**a lot**	**a little**	**not very much**	**not at all**
11	How much do you like **vegetables**?	☐	☐	☐	☐
12	When you try a new vegetable for the first time, how much do you usually like it?	☐	☐	☐	☐
13	How much do you like tasting new **vegetables**?	☐	☐	☐	☐

Please tell how you feel about tasting new vegetables.	**definitely**	**probably**	**probably not**	**definitely not**
14 Will you taste a **vegetable** if you don't know what it is?	☐	☐	☐	☐
15 Will you taste a **vegetable** if it looks strange?	☐	☐	☐	☐
16 Will you taste a **vegetable** if you have never tasted it before?	☐	☐	☐	☐
17 When you are at a **friend's house**, will you try a new **vegetable**?	☐	☐	☐	☐
18 When you are at **school**, will you try a new **vegetable**?	☐	☐	☐	☐
19 When you are at **home**, will you try a new **vegetable**?	☐	☐	☐	☐

	Never	**1 time**	**2 times**	**3 times**	**at least 4 times**
20 How many times have you tried a new **vegetable** since school started this year?	☐	☐	☐	☐	☐

21. How many times in your life have you been to a farm?

- ☐ Never
- ☐ 1 time
- ☐ 2 times
- ☐ 3 times
- ☐ 4 times or more

22. How do tomatoes grow? *Please check one.*

- ☐ As plants
- ☐ As animals
- ☐ As minerals
- ☐ Something else

23. What part of a plant is a carrot? *Please check one.*

- ☐ Leaf
- ☐ Root
- ☐ Stalk
- ☐ Flower

24. Where do eggs come from? *Please check one.*

- ☐ Cows
- ☐ Goats
- ☐ Chickens
- ☐ Something else

25. What is a benefit of using compost?

- Compost feeds wild animals.
- Makes farmers use more chemical fertilizers.
- Compost keeps food out of landfills.
- None of the above.

26. Do insects play an important role in growing plants?

- Yes
- No
- I don’t know

27. Do TOMATOES grow in Wisconsin?

- Yes
- No
- I don’t know

28. Do ORANGES grow in Wisconsin?

- Yes
- No
- I don’t know

29. Do APPLES grow in Wisconsin?

- Yes
- No
- I don’t know

30. Does SQUASH grow in Wisconsin?

- Yes
- No
- I don’t know

31. Do BANANAS grow in Wisconsin?

- Yes
- No
- I don’t know

32. Imagine a meal with a hotdog in a bun and a glass of milk. What food group is missing? *Please check one.*

- Dairy
- Fruits & Vegetables
- Meat
- Grains

33. What food group does the pear belong to? Please check one.

- Dairy
- Fruits & Vegetables
- Meat
- Grains

34. Why do I need to eat food?

- I need food for energy and to grow.
- I need food ONLY because it tastes good.
- I don't need food.
- I don't know.

35. Why do I need to eat different kinds of foods?

- I can get a lot of the **SAME** nutrients.
- I can get many **DIFFERENT** nutrients.
- I don't need to eat different kinds of food.
- I don't know.

36. Healthy eating is:

- eating fruits but **not** vegetables.
- **not** eating fruits or vegetables.
- eating **both** fruits ***and*** vegetables.
- I don't know.

37. The foods that I eat for meals and snacks are healthy. *(Choose one.)*

- Yes, all of the time
- Yes, sometimes
- No

38. How likely are you to eat fresh fruit instead of candy? *(Choose one.)*

- Not likely
- Likely
- Very Likely

39. Have you ever eaten an apple?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

40. Have you ever eaten an orange?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

41. Have you ever eaten watermelon?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

42. Have you ever eaten a pear?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

43. Have you ever eaten a kiwi?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

44. Have you ever eaten a strawberry?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

45. Have you ever eaten a blueberry?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

46. Have you ever eaten cantaloupe?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

47. Have you ever eaten a grape?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

48. Have you ever eaten a cranberry?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

49. Have you ever eaten asparagus?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

50. Have you ever eaten broccoli?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

51. Have you ever eaten a cucumber?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

52. Have you ever eaten a green pepper?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

53. Have you ever eaten a sweet potato?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

54. Have you ever eaten peas?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

55. Have you ever eaten spinach?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

56. Have you ever eaten green beans?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

57. Have you ever eaten avocado?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

58. Have you ever eaten a tomato?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

59. Have you ever eaten a carrot?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

60. Have you ever eaten a radish?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

Thank you for taking the time to complete this survey!

AmeriCorps Activity Observations

Date:_____

Name:_____

Activity:_____

School:_____

Grade Level(s):_____

Teacher/Food Service Rep:_____

# of Students:_____

Food Served:_____

Amount Served:_____

Who led the activity?

- AmeriCorps Member_____
- Teacher_____
- Famer Educator_____
- Volunteer_____
- Other_____

Resources Provided:

- Lesson Plan_____
- Letter Home_____
- Atlases_____
- Snack Bite_____

Observations: Were students engaged? Did they enjoy the food? What went well? What did not?

Suggested changes/adaptations:

Quotes (Kids/Teachers/Food Service, etc)

Other comments:

INTERVIEW GUIDES

Farmer Interview Guide - Pre-Program Interview

I would like to talk about: 1) how farm to school marketing opportunities compare with other marketing opportunities that you have; 2) how you made decisions about working with farm to school programs; 3) what kinds of experiences you have had with farm to school programs; 4) what are the opportunities and challenges for farmers of working with farm to school programs.

I would like to audio-record our discussion if that is okay with you. It will help us to save your thoughts and ideas accurately without using your time to write them down. I will work to keep this interview to 30-45 minutes. We will not store or use your name with your comments.

May I have your permission to audio-record our discussion?

- ☐ Yes ⇒ *(Turn on recorder and continue.)*
- ☐ No ⇒ That's fine. We will not record. I will take notes.

Do you have any questions about the interview before we begin?

- ☐ Yes ⇒ *(Find out what the questions are and answer them. Then continue.)*
- ☐ No ⇒ (Continue.)

1. Which school(s) do you partner with in F2S programming?
2. Can you tell me about your farm operation?
    a. How many acres do you farm?
    b. What do you grow?
    c. What are your growing practices:
        i. Do you use integrated pest management practices?
        ii. How do you manage fertility on your farm? (green manures, compost, animal manures, chemical fertilizers, etc..)
        iii. Are you certified organic?
    d. Do you have your own storage and packing facilities?

e. Who are your customers? To whom do you sell? *

f. What market outlets do you use to reach your customers?

g. Are you a member of a farm cooperative?

3. How do you get your product to each of your market outlets?

   a. What do you need to do (packing, weighing, washing, or other value-added processing) to get your product ready for market?

   b. Do you go through any intermediaries (brokers, distributors, packers)?

4. There has been recent publicity about locally grown food.

   a. How do you define "locally grown"? *Probes: same city, county, region, state, country? Within a specific mileage radius? Within a day's drive?*

   b. How important is it for you to sell your product to your local market(s)?

5. How did you get involved in the farm to school program?

   a. What do you think the benefits will be?

   b. What do you think the drawbacks might be?

   c. What do you think the challenges might be?

6. What are your primary reasons for choosing to participate in farm to school programs?

   a. Develop ability to sell to institutions

   b. Support local school

   c. Support health of local students

   d. Increase farm's local visibility

   e. Have a market for seconds or off size product

   f. Have a market for items I cannot sell elsewhere

   g. Interest in educational programs

   h. Other (please explain)

7. Do you anticipate that you will have to make any changes to accommodate schools?

   Probes: production, processing, marketing, or distribution routines, price compromising, …

If the farmer began participating in farm to school in 2009-10 academic year or earlier), include these questions:

8. When did you begin selling to schools? *Year* _____
9. Approximately what percent of your product volume goes to farm to school programs?
   a. How does that percentage compare with your other market outlets?
   b. Has the percentage varied greatly by month? How has it changed over the course of a year?
10. Approximately what percent of your sales dollars comes from farm to school programs?
   a. How does that percentage compare with your other market outlets?
   b. Has the percentage varied greatly by month? How has it changed over the course of a year?
   c. Have you received additional revenue due to participating in farm to school programs? If so, how much (or, by approximately what percentage have your revenues increased)?
   d. How are the prices determined for the products you sell to schools?
   e. Are you consistently able to meet the school's demand?
11. Are you satisfied with the business relationship you have with the school(s) you sell to? Why or why not?

Farmer Interview Guide – Post-Program Survey

I would like to talk about: 1) how farm to school marketing opportunities compare with other marketing opportunities that you have; 2) how you made decisions about working with farm to school programs; 3) what kinds of experiences you have had with farm to school programs; 4) what are the opportunities and challenges for farmers of working with farm to school programs.

I would like to audio-record our discussion if that is okay with you. It will help us to save your thoughts and ideas accurately without using your time to write them down. I will work to keep this interview to 30-45 minutes. We will not store or use your name with your comments.

May I have your permission to audio-record our discussion?

- ☐ Yes ⇒ *(Turn on recorder and continue.)*
- ☐ No ⇒ That's fine. We will not record. I will take notes.

Do you have any questions about the interview before we begin?

- ☐ Yes ⇒ *(Find out what the questions are and answer them. Then continue.)*
- ☐ No ⇒ (Continue.)

1. Which school(s) do you partner with in F2S programming?
2. Has anything changed about your farming operation in the past year? *[have notes from fall to ask the most appropriate probes]*
    a. How many acres do you farm?
    b. Did you change what you grow?
    c. Did you drastically alter your growing practices?
        i. Did you begin or stop using integrated pest management practices?
        ii. Did you alter how you manage fertility on your farm? (green manures, compost, animal manures, chemical fertilizers, etc..)
        iii. Did you become certified organic (or did you lose your certification)?
    d. Did you add or get rid of your own storage and packing facilities?

e. Have your customers changed? (if so, please describe)

f. Have your market outlets changed for reaching your customers?

g. Are you a member of a farm cooperative?

3. Have you changed how you get your products to each of your market outlets?

   a. What do you do (packing, weighing, washing, or other value-added processing) to get your product ready for market?

   b. Do you go through any intermediaries (brokers, distributors, packers)?

4. How important is it for you to sell your product to the local market?

5. When did you begin selling your product to schools? *Year* _____

6. Approximately what percent of your produce volume goes to farm to school programs?

   a. How does that percentage compare with your other market outlets?

   b. Does the percentage vary greatly by month? How did it change during this year?

7. Approximately what percent of your sales dollars comes from farm to school programs?

   a. How does that percentage compare with your other market outlets?

   b. Does the percentage vary greatly by month? How did it change during this year?

   c. Have you received additional revenue due to participating in farm to school programs? If so, approximately how much or by what percentage have your revenues increased?

   d. How are the prices for the products you sell to schools determined?

   e. Are you consistently able to meet the school's demand?

8. What benefits, if any, did you experience this year by working with F2S programs?

9. What drawbacks or challenges, if any, did you experience?

   a. How did you overcome these challenges?

   b. Are there still challenges to deal with? How are you working through them?

   c. *(If drawbacks)* What kind of impact, if any, did those drawbacks have on your perceptions of F2S?

10. Has your involvement with F2S changed over the year? If so, how has it changed?
    a. Do you sell more or less to schools? How many schools total?
    b. Wider or narrower variety of produce?
    c. More centralized/decentralized?
    d. Other changes?
11. What changes, if any, have you had to make in order to accommodate schools?
    a. Have you had to make changes in terms of your production, processing, marketing, or distribution routines?
    b. Have you had to compromise your prices in order to sell to school districts?
12. What, if any, have been your experiences interacting with school food service?
    a. What are the benefits?
    b. What are the problems or challenges?
13. What, if any, have been your experiences interacting with students?
    a. What are the benefits?
    b. What are the problems or challenges?
14. Have there been any surprises, positive or negative, for you from your involvement with F2S programs?

    Probes: jobs created? Higher visibility in, or increased interaction with, the community? Increased local sales? *[are there any negative examples we want to offer?]*

15. What do you think is the long-term potential of F2S programs? What factors would determine whether or not you continue to work with the school?
    a. Do you consider schools a reliable and stable market?
    b. Are you satisfied with the price you are receiving?
    c. Are there other factors?

16. In deciding whether to continue participating in farm to school programs:
    a. How important is price in your decision?
    b. How important is the quantity that you deliver?
    c. Are there other factors involved in your decision?
17. Do you plan to continue to do business with schools? Why or why not?
    a. Is the Farm to School program profitable for you?
    b. If not, what would it take to make the program more profitable?
    c. Do you participate in Farm to School for reasons other than profit?
18. What plans, if any, do you have to sell your product to more schools? What, if anything, limits you from selling your product to more schools (or selling more products to the same schools) in your local area?
19. At what point do you think it would make sense to have an intermediary facilitating the sale between you and the school? Would you consider becoming part of a farmer cooperative that sold product to schools?
20. What has been your experience working with the statewide F2S Coordinator this year?
    a. Were you able to gain answers to your questions and learn what you needed to know?
    b. Do you have any suggestions for changes or improvements to the way the coordinator can serve Wisconsin farmers?
21. What has been your experience working with the F2S Toolkit this year?
    a. Were you able to learn what you needed to know?
    b. Do you have any suggestions for changes or improvements to the Toolkit?
22. Is there anything else that you would like to talk about with regard to the Farm to School program and its initiatives?

    -In particular, stories of what worked/what didn't that we have not yet discussed.

Food Service Professional Interview Guide

(Note: have a copy of the fact sheet with you at the interview. If the interviewee tells you that s/he has not reviewed it prior to the interview, ***review it before you start****.)*

Thank you for agreeing to talk with us today about the Farm to School program and how it relates to your job. We appreciate your time. I will work to keep this interview to 30-45minutes. Have you had a chance to review the fact sheet that we emailed to you? (*If interviewee has not reviewed,* ***go over it before you begin the interview.)*** Do you have any questions or concerns about participating in this interview?

I would like to audio-record our discussion if that is okay with you. It will help us to save your thoughts and ideas accurately without using your time to write them down. We will not store or use your name with your comments.

May I have your permission to audio-record our discussion?

- Yes ⇒ *(Turn on recorder and continue.)*
- No ⇒ That's fine. We will not record. I will take notes.

Do you have any questions about the interview before we begin?

- Yes ⇒ *(Find out what the questions are and answer them. Then continue.)*
- No ⇒ (Continue)

The purpose of this interview is to understand farm to school programs within the context of the school food environment. We also want explore how food service professionals characterize the opportunities and challenges of farm to school programs.

1. What school are you in and what is your job title?
2. Would you please describe what your typical day is like:
    a. What are your primary job responsibilities?
        i. Are you directly involved with purchasing? If so, please describe.
    b. What kind of interaction with the students do you have?
    c. In what ways do you participate in the food preparation processes?

3. Is F2S new this year in your school?
    a. Yes
    b. No →How many years has your school been participating in F2S programming?
4. What F2S initiatives have you incorporated into your cafeteria?
    a. Did you initiate this (them), or did someone else? *If someone else, who?*
    b. For each program, would you please describe how it was implemented in the cafeteria?
5. How, if at all, has introducing these programs into the cafeteria affected your job?
    a. Have your regular duties changed?
    b. Has your interaction with the students changed?
    c. Has your involvement with food preparation changed?
6. Have the farm to school initiatives impacted revenues from school meal programs? If so, how?
    a. How do the local food prices compare to similar items purchased from other food distributors?
    b. Has participation changed in any of the meal or snack programs? If so, how?
7. How, if at all, have the initiatives changed the flow and/or atmosphere in the cafeteria…
    a. for the school food service staff? (probes: food position in the serving line, food preparation time, use of a garden/salad bar, …)
    b. for the students? (probes: how quickly students move through the line, …)
8. Have the initiatives changed what foods the students eat in the cafeteria?
    a. If yes, in what ways? (what food items, frequency of offerings, …)
    b. If no, why not?
9. Have the initiatives impacted what you eat personally?
    a. If yes, in what ways?
    b. If no, why?
10. Have the initiatives impacted what your staff or other school staff eats?
    a. If yes, in what ways?
    b. If no, why do you think this is so?

11. Have the initiatives of the Farm to School program in general changed the way you feel about your job, either positively or negatively?
    a. If yes, in what ways?
    b. If no, why?
12. On a scale of 1 to 5 (5 being the highest), what level of support do you feel for implementing Farm to School, particularly in the cafeteria…
    a. from the school administration? 1 2 3 4 5
    b. from teachers? 1 2 3 4 5
    c. from students? 1 2 3 4 5
    d. from parents? 1 2 3 4 5
    e. from your staff? 1 2 3 4 5
    f. from the others in the community? 1 2 3 4 5
    g. Is there anything you would like to explain about your choices?
13. Regarding your Food Service staff attitudes:
    a. For those who are positive, what do they enjoy or appreciate about F2S initiatives?
    b. For those who are negative, what are their major dissatisfactions?
14. Are there any aspects of the Farm to School program that you feel went particularly well or were very successful? If so, please describe them.
15. What barriers have you experienced to implementing Farm to School in the cafeteria?
    a. Are there more individual-level barriers (such as resistance from students or staff), or systemic barriers (such as lack of kitchen equipment, delivery problems, quality issues)?
    b. Can you please describe your efforts to overcome any of these barriers, and what worked/what didn't?

16. Do you think you have learned how to gain access to farms, farmers, or cooperatives to continue incorporating Farm to School in your cafeteria?
    a. Have you personally interacted with local farmers during this year? If so, please describe the extent of your involvement with procuring local food.
17. Do you think it is possible to continue using local foods in your school? Which foods in particular?
18. Were the local producers able to consistently meet your needs this year?
    a. If so, do you anticipate the need continuing to be able to be met in the future?
    b. If not, was the communication open and timely so that you could adapt as necessary?
    c. What changes would make the experience better?
19. In previous years, have you typically had community or parent volunteers (other than AmeriCorps) in your cafeteria to help with food preparation or food service (tasks unrelated to student behavior supervision)? Has this changed in any way as a result of the Farm to School programming? If so, please describe the changes.
20. What has been your experience working with the statewide Farm to School Coordinator this year?
    a. Were you able to gain answers to your questions and learn what you needed to know?
    b. Do you have any suggestions for changes or improvements to the way the coordinator can serve Wisconsin school food service directors and staff?
21. What has been your experience working with the F2S Toolkit this year?
    a. Were you able to learn what you needed to know?
    b. Do you have any suggestions for changes or improvements to the Toolkit?
22. Is there anything else that you would like to talk about with regard to the Farm to School program and its initiatives?

    -In particular, stories of great success - or what worked/what didn't – that we have not yet discussed.

Stakeholders' Interview Guide

(Note: have a copy of the fact sheet with you at the interview. If the interviewee tells you that s/he has not reviewed it prior to the interview, ***review it before you start****.)*

Thank you for agreeing to talk with me today about the F2S program. We appreciate your time, and I will work to keep this interview to 30-45 minutes. Have you had a chance to review the fact sheet that was emailed to you? (*If interviewee has not reviewed,* ***go over it before you begin the interview.)***

I would like to audio-record our discussion if that is okay with you. It will help us to save your thoughts and ideas accurately without using your time to write them down. We will not store or use your name with your comments.

May I have your permission to audio-record our discussion?

- Yes ⇒ *(Turn on recorder and continue.)*
- No ⇒ That's fine. We will not record. I will take notes.

Do you have any questions about the interview before we begin?

- Yes ⇒ *(Find out what the questions are and answer them. Then continue.)*
- No ⇒ (Continue)

1. a) Title:

   b) (if applicable) Organization through which you are affiliated with F2S:

2. Which school(s) are you involved with in F2S programming?
3. Why did you get involved in F2S? *(Use the following probes as necessary.)*
   a. Did you have interests or concerns that you thought the program could address?
      i. What were those interests or concerns?
      ii. *Probe to learn whether their concerns were related to:*
         - Food Quality
         - Parenting
         - Health care or health education
         - Farming or producing food

- Local economic development
- Environment
- Other

b. How well were you able to address your interests/concerns through participating in the F2S program?

   i. Did that change over time? If so, please explain.

c. What benefits, if any, did you anticipate by getting involved in F2S?

   i. To what extent have you realized these benefits?

d. At the time that you got involved with F2S at this school, were you involved in any other efforts that supported making locally grown food more available in your community?

   i. If so, what were the other efforts?

4. How did you first get involved in the F2S program? *(Use the following probes as necessary.)*

   a. How did you hear about the program?

      i. What did you hear about it?

      ii. From whom did you hear?

   b. What happened *during* your first contact with the program?

      i. When did that happen? *(year)*

      ii. Who were your first contacts?

      iii. How would you describe your association? Were they friends, relatives, acquaintances, community leaders, other?

   c. What followed *after* your first contact?

   d. How would you describe your level of involvement with or commitment to the program when you *first got involved*? Can you give me an example?

5. How has your involvement with F2S changed over this year?

   a. Has your role with F2S changed? If so, how?

   b. Has the amount of effort you contribute changed? If so, how?

c. Have you experienced any challenges or disadvantages related to F2S and/or your involvement with it? If so, what are they?

6. Will you still be involved with F2S after this academic year?
   a. If yes, how do you plan to be involved?
   b. If no, why have you chosen to stop your involvement?
7. On a scale of 1 to 5 (5 being the highest), how do you perceive the level of support for implementing Farm to School…

a. from the school administration?	1	2	3	4	5
b. from teachers?	1	2	3	4	5
c. from students?	1	2	3	4	5
d. from parents?	1	2	3	4	5
e. from food service staff?	1	2	3	4	5
f. from others in the community?	1	2	3	4	5

   g. Is there anything you would like to explain about your choices?
8. In your opinion, who are the key people who have been responsible for **getting the F2S program started?**

   (List the name of people and/or their positions in the community. For each person, ask:)

   1. Why was this person key?
   2. What contribution did this person make to the program?
9. Who are the key people responsible for **keeping the F2S program going?**

   (If these people are different from those who got it going initially, ask:)

   a. Why was this person key?
   b. What contributions did this person make to the program?

10. What defining events have there been for **getting the program started?**

    (List each defining event. For each, ask:)

    a. Why was this a defining event?

    b. Who was involved in this event?

    c. When did it take place?

    d. Why/How did it happen?

11. Were there any defining events that have **kept the program going?**

    (List the defining event. For each, ask:)

    a. Why was this a defining event?

    b. Who was involved in this event?

    c. When did it take place?

    d. Why/How did it happen?

12. Has the F2S program grown beyond your school district?

    a. How did this growth come about?

    Use the following probes as appropriate and necessary:

    b. Did a representative from F2S or the school district make the first contact or was it someone from outside the school district who came to F2S?

    c. What has F2S done to support other farm to school programs?

    d. Have people involved with F2S attempted to reach out to more school districts to help them develop farm to school programs? How about worksites, to develop farm to worksite programs?

    e. Does F2S send representatives to conferences or other events where those pursuing changes in the availability of local food meet? Locally? Regionally? Nationally? Internationally?

    f. Do representatives of F2S ever lobby, publish or speak to groups to promote purchase and use of locally grown foods?

13. To your knowledge, has F2S made a difference for anyone in your community or for the community as a whole?

    a. What differences has it made? Please describe each one.

    For each difference, ask:

    b. Was this difference positive or negative?

    c. Who experienced the positive or negative difference?

    d. What was the benefit or the cost?

14. Did the program face any challenges **during its early development**?

    a. If so, what were they?

    For <u>each</u> challenge ask:

    b. Was the challenge overcome? If so, how?

    c. Who were important people that helped or hindered facing the challenge?

    d. Were there organizations that were important in helping the F2S program face the challenge?

15. Did the program have any particular successes **during its early development**?

    a. If so, what were they?

    (For each success ask:)

    b. Who were important people that helped or hindered in bringing about this success?

    c. Were there organizations that were important in helping the F2S program achieve this?

16. What challenges does F2S face now? Who are the key people and/or organizations who are working on overcoming them?

17. In your opinion, what is the future of F2S? Why do you think so?

Other questions for specific stakeholders:

Parents

1. Did your child(ren) ask for more and/or specific fruits and vegetables, such that you can attribute this behavior to the F2S program?
2. Did your child(ren) ask for trips to the farmers market and/or farms to buy or pick fruits and vegetables, such that these trips resulted from the F2S program?
3. Did you observe your child(ren) asking for more and/or specific fruits and vegetables for snacks as a result of the F2S program? (or other consumption questions?)
4. Have you changed your family meal and/or snack habits as a result of the F2S program?

Teachers, School administrator, Non-parent volunteers

1. Did you observe or experience any differences in students' classroom behavior that can be attributed to the F2S program (including eating habits)?
2. Have you changed your own meal and/or snack habits as a result of the F2S program?

Community champions, *ie community business leaders supporting F2S*

1. In your workplace, have you made any changes to health-related or food-related policies as a result of your involvement in F2S? Or do you have plans to make changes?
2. Have you experienced any changes for your workplace as a result of your involvement in F2S, such as increased community visibility and/or increased revenues?

Student Focus group

Thank you for coming to talk about the Farm to School program that has been going on at your school this year. We appreciate your help.

I would like to audio-record our discussion if that is okay with you. That way, I can remember what you say without taking your time to write them down. I will not store or use your names with your comments.

May I have your permission to audio-record our discussion?

- ☐ Yes ⇒ *(Turn on recorder and continue.)*
- ☐ No ⇒ That's fine. We will not record. I will take notes.

Do you have any questions about the interview before we begin?

- ☐ Yes ⇒ *(Find out what the questions are and answer them. Then continue.)*
- ☐ No ⇒ (Continue.)

The purpose of this interview is to hear from you about some of the activities you did this year to learn about food and farms. We want to hear if there was anything you liked, if you learned anything that was important, and if you shared with your friends and family.

1. Collect student information:

School name:	
Grade of students:	
# of students in this group:	

2. Who is the Farm to School person? What else does he/she do at your school?
3. What new foods did you try this year? Did you like them? Was it fun? (probe with specific foods introduced in tastings, harvest of the month, other activities – specific to individual site)
4. What were your favorite new foods that you tried this year at school?
5. What were your least favorite new foods that you tried this year at school?
6. Were there any foods that you asked your parents to have at home because you tried them at school?
7. Were there any foods that you asked your parents NOT to have at home after you tried them at school?
8. Did you enjoy (any of various F2S activities specific to the school)? What was your favorite part? What did you learn? – *maybe do this for all, or several, of the activities?*
9. Were there any activities that you really didn't like?

10. What did you learn about food this year? (probe with key points from AmeriCorps curriculum – how to grow food, composting, how to cook foods, others?)
11. Do you help choose and cook meals and snacks at home? What do you like to choose? What do you like to cook?
12. Are there foods that you do *not* like to have at home, or foods that you do *not* like to cook?
13. Do you have a garden at home where your family grows food? Do you help with it? What parts do you like to help with the most? What parts do you like to help with the least?

School Food Service forms

The information submitted from School Food Services is the same that is required to be reported to the district for DPI reporting in order to obtain federal and state reimbursements. The forms are adapted from the Fresh Fruit and Vegetable Program Supplemental Claim Forms. Additional information requested from the Evaluation Team is also required by DPI at the district level; since all schools must track this information, the Evaluation Team requests it at the school level for better analysis. An abbreviated sample of the ***Supplemental Claim form*** *is below.*

Fresh Fruits

Invoice Date	Service Date	Fruit Description	Source (Name, local/not local)	Size/Weight of Shipping Unit	Number of Units	Cost Per Unit	Total Cost
						FRUITS TOTAL:	

Fresh Vegetables

Invoice Date	Service Date	Vegetable Description	Source (Name, local/not local)	Size/Weight of Shipping Unit	Number of Units	Cost Per Unit	Total Cost
						VEGETABLES TOTAL:	

Other local foods (dairy, meat, spices, etc)

Invoice Date	Service Date	Food Description	Local Source (Name)	Size/Weight of Shipping Unit	Number of Units	Cost Per Unit	Total Cost
						OTHER LOCAL FOODS TOTAL:	

Operating and Administrative Costs

1/0/1900

0

Operating Costs

Operating Cost Categories = Non-Food Items - Supplies that go toward the preparation, delivery, clean-up of fruits and vegetables, and small equipment (large equipment should be listed under administrative costs). Labor - ONLY for the preparation and service of fruits and vegetables.

Non-Food Items

Invoice Date		TOTAL COSTS

Labor

Payroll Date		TOTAL COSTS

Administrative Costs*

Administrative Cost Categories = Equipment - purchase or leasing of large equipment. Labor - time spent planning and promoting program, staff training, financial reporting, ordering produce; etc. *LIMITED TO 10 PERCENT OF TOTAL GRANT.

Equipment

Invoice Date		TOTAL COSTS

Labor

Payroll Date		TOTAL COSTS

School Food Services: Summary File

This Excel file will be offered to school food service authorities as an option for submission of the information required by the Evaluation Team. As described above, all the information on this form is required to be reported by each school the district for reporting to DPI, but the Evaluation Team requests school-level data for better analysis.

School:				
Who submitted:				
	Sep-10	**Oct-10**	**Nov-10**	**Dec-10**
Number of students approved for free:				
Number of students approved for reduced-price:				
Total number of days operating:				
Nonreimbursable meals:				
Enrollment:				
LUNCHES				
Average Daily Attendance:				
Free student meals:				
Reduced price meals:				
Paid student meals:				
Total number of student meals:				
BREAKFASTS:				
Average Daily Attendance:				
Free student meals:				
Reduced price meals:				
Paid student meals:				
Total number of student meals:				
EXPENDITURES:				
Amount spent on local foods:				
Total expenditures:				
Itemization of local food purchases - see additional files				
MENUS:				
Work with AmeriCorps member to identify when locally-produced items appeared on school menu				

APPENDIX 3. Transform Wisconsin Farm to School Evaluation Manual (2013-2014)

Transform Wisconsin Farm to School Evaluation Manual

May 2013 – May 2014

Contents

Overview

Evaluating program impact is important for communicating the effect a program has. Prior to this school year, Wisconsin Farm to School programs run through AmeriCorps and through grant-funded initiatives (ARRA and CPPW, or the American Reinvestment & Recovery Act and Communities Putting Prevention to Work) have participated in formal program evaluation (2010-11 and 2011-12 school years) to provide information to the Centers for Disease Control, to Wisconsin legislators, and to local communities. The information available quantifies the value of the Farm to School programs in ways that are meaningful to our current economic and public health environments. The Transform Wisconsin programs will continue this work by collecting more program impact data.

The data collected will include de-identified student quantitative data, as well as broader, community- and school-level quantitative and qualitative data. It will be used to measure the programs' impact on students' knowledge, attitudes, and behavior as well as changes in the school food environment, and the potential economic benefit of such programs to the broader community – certainly a valuable piece of information in the current economy. Schools are expected to comply with the data collection procedures described here to ensure coordinated statewide evaluation data collection and the ability to comprehensively understand the programs' implementation and impact in each community.

Collaborative efforts led to the Transform Wisconsin granting programs. The Wisconsin Clearinghouse for Prevention Services (University Health Service, UW-Madison) gathered a team of experts from UW-Madison and the Wisconsin Department of Health Services (DHS) to write a grant proposal in an effort to ensure the growth and sustainability of important public health programs initiated through ARRA- and CPPW-funded initiatives. An overall goal of the Transform Wisconsin (TWi) program is to make it easier for all Wisconsin residents to make healthy choices relative to active living and healthy eating. Our focus here is healthy eating, specifically by increasing access to fruits and vegetables and improving eating behaviors through comprehensive Farm to School (F2S) efforts. Rigorous evaluation is necessary in a culture increasingly focused on evidence-based practice and tight budgetary constraints.

Partnerships between schools, public health, and human service agencies, and institutions of higher learning are vital to the success of improving children's long-term health. Schools provide an environment that is conducive to effective nutrition education delivery, and many children consume meals at school (Story 2008; Sallis 2009). The disease risks from poor nutrition and obesity have significant effects on lifetime health, and children are at greater risk for chronic disease such as Type II Diabetes Mellitus (T2DM) and cardiovascular disease, both as children and into adulthood (Office of the Surgeon General 2010; Freedman 2009; Krebs 2007). Overweight and obesity also are associated with lower cognitive and academic performance (Basch 2011; Judge & Jahns 2007; Taras & Potts-Datema 2005). As such, schools ought to teach and model optimal eating patterns in order to positively influence children's ideas and behaviors relating to their own health.

Another possible benefit of F2S programs is positively influencing the local economy by providing consistent new markets for farmers and increasing the proportion of residents' income spent locally. While this is not a focus of this evaluation, other groups are working to investigate the potential effectiveness of farm-based opportunities to grow local (community- and state-level) economies.

Community agencies can collaborate with schools and parents in the school setting to address critical health behaviors and to provide services to guide all community residents toward improvements in health. This evaluation aims to engage all partners (communities, schools, state agencies, and the university) in student-focused health issues that will ultimately lead to building better systems in Wisconsin so that we can establish conditions for healthy students, families, and communities.

Community and School Responsibilities

Farm to School (F2S) program evaluation must be done systematically to ensure complete, reliable information to the evaluation team. Communities are responsible for the following:

- **Obtain and keep a record of paired student names and assigned student evaluation ID numbers. These IDs will be used for all student behavior and health measures**. A spreadsheet template is provided.
    - Keep a master copy for yourself, and make a copy *without* student names to send to the UW Evaluation Team. The evaluation team should never see the paired list, so that information given to the university remains de-identified.
    - For optimal record-keeping, obtain a class list for each of the grades that you're working with. The class list should include birthday, gender, and ethnicity parameters so that this can be double-checked against students' entries.
- Collect student height, weight, and demographic information (to check against the file created above) using the Student Demographics and Measurement form (page 231). Best-practice measurement procedures are included in the document *To Weigh and Measure*, published by Wisconsin DHS.
    - If a calibrated scale and stadiometer are not available in your district, please contact a member of the UW evaluation team as soon as possible.
- Facilitate a **Student Knowledge and Attitudes Survey** (online) with third, fourth, and fifth grade classes.
- Organize and administer a **Lunch Tray Photo Observation** (digital photography) according to protocol (see page 226). This includes submitting menus and information about the school cafeteria environment, and taking and submitting digital photos of student lunch trays.
- Submit **school-level information**:
    - Submit grade-aggregate **attendance, standardized test scores, percent of students eligible for free/reduced-price lunches, and the percent of students participating in the school lunch program** for the 2011-2012, 2012-2013, and 2013-14 academic years.
    - This information is available to the public via the Department of Public Instruction, aggregated to the entire school. We are asking for grade-aggregate information because it enhances the precision of our analyses.
- Submit **monthly activity reports** (via an online survey) to describe the actual Farm to School activities happening each month.
- Submit **quarterly reports** as part of the TWi quarterly report.
- Facilitate audio-recorded **qualitative surveys** to measure perceptions of key stakeholders.

Evaluation Tools

1. **Student Evaluation ID number** – *due May 1, 2013*
   The site coordinator or the school will assign all third- to fifth-graders an evaluation ID number. This will comprise a 2-digit school ID (assigned by the evaluation team), 2-digit grade ID, and 3-digit individual ID, resulting in a 7-digit evaluation ID, i.e. 1003005). This record must be maintained throughout the evaluation, and students must be given their same unique ID for each student measures at both time points.

   A Microsoft Excel file template is available in Dropbox (file name: **Student Evaluation ID.**xlsx) for collecting and maintaining this information (please save your own copy in a separate location such as your own computer). *The evaluation team must never see the list pairing IDs with names*, but it is important to use the same number throughout the evaluation because it enables assessment of within-student changes. It may be helpful to give each classroom teacher a copy with their students' names and evaluation ID numbers.

   Please assign ID as follows:

   XXYYZZZ where XX = school number, YY = current grade (03, 04, or 05), ZZZ = individual number, starting with 500.
   *By starting with **500**, students will be recognized as participants in the Transform Wisconsin F2S evaluation.*

   *****These ID numbers will need to be maintained and used again for the May 2014 evaluation*****

   Some students in this evaluation participated in the 2010-2011 and 2011-2012 evaluations. For these students, please assign as follows:

   XXYYZZZ where: XX = school number,
   YY = current grade*,
   ZZZ = individual, using each student's **SAME** 3-digit number from 2010-2011 and 2011-2012 evaluations.

   *Current grade: If the student was first given an evaluation ID in 2011-2012, use 13, 14, or 15 for the grade identifier (likely, only 14 and 15 are possible because they would have been 3rd or 4th graders in 2011-2012).
   If the student was first given an evaluation ID in 2010-2011, use 23, 24, or 25 for the grade identifier (likely, only 25 is possible because they would have had to begin as 3rd graders in 2010-2011).
   Previously, Grade was represented by "0[3-4-5]" so by changing the "0" digit it is possible to identify a student as a second- or third-year evaluation participant.

   Example: *A student whose ID was* 1103045 *in 2010-11, should have been* 1114045 *in 2011-12. This year, that same student's ID would be* 1125045.

2. **Dropbox**
   A series of Dropbox folders have been created to assist with submitting and maintaining de-identified data and files to the Evaluation Team. Community coalition members will receive personal email invitations to "share" these folders as soon as possible.

   To download Dropbox, go to https://www.dropbox.com and follow instructions after clicking "Download Dropbox". To begin to learn how to use Dropbox, take the tour available at https://www.dropbox.com/tour or see https://www.dropbox.com/help/ for more information. If you have problems downloading the desktop application to a school-based computer, a web version is available. See https://www.dropbox.com/help/90 to learn how to add files using the website (see the box titled "On the Dropbox website").

3. **Student Heights and Weights** – *May 2013, May 2014 (include 6th graders in 2014)*
   Height and weight measurements for third through fifth graders should be taken by the school nurse or another person trained according to the guidelines in the DHS publication *To Weigh and Measure* (2008; posted in Dropbox), and the measurements should be submitted with students' corresponding evaluation IDs. It is very important that birthdates and genders be correct when using this data to calculate BMI z-score. It is important to use a calibrated scale and stadiometer; please contact the UW-Madison evaluation team if they are not available in your district. A sample data collection sheet is provided in this manual (page 231) and an electronic version is in Dropbox (**Student Height-Weight-demographics.pdf**). Submit this information to the UW Evaluation Team with respective evaluation IDs, preferably in spreadsheet format; this can be included in the evaluation ID spreadsheet (in Dropbox: **Student Evaluation ID.xlsx**). Mailing the paper forms is also acceptable (mail to Andrea Bontrager Yoder, 1415 Linden Dr, Madison, WI 53706).

4. **Student Knowledge & Attitudes Survey** – *May 2013, May 2014 (include 6th graders in 2014)*
   Expected time for student online survey completion: approximately 35-40 minutes

   A link to this survey will be emailed to site coordinators in April both years. Students must enter their correct 7-digit evaluation ID number both times. Students may ask questions during the survey. A paper version of this survey is available upon request. A PDF version is available for preview in Dropbox (file name: **Student Knowledge & Attitudes Survey 2012-2013.pdf**). However, schools are strongly encouraged to use the online version of the survey.

   Scripts for introducing this and other surveys/tools are included (see page 230).

5. **Lunch Tray Photo Observation** – *May 2013, May 2014 (include 6th graders in 2014)*
   Per protocol (page 226), complete 4 days of digital photography observation of school lunches in the fall and in the spring, each within in a two-week period (four consecutive days are preferred).

   Additionally, we ask you to take photographs and collect other information from the food service staff (see **School Food Environment Data Form**, page 247; see **School Lunch Menu Information**, page 249) to give a full understanding of how the lunch program works at your school (described in the protocol). Upload the files and digital photographs to the "Plate Waste Digital Photos – Shared"

DropBox folder specific to your school and day. It is very important that you use the numbering system described in the protocol so that we can create averages across the four days for each student.

6. **Activity Reports** – *due on the 5th of each month (i.e., October 5th for September)*
***and* Quarterly Progress Reports** – *due Nov 10 2013, Feb 10 2014, and June 10 2014*
Each month, a selected individual from each site will receive an email with a link to an online reporting system, in the form of a survey. Additionally, three "quarterly" progress reports (accessed the same way) will be due November 10th, February 10th, and June 10th. An activity observation log is included if you find that kind of record-keeping helpful (page 232; electronic version in Dropbox: **Activity Observation Log.docx**).

The monthly reports are important for determining the type and level of Farm to School activity taking place at your school(s), which, in turn, helps us better understand any changes in student outcome measures that occur between September and the end of the school year. The quarterly reports help document "Great Stories," which are useful in describing program implementation and successes.

7. Qualitative Interviews – *due June 1 2014*
A series of interviews have been developed to understand key pieces of the Farm to School program and environment in each community (see Dropbox). Where permission is granted, these interviews should be audio recorded. Digital recorders are available upon request; using school or personal audio recording equipment (such as an iPod or smart phone) is also acceptable. <u>If recording permission is not granted, please take detailed notes during the interview</u>. Recorded interviews should be submitted to the evaluation team by the date above; they then will be transcribed and analyzed for themes. Interviews ought to be conducted with the following key stakeholders:

School food service director
Farmer
School administrator (i.e., principal)
Teacher
Parent
Community member
Students (in a focus group setting)

<u>Interview questions for each stakeholder category are in the Dropbox folder, within the sub-folder entitled "Interviews."</u>
**<u>*These interviews are also available online*</u> for individuals who prefer that approach. To do this, send the name and email address of the interviewee to Andrea Bontrager Yoder.

***If these interviews are too cumbersome for your county, members of the UW-Madison Evaluation Team are happy to help out and perform the interviews.* However, we need your assistance in <u>identifying and approaching the appropriate individuals</u> in your community to be interviewed. For the student focus group, we are hoping to use a Story Capture tool from the UW-Clearinghouse but are still negotiating logistics.

8. **School-aggregate data:** A form is provided (see page 246; electronic file in Dropbox: **School Aggregate Data Form.docx** *or* **School Aggregate Data Form.xlsx**) for collecting the important grade- and school-aggregate information from the appropriate school officials. This information is public knowledge through the Department of Public Instruction at the district level. By documenting it for each grade within schools, the evaluation team will better be able to assess potential changes that happen alongside program implementation.

If you have any questions, concerns, or comments, please contact:

***Evaluation logistics:**

Andrea Bontrager Yoder, PhD candidate, 1415 Linden Dr, Madison WI 53706

Cell phone: (608) 234-2870

E-mail: ayoder@wisc.edu

Also available by Skype if that would be helpful – (Andrea Bontrager Yoder in Madison, WI)

***Broader questions** *(e.g., role of F2S in county food system changes; how the F2S evaluation links with your local group's effort to Transform Wisconsin; F2S program implementation; etc):* Contact your Transform Wisconsin Program Officer.

Questions regarding Farm to School program implementation: Contact your TWi Program Officer.

***For additional resources, see* http://www.farmtoschool.org/WI/programs.htm**

Lunch Tray Photo Observation: Protocol

We will use digital photography to assess **third-, fourth-, and fifth-graders'** (and in 2014, 6th-graders) fruit and vegetable consumption, in both May 2013 and May 2014. At both time points, photos of student lunch trays will be collected for **four days** within a 2-school-week period, thus obtaining a variety of menus.

Site coordinators should enlist 1-3 volunteers (depending on the number of students and the cafeteria set-up) to take photographs of "before" and "after" school lunch trays each day. Ideally, these should be the same volunteers each day, but that is not mandatory. Cameras will be provided to each site; site coordinators should determine the number of cameras needed and communicate with Andrea Bontrager Yoder as early as possible so that cameras and other materials can be mailed well in advance of your determined photo days. Upload the photos to a computer immediately following the 'photo shoot' to make room for the next day's photos. Batteries should be new or freshly charged (with extras readily available) each day to prevent delays and missed photos. Several previous studies have found this method to not disrupt the school cafeteria setting, and analysts' estimations of consumption levels agreed with each other well (see References, page 228).

Prior to beginning the LTPO, assess the lunch room and talk with the food service staff to learn the following:

1. Standard serving sizes of each menu item
2. Presence of a salad bar and how it fits with the school's lunch offerings
3. Presence of other à la carte or self-serve foods
4. Whether lunch menu items are selected by or served to students, particularly fruits and vegetables
5. Whether any of the menu items are locally sourced and, if they are, whether they are advertised to students as such

An Excel file is available in Dropbox for collecting menu-related data (see page 249; **SchoolLunch_MenuInformation_LTPO.xlsx** – this includes sample entries for your reference), and a Word file for the cafeteria environment (see page 247; **School Food Environment_LTPO.docx**). If you prefer, the menu-related data can be relayed to Andrea by phone or by making notes on a school's lunch menu (scan and email, or send by postal mail, the marked-up menu to Andrea).

On site – each day:

1. **Site coordinators** will be provided with stickers that dissolve easily in the dishwasher. Site coordinators must communicate early with the evaluation team the number of students in each grade so that the appropriate number of labels can be sent.

   -Clearly number the stickers so that they are legible in photos (large, written with a bold pen).

   -Ideal numbering system:

   XYYY, where: X grade

   YYY student 3-digit evaluation ID (starting with "5xx")

   - Using students' evaluation IDs for the tray numbers is optimal for the evaluation; it allows us to link students' fruit and vegetable consumption at school lunch with the other F2S evaluation measures. If this is not possible, please communicate with the evaluation team as soon as possible to discuss alternative procedures.

- Place stickers on lunch trays where they will be easily visible in a photograph (ideally, a central part of the tray).

2. **Photographers:** Digital photographs should be taken from a height of approximately 16 inches above the tray and at approximately a 45° angle. The goal is to see the entire tray in the photo frame, with tray boundaries just inside the frame boundaries, offering more or less a bird's-eye view, but with a slight angle to offer depth perception.
   - Make sure the sticker/number is **visible** (not covered by food or a hand)
   - Try to make sure that the photo is **not blurry or glared** before allowing the student to move along. Taking a couple of test photos prior to the lunch period starting is a good way to verify that the cafeteria lighting and camera settings match each other well.
   - Take the pictures from as **consistent and angle and height** as possible.

   <u>Photo procedure:</u>

   a) As students exit the lunch line, take a picture of each "before" tray.

   b) Just before students dump their tray at the end of the meal, take a picture of the "after" tray with the student's tray sticker showing.

   (i) You may need to make adjustments to differentiate between eaten and uneaten portions (for example, orange peels remaining versus uneaten orange slices should be clearly distinguishable). Photographers may ask the children to move the food themselves, or the photographers may wear gloves and adjust the foods themselves.

   (ii) If time constraints do not allow for "after" photos ***and*** if lunch trays are disposable, students may leave trays on the table for photographs to be taken after children have left the cafeteria.

   (iii) **A special note about post-meal milk cartons:** In order to get the best estimate of students' milk consumption, please ask students to:
   - *If the milk is all consumed* – turn carton on its side (or crush the carton)
   - *If the milk is NOT all consumed* – open the carton so that the height of the remaining milk can be seen as part of the picture with the rest of the lunch tray

   c) **Please set the cameras' date and time function to appear on the pictures**. This helps verify the date (as long as the camera is set to the correct date).

4. **Food Service Staff – as much as possible, please:**
   - Put the same foods in the same compartments of the trays from student to student
   - Serve uniform serving sizes (though I recognize and appreciate that you don't want students to waste food)
   - **Submit portion sizes (weights or volumes) planned to the UW Evaluation Team with the month's menu for the days on which photos are taken.**

5. **Site coordinators**: upload the photo files and the menu information to the computer to clear cameras for the next day. After they are on your computer, please move them into the appropriate Dropbox folder, specific to your school and the day, so that the evaluation team may access them.

6. The **site coordinator** will provide notes and observations to the evaluation team, such as:
   a) any problems that arose during data collection (photography slowing the serving line, or students disposing of trays prior to photography)
   b) whether or not students received same numbers for ID sticker each day
   c) whether or not sticker numbers correspond exactly to an evaluation ID each day
   d) any other observations that you think may be helpful for analysis and interpretation
   e) a copy of the school meal menu for the days on which photos were taken with the information described above

Off-site – after photos are submitted:

The **Evaluation Team** will match "before" and "after" tray photos according to sticker number for each day, then compare the paired trays to visually estimate the amount of food consumed.

The ideal data collection is for each participating school to take "before" and "after" photographs of school lunch trays:

-for all third, fourth, and fifth graders,
-on four consecutive days (see timeline), but within two school weeks,
-by site coordinators and the enlisted volunteers each day, with cameras provided, and
-with complete information about menu offerings, portion sizes, and the cafeteria environment.

References

Swanson, M. (2008) Digital Photography as a Tool to Measure School Cafeteria Consumption. *J School Health*, 78(8): 432-437.

Martin CK, Han H, Coulon SM, Allen HM, Champagne CM, Anton SD. A novel method to remotely measure food intake of free-living individuals in real time: the remote food photography method. *British Journal of Nutrition* 2009; 101:446-456.

Williamson DA, Allen R, Martin PD, Alfonson AJ, Gerald B, & Hunt A. Comparison of digital photography to weighed and visual estimation of portion sizes. *Journal of the American Dietetic Association*, 2003; 103(9):1139-1145.

Martins Rodrigues AG & da Costa Proenca RP. Use of food images for evaluating food intake. *Brazilian Journal of Nutrition*, 2011; 24(5):765-776.

Timeline

Due Date	Action	Tool/File	Objective
SPRING 2013			
ASAP	Obtain from school and maintain records of students' school evaluation ID numbers	Excel spreadsheet in Dropbox	Organization of data, to enable comparisons of individual student change through the year.
May 1-31	Collect students' heights, weights, and demographics	Student Demographics form. See also *To Weigh and Measure* (DHS, 2008)	Baseline assessment
May 1-31	Student Knowledge & Attitudes Survey	Online (link will be emailed)	Baseline assessment (attitudes, knowledge, exposure to fruits/vegetables)
May 1-31	Lunch Tray Photo Observation (4 days within a 2-week period)	See protocol, page 226. *Recruit volunteers; cameras and tray stickers will be mailed.*	Baseline assessment (student school lunch consumption)
ONGOING THROUGHOUT EVALUATION PERIOD			
Monthly	Activity report	Online	Provide accurate records of F2S program activities.
With TWi deadlines	Quarterly Progress Report	Online	Provide "Great Stories" and other additional information not covered by activity reports.
END OF 2013-2014 SCHOOL YEAR			
May 1-31	Student Knowledge & Attitudes Survey	Online (link will be emailed)	End-of-year assessment (attitudes, knowledge, exposure to fruits/vegetables)
May 1-31	Lunch Tray Photo Observation (4 days within a two-week period)	See protocol, page 226. *Recruit volunteers; cameras and tray stickers will be mailed.*	End-of-year assessment (student school lunch consumption)
May 1-31	Collect students' heights and weights	Student Height, Weight, and Demographics form. See also *To Weigh and Measure* (DHS, 2008)	End-of-year assessment
May 31	Qualitative interviews with key stakeholders (may begin these in April)	Interview guides (in Dropbox). Use digital audio recorder.	Qualitative assessments of stakeholders' perceptions of F2S programming

Evaluation Tool Scripts

Measuring Height/Weight

Today, [*name the person – school nurse? PE teacher? other?*] is going to measure how tall you are and how much you weigh. We want to see how the students at [*this school*] compare to students in other Wisconsin schools. We want to learn whether students in schools that participate in Farm to School programs are healthier than students in schools that do not participate in Farm to School.

If there are questions about whether we'll know who they are:

We will not put your name with your height and weight, only your evaluation ID number. Lots of students all around Wisconsin are being measured at their schools.

Student Knowledge & Attitudes survey

This survey asks what you think about food. The first part of this survey asks what you think about fruits and vegetables, and if you are willing to try new ones. The second part asks questions about where food comes from and how we eat. The third part of the survey asks whether you have ever tried specific fruits and vegetables. The last part of the survey asks if, and how much, you have eaten different types of foods. This survey should take about 30 minutes. If you have questions, ask [*whoever is administering the survey*].

Lunch Tray Photo Observation

This week during lunch, there will be people taking pictures of your school lunch trays. We want to learn more about what you are eating and not eating. When you leave the lunch line, please stop for a couple of seconds to let [*name of photographers*] take a picture of your lunch tray **before** you sit down to eat. At the end of lunch, we want to take another picture of your lunch tray – so before you throw your leftover food into the garbage, stop at [*this location*] to get another picture taken. Do not take the piece of tape with the number on it off of your tray, and please make sure we can see it for both pictures. The pictures will only be of your food.

Student Demographics and Measurement

Please be sure to have read* To Weigh and Measure *(DHS, 2008) prior to collecting this data.

Student Evaluation ID

Date of birth _____ *mm/dd/yyyy*

Today's date _____ *mm/dd/yyyy*

Gender ☐ Male ☐ Female

Ethnicity
- ☐ African-American
- ☐ Asian-American
- ☐ Caucasian
- ☐ Hispanic
- ☐ Native American/American Indian
- ☐ Other – please describe: _____

Measurement data:

Note: *Clearly indicate if you are using measurements other than pounds and inches.
*If the difference between height measurements 1 and 2 is greater than ¼ inch, re-measure.
*If the difference between weight measurements is greater than ¼ pound, re-measure.

1st height: _____&_____/8th inches

2nd height: _____&___/8th inches

1st weight: _____._____pounds

2nd weight: ____._____pounds

Unable to assess:

Check a reason below if measurement or student data cannot be obtained:

- ☐ Parent refused
- ☐ Physical disability
- ☐ No longer at this school
- ☐ Student refused
- ☐ Could not get two height measurements within ¼ inch or two weight measurements within ¼ pound
- ☐ Other: _____

School information: Scale make/model: _____

Last calibration date: _____

Stadiometer make/model: _____

Activity Observation Log

Date:_____

Name:_____

Activity:_____

School:_____

Grade Level(s):_____

Teacher/Food Service Rep:_____

# of Students:_____

Food Served:_____

Amount Served:_____

Who led the activity?

- AmeriCorps Member_____
- Teacher_____
- Famer Educator_____
- Volunteer_____
- Other_____

Resources Provided:

- Lesson Plan_____
- Letter Home_____
- Atlases_____
- Snack Bite_____
- Other _____

Observations: Were students engaged? Did they enjoy the food? What went well? What did not?

Suggested changes/adaptations:

Quotes (Kids/Teachers/Food Service, etc)

Other comments:

Student Knowledge & Attitudes Survey

Wisconsin Farm-to-School
2012-2013
Student Survey

Welcome to the Wisconsin Farm to School Student Survey. We want to hear what you think about fruits and vegetables - thank you for helping us!

This is not a test and it will not affect your grades. Please answer every question, telling us what you really think. If you have questions you may ask your teacher or AmeriCorps member.

Student Evaluation ID:

Today's date: _____
month / day / year

What is your gender? ☐ **Male** ☐ **Female**

What grade are you in? ☐ **3rd** ☐ **4th** ☐ **5th**

What ethnic group do you belong to?

- ☐ **African-American**
- ☐ **Asian-American**
- ☐ **Caucasian**
- ☐ **Hispanic**
- ☐ **Native American/American Indian**
- ☐ **Other – please describe:** _____

When is your birthday?

Month: _____ **Day:** _____

Year (that you were born): _____

	Please tell how you feel about fruit.	**a lot**	**a little**	**not very much**	**not at all**
1	How much do you like **fruit**?	☐	☐	☐	☐
2	When you try a new fruit for the first time, how much do you usually like it?	☐	☐	☐	☐
3	How much do you like tasting new **fruits**?	☐	☐	☐	☐

	Please tell how you feel about tasting new fruit.	**definitely**	**probably**	**probably not**	**definitely not**
4	Will you taste a **fruit** if you don't know what it is?	☐	☐	☐	☐
5	Will you taste a **fruit** if it looks strange?	☐	☐	☐	☐
6	Will you taste a **fruit** if you have never tasted it before?	☐	☐	☐	☐
7	When you are at a **friend's house**, will you try a new **fruit**?	☐	☐	☐	☐
8	When you are at **school**, will you try a new **fruit**?	☐	☐	☐	☐
9	When you are at **home**, will you try a new **fruit**?	☐	☐	☐	☐

		Never	**1 time**	**2 times**	**3 times**	**at least 4 times**
10	How many times have you tried a new **fruit** since school started this year?	☐	☐	☐	☐	☐

Please tell how you feel about vegetables.	**a lot**	**a little**	**not very much**	**not at all**
11 How much do you like **vegetables**?	☐	☐	☐	☐
12 When you try a new vegetable for the first time, how much do you usually like it?	☐	☐	☐	☐
13 How much do you like tasting new **vegetables**?	☐	☐	☐	☐

Please tell how you feel about tasting new vegetables.	**definitely**	**probably**	**probably not**	**definitely not**
14 Will you taste a **vegetable** if you don't know what it is?	☐	☐	☐	☐
15 Will you taste a **vegetable** if it looks strange?	☐	☐	☐	☐
16 Will you taste a **vegetable** if you have never tasted it before?	☐	☐	☐	☐
17 When you are at a **friend's house**, will you try a new **vegetable**?	☐	☐	☐	☐
18 When you are at **school**, will you try a new **vegetable**?	☐	☐	☐	☐
19 When you are at **home**, will you try a new **vegetable**?	☐	☐	☐	☐

	Never	**1 time**	**2 times**	**3 times**	**at least 4 times**
20 How many times have you tried a new **vegetable** since school started this year?	☐	☐	☐	☐	☐

39. How many times in your life have you been to a farm?

- ☐ Never
- ☐ 1 time
- ☐ 2 times
- ☐ 3 times
- ☐ 4 times or more

40. How do tomatoes grow? *Please check one.*

- ☐ As plants
- ☐ As animals
- ☐ As minerals
- ☐ Something else

41. What part of a plant is a carrot? *Please check one.*

- ☐ Leaf
- ☐ Root
- ☐ Stalk
- ☐ Flower

42. Where do eggs come from? *Please check one.*

- Cows
- Goats
- Chickens
- Something else

43. What is a benefit of using compost?

- Compost feeds wild animals.
- Makes farmers use more chemical fertilizers.
- Compost keeps food out of landfills.
- None of the above.

44. Do insects play an important role in growing plants?

- Yes
- No
- I don't know

45. Do TOMATOES grow in Wisconsin?

- Yes
- No
- I don't know

46. Do ORANGES grow in Wisconsin?

- Yes
- No
- I don't know

47. Do APPLES grow in Wisconsin?

- Yes
- No
- I don't know

48. Does SQUASH grow in Wisconsin?

- Yes
- No
- I don't know

49. Do BANANAS grow in Wisconsin?

- Yes
- No
- I don't know

50. Imagine a meal with a hotdog in a bun and a glass of milk. What food group is missing? *Please check one.*

- Dairy
- Fruits & Vegetables
- Meat
- Grains

51. What food group does the pear belong to? Please check one.

- Dairy
- Fruits & Vegetables
- Meat
- Grains

52. Fruits and vegetables that are high in Vitamin A are _____ in color.

- Red and white
- Blue and light brown
- Yellow-orange and dark green
- Brown and purple
- I don't know

53. Why do I need to eat food?

- I need food for energy and to grow.
- I need food ONLY because it tastes good.
- I don't need food.
- I don't know

54. Why do I need to eat different kinds of foods?

- I can get a lot of the **SAME** nutrients.
- I can get many **DIFFERENT** nutrients.
- I don't need to eat different kinds of food.
- I don't know.

55. Healthy eating is:

- eating fruits but **not** vegetables.
- **not** eating fruits or vegetables.
- eating **both** fruits ***and*** vegetables.
- I don't know.

56. The foods that I eat for meals and snacks are healthy. *(Choose one.)*

- Yes, all of the time
- Yes, sometimes
- No

57. How likely are you to eat fresh fruit instead of candy? *(Choose one.)*

- ☐ Not likely
- ☐ Likely
- ☐ Very Likely

58. Which of these is the HEALTHIEST way to eat potatoes?

- ☐ Potato salad
- ☐ French fries
- ☐ Baked potato
- ☐ I don't know

For the remaining questions, please answer all parts of each question.

41. Have you ever eaten an apple?

- ☐ **Yes** Did you like it? ☐ yes ☐ no
- ☐ **No** Would you try one?
  - ☐ yes
  - ☐ no
  - ☐ maybe

42. Have you ever eaten an orange?

- ☐ **Yes** Did you like it? ☐ yes ☐ no
- ☐ **No** Would you try one?
  - ☐ yes
  - ☐ no
  - ☐ maybe

43. Have you ever eaten a mango?

- ☐ **Yes** Did you like it? ☐ yes ☐ no
- ☐ **No** Would you try one?
  - ☐ yes
  - ☐ no
  - ☐ maybe

44. Have you ever eaten watermelon?

- ☐ **Yes** Did you like it? ☐ yes ☐ no
- ☐ **No** Would you try one?
  - ☐ yes
  - ☐ no
  - ☐ maybe

45. Have you ever eaten a pear?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

46. Have you ever eaten a kiwi?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

47. Have you ever eaten a strawberry?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

48. Have you ever eaten a blueberry?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

49. Have you ever eaten cantaloupe?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

50. Have you ever eaten a grape?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

51. Have you ever eaten papaya?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try it?
☐ yes
☐ no
☐ maybe

52. Have you ever eaten a cranberry?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

53. Have you ever eaten asparagus?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

54. Have you ever eaten broccoli?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

55. Have you ever eaten beets?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

56. Have you ever eaten a cucumber?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

57. Have you ever eaten a green pepper?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

58. Have you ever eaten a sweet potato?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

59. Have you ever eaten peas?

☐ **Yes** Did you like them? ☐ yes ☐ no
☐ **No** Would you try them?
☐ yes
☐ no
☐ maybe

60. Have you ever eaten eggplant?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try it?
☐ yes
☐ no
☐ maybe

61. Have you ever eaten spinach?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try it?
☐ yes
☐ no
☐ maybe

62. Have you ever eaten green beans?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

63. Have you ever eaten avocado?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

64. Have you ever eaten a tomato?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

65. Have you ever eaten a carrot?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

66. Have you ever eaten a radish?

☐ **Yes** Did you like it? ☐ yes ☐ no
☐ **No** Would you try one?
☐ yes
☐ no
☐ maybe

Think about everything you ate or drank yesterday. Remember what you had for breakfast, lunch, dinner, after school, while watching TV, and at bedtime.

	Did you eat or drink it yesterday?		**How much did you eat?**		
Apples, bananas, or oranges	☐ Yes	☐ No	☐ ½	☐ 1	☐ 2
Applesauce, fruit cocktail	☐ Yes	☐ No	☐ A little	☐ Some	☐ A lot
Any other fruit, like strawberries, grapes	☐ Yes	☐ No	☐ A little	☐ Some	☐ A lot
French fries, hash browns, tater tots	☐ Yes	☐ No	☐ A little	☐ Some	☐ A lot
Other potatoes, like mashed or boiled	☐ Yes	☐ No	☐ A little	☐ Some	☐ A lot
Ketchup or salsa	☐ Yes	☐ No	☐ A little	☐ Some	☐ A lot
Lettuce salad	☐ Yes	☐ No	☐ A little	☐ Some	☐ A lot
Tomatoes, including on salad	☐ Yes	☐ No	☐¼ tomato	☐½ tomato	☐1 tomato
Green beans or peas	☐ Yes	☐ No	☐ A little	☐ Some	☐ A lot
Other vegetables, like corn, carrots, greens, broccoli	☐ Yes	☐ No	☐ A little	☐ Some	☐ A lot
Vegetable soup, tomato soup, any soup or stew with vegetables in it	☐ Yes	☐ No	☐ A little	☐ Some	☐ A lot
Chili beans, pinto beans, black beans, including in burritos	☐ Yes	☐ No	☐ A little	☐ Some	☐ A lot
Refried beans	☐ Yes	☐ No	☐ A little	☐ Some	☐ A lot

How sure are you that you can do the following:

Eat vegetables at dinner.

- ☐ I know I can
- ☐ I think I can
- ☐ I'm not sure I can
- ☐ I know I can't

Eat my favorite fruit instead of my usual desert with dinner.

- ☐ I know I can
- ☐ I think I can
- ☐ I'm not sure I can
- ☐ I know I can't

Eat a vegetable that's being served with my lunch at school.

- ☐ I know I can
- ☐ I think I can
- ☐ I'm not sure I can
- ☐ I know I can't

Eat a fruit that's being served with my lunch at school.

- ☐ I know I can
- ☐ I think I can
- ☐ I'm not sure I can
- ☐ I know I can't

Thank you for taking the time to complete this survey!

School Aggregate Data Form

Site coordinator: Please work with school administration to obtain official records for this information. Submit to Andrea Bontrager Yoder by Dropbox, e-mail, or mail.

	2011-2012			2012-2013			2012-2013		
School-wide – note which grades are represented (ex, K-5)									
# students enrolled									
% of students eligible for FRPL									
Attendance rate (%)									
National School Lunch Program:									
Average Daily Participation (# lunches served)									
Average daily participation (%)									
# lunches served that were FRP									
Average daily FRP participation (%)									
Grade-specific	**3rd**	**4th**	**3rd**	**4th**	**5th**	**5th**	**3rd**	**4th**	**5th**
# students enrolled									
Attendance rate (%)									
% of students eligible for FRPL									
National School Lunch Program:	**3rd**	**4th**	**3rd**	**4th**	**5th**	**5th**	**3rd**	**4th**	**5th**
Average Daily Participation (# lunches served)									
Average daily participation (%)									
# lunches served that were FRP									
Average daily FRP participation (%)									
Standardized Test Scores - % advanced and proficient	**3rd**	**4th**	**3rd**	**4th**	**5th**	**5th**	**3rd**	**4th**	**5th**
Reading									
Language Arts									
Mathematics									
Science									
Social Studies									
Behavioral	**3**	**4th**	**5th**	**3rd**	**4th**	**5th**	**3rd**	**4th**	**5th**
# of disciplinary referrals (average per month)									

School Food Environment Data Form

Site coordinators:

1) Please take photos of the following aspects of the school cafeteria:

Serving line (so that approximate menu item placement is apparent)

Overall layout of the cafeteria

Salad bar/PB&J bar/bread & butter/condiments stations, if they are available (preferably stocked as they would be for student lunch time)

Anything else that provides context to your school's cafeteria setting

2) Please work with School Food Service (SFS) Staff to obtain the following information.

1. **Is there a salad bar at your school?** _____ yes _____ no
   If yes, please answer the following:
   a. Is the salad bar available every day? yes/no
      i. If not, which days is it available? *circle all that apply*
      Mon Tues Wed Thurs Fri
      Other arrangement – *please describe:*_____
      _____
      _____

   b. What is typically on your salad bar? *select all that apply*
   - o Lettuce – iceberg
   - o Lettuce – romaine or green leaf
   - o Other salad greens
   - o Carrots
   - o Cucumber
   - o Tomatoes
   - o Cheese
   - o Radishes
   - o Peas
   - o Cut fruit
   - o Other – please list:_____
     _____
     _____

   c. Are any of those items locally sourced or from a school garden?
   If so, please note above with an **L** *for locally sourced items and/or a* **G** *for school garden items. Explain any details that you feel are important here:*_____
   _____
   _____

   d. Do students serve themselves from the salad bar, or does SFS staff serve them?
   ____students serve themselves _____ SFS staff serves students

   e. Are the items pre-portioned? yes/no
   If yes, what is the portion size?
   _____ ¼ cup _____ ½ cup other:_____

   f. What, if any, education occurs alongside the salad bar and school lunch program to aid students in lunch food item selection?
   *Please describe:*_____
   _____
   _____
   _____

   g. How are the salad bar items financially supported?
   Please describe: _____
   _____
   _____
   _____

2. **Is there a peanut butter/jelly or bread bar at your school?** _____ yes _____ no
   If yes, please answer the following:
   a. Is it monitored? yes/no
      i. If yes, how is it monitored? *Please describe*_____
   b. Is it included in the cost of the school lunch program? yes/no
   c. Is it available every day? yes/no Mon Tues Wed Thurs Fri

3. Is there any other type of self-serve food at your school? _____ yes _____ no
   If yes, please answer the following:
   a. Is it monitored? yes/no
      i. If yes, how is it monitored? *Please describe*_____
   b. Is it included in the cost of the school lunch program? yes/no
   c. Is it available every day? yes/no Mon Tues Wed Thurs Fri

4. What, if any, a la carte items are available at your school?
   a. Table: item, price, available every day?

Item	**Price**	**Available every day? (y/n)**	**Notes**

5. Is chocolate milk available to students every day? _____ yes _____ no
   If no, please circle when chocolate milk is available:
   Mon Tues Wed Thurs Fri
   Other arrangement – *please describe:*_____

School Food Service: School Lunch Menu Information

Also available as an Excel spreadsheet in Dropbox.

Date	Menu item	Serving size (specify cups, ounces, etc)	Locally sourced (y/n)?	If locally sourced, was it advertised as such to students?	Is the item *served* to all students, or *selected* as an option?	Notes
SAMPLE	Fruit cocktail	0.5 cups	N	n/a	served/all students	students could request less; minimum amount placed on tray 1/8 cup
SAMPLE	carrot sticks	0.25 cups	Y	yes	selected/one of 2 veg choices	students could choose one or both veg options
SAMPLE	burger (whole wheat bun, 100% beef patty, cheese optional)	0.25 # patty, standard dinner roll bun	N	n/a	entrée choice	

References

Basch CE. Healthier students are better learners: a missing link in school reforms to close the achievement gap. *Journal of School Health.* 2011;81(10):593-598.

Freedman D, Wang J, Thornton JC, et al. Classification of body fatness by body mass indexfor-age categories among children. *Archives of Pediatric and Adolescent Medicine*. 2009;163:801–811.

Judge S, Jahns L. Association of overweight with academic performance and social and behavioral problems: an update from the early childhood longitudinal study. *Journal of School Health.* 2007;77(10):672-678.

Knitter, A., Wubben, D., and Tedeschi, S. *Wisconsin Farm to School Toolkits for School Nutrition Directors and Producer*. 2011. University of Wisconsin—Madison, Centers for Integrated Agricultural Systems. http://www.cias.wisc.edu/toolkits/

Krebs NF, Himes JH, Jacobson D, Nicklas TA, Guilday P, Styne D. Assessment of child and adolescent overweight and obesity. *Pediatrics.* 2007;120(S4):S193-228. http://pediatrics.aappublications.org/cgi/content/full/120/Supplement_4/S193.

LaRowe, T., Bontrager Yoder, A., Knitter, A., Meinen, A., Liebhart, J., and Schoeller, D. *Wisconsin Farm to School: One year evaluation report.* 2011. University of Wisconsin – Madison, Department of Family Medicine. http://www.fammed.wisc.edu/sites/default/files//webfm-uploads/documents/research/wif2s-report.pdf

Office of the Surgeon General. The Surgeon General's Vision for a Healthy and Fit Nation. Rockville, MD, U.S. Department of Health and Human Services; 2010.

Sallis JF, Glanz K. Physical activity and food environments: solutions to the obesity epidemic. *The Millbank Quarterly*. 2009;87:123-54.

Story M, Kaphingst KM, Robinson-O'Brien R, Glanz K. Creating Healthy Food and Eating Environments: Policy and Environmental Approaches. *Annual Review of Public Health.* 2008;29:253–72.

Taras H, Potts-Datema W. Obesity and student performance at school. *Journal of School Health.* 2005;75(8):291-295.

APPENDIX 4. Wisconsin Farm to School Evaluation Information and Opt-Out Form, 2010-2011

[please put on school letterhead]

Dear Parent of [Name of School] Student(s):

[School Name Here] has been selected to participate in a statewide "Farm to School" program to increase local foods in schools. Farm to School is an exciting program that connects schools, families and local farms. A main goal of this program is to improve the health of students by offering nutritious locally grown foods in school meals. Improving nutrition in children is one way to decrease risk for becoming overweight and developing chronic disease later in life. Farm to School also provides agriculture, health, and nutrition education opportunities for students, and supports local and regional farmers.

As part of [School Name here] participation in this program, we are required to gather necessary information from our school and students so that we can track the progress of this program. The Farm to School program is especially interested in how eating behaviors change in your child as a result of this program. Therefore, your child will be asked to participate in surveys about what he/she eats and their thoughts about local foods. In addition, your child's height and weight will be measured in a private area by school personnel. The information gathered from your child will be combined with all students participating in Farm to School programs across Wisconsin and a summary of results will be provided to schools and parents.

Participation in Farm to School activities is very important to help us track the progress, improve the program, and continue statewide funding.

If you have questions about this program, you can contact [school principal] at any time. Your child's participation is voluntary and he/she can decide not to participate at any time.

If, after asking questions, you prefer that your child not participate in the evaluation portion of Farm to School programs, please sign and return this form.

Name of Student (please print):_____

_____ I do not want my child to participate in the evaluation process of the Farm to School program.

Signature Date

APPENDIX 5. Knowledge & Attitudes Survey Scoring Procedure, 2010-2011

Six constructs from the Knowledge and Attitudes (KA) survey were measured from students' responses.

1) **Knowledge** (questions 22-36, 15 questions): Fifteen questions focused on material typically covered in the curricula used by AmeriCorps F2S members. Correct responses received a score of 1, and incorrect answers received a score of 0. Students who selected *I don't know,* when it was a response option, received a score of 0. Scores ranged from 0 to maximum of 15.

$$\boldsymbol{Knowledge} = \sum(\boldsymbol{correct\ responses, Q22-36})$$

2) **Attitudes** (questions 1-20): Six questions ask how much a student likes F/V and how much a student likes *new* F/V. Response options included *a lot* (score = 4), *a little*, *not very much*, or *not at all* (score= 1). Twelve questions asked a student how willing he/she is to try a F/V in a variety of situations, with a response scale ranging from *definitely* (score = 4) to *definitely not* (score = 1). Finally, two questions asked how many times a student had tried a new F/V since the start of the school year, with a response scale ranging from *never* (score= 1) to *at least 4 times* (score= 5). The total *Attitudes* score summed the values for the 20 questions, with a possible score range from 20 to 82.

$$\boldsymbol{Attitudes} = \sum(\boldsymbol{scored\ responses, Q1-20})$$

3) **Perception/Self-efficacy** (questions 37-38): Two questions asked students' perception of their own diets – whether the foods they eat are healthy: *yes, all the time* (score = 2), *yes, sometimes* (score= 1), or *no* (score= 0); and whether they are likely to eat fresh fruit instead of candy: *very likely* (score=2), *likely* (score = 1), or *not likely* (score= 0). Possible scores are 0 to a maximum of 4.

$$\boldsymbol{Perception/self\ efficacy} = \sum(\boldsymbol{scored\ responses, Q37-38})$$

4) **Exposure** (questions 39-60, part 1a): 22 questions asked if a student had tried particular fruits/vegetables. (In the final scoring, two foods were omitted (broccoli, asparagus) due to discrepancies between the paper and electronic versions of the survey as well as an error in the

electronic version.) Each question included a photograph of the food to aid with recognition. *Yes* responses (score=1) were summed to create the Exposure construct score; *no* responses scored 0. The response to the Exposure question then led to either a Liking (if the response was *yes*) or Willingness (if the response was *no*) follow-up question. Exposure scores ranged from 0 to 20.

$$\boldsymbol{Exposure} = \sum(\boldsymbol{yes\ responses, Q39-60\ parts\ a})$$

5) **Liking** (questions 39-60, part b): Among the previously F/V, students were asked whether they liked it (yes/no response options; *yes*=score 1). The sum of *yes* responses were divided by the total number of F/V the student tried (=the Exposure score) and represented as a percentage. The likeness scores ranged from 0 to 100.

$$\boldsymbol{Liking} = \frac{\sum(\boldsymbol{yes\ reponses, Q39-60, parts\ b})}{\boldsymbol{Exposure\ score}}$$

6) **Willingness** (questions 39-60, part c): Among the F/V reported in the Exposure questions to have not been previously eaten, students were asked whether they would try it. Response options were *yes* (score= 2), *maybe* (score =1), and *no* (score= 0). The sum of responses were divided by twice the number of *no* responses to Exposure questions (or 20-Exposure score, x 2; because students could score up to two points per Willingness question asked) and reported as a percentage. The willingness scores ranged from 0 to 100.

$$\boldsymbol{Willingness} = \frac{\sum(\boldsymbol{scored\ responses, Q39-60, parts\ c})}{\boldsymbol{2 \times (20 - Exposure\ score)}}$$

APPENDIX 6. Knowledge & Attitudes Survey Scoring Procedure, 2013

Knowledge and Attitudes Survey Scoring Procedure

The scoring procedures described here apply to both pre- and post-test administration scoring. To evaluate pre/post change, calculate the difference in construct scores by subtracting the pre-test score from the post-test score (each section separately).

Scoring procedure

Students' responses from the KA survey were categorized into different scores.

1) **Knowledge:** There are seventeen questions in this section. The questions focus on material typically covered in farm to school programs. Score the questions accordingly:
    - Correct responses = score 1
    - Incorrect answers = score 0 (including the response *I don't know*, when that is a response option)

    Scores can range from 0 to maximum of 17. To determine a student's Knowledge score, add the sum of all questions in this section (Q22-37, Q40).

$$\boldsymbol{Knowledge} = \sum(\boldsymbol{correct\ responses}, \boldsymbol{Q22-37}, \boldsymbol{Q40})$$

2) **Attitudes:** There are twenty questions in this section. Six questions (Q1-3, Q11-13) ask how much a student likes F/V and how much a student likes *new* F/V. Score the responses as:

a lot	a little	not very much	not at all
4	3	2	1

Twelve questions (Q4-9, Q14-19) ask students' willingness to try a F/V in a variety of situations. Score responses as:

definitely	probably	probably not	definitely not
4	3	2	1

Finally, two questions (Q10, Q20) ask how many times a student had tried a new F/V since the start of the school year. Score responses as:

Never	1 time	2 times	3 times	At least 4 times
1	2	3	4	5

Scores can range from 20 to a maximum of 82. To determine a student's Attitudes score, add the sum of all the questions in this section (Q1-20).

$$\boldsymbol{Attitudes} = \sum(\boldsymbol{scored\ responses, Q1-20})$$

3) **Perception/Self-efficacy:** There are six questions in this section. Two questions (Q38-39) ask students' perception of their own diets – whether the foods they eat are healthy. Score responses as:

Q38	Yes, all the time	Yes, sometimes	no
Q39	Very likely	Likely	Not likely
Score	2	1	0

Four additional questions (Q80-83) ask students to reflect on their ability to make healthy choices: eat vegetables at dinner; eat fruit instead of dessert at dinner; eat a vegetable being served at school lunch; and eat a fruit being served at school lunch. Score responses as:

I know I can	I think I can	I'm not sure I can	I know I can't
4	3	2	1

Scores can range from 4 to a maximum of 20. To determine a student's Perception/Self-Efficacy score, add the sum of all the questions in this section (Q38-39. Q80-83).

$$\boldsymbol{Perception/self\ efficacy} = \sum(\boldsymbol{scored\ responses, Q38-39, Q80-83})$$

4) **Exposure:** There are 26 questions in this section (Q41-66, parts a). Each question asks if a student has tried a particular fruit or vegetable. Each question includes a photograph to aid with food recognition. Score responses as:

Yes	No
1	0

Scores can range from 0 to a maximum of 26. To determine a student's Exposure score, add the sum of all the questions in this section (Q41-66, parts a)).

$$\boldsymbol{Exposure} = \sum(\boldsymbol{yes\ responses, Q41-66, parts\ a})$$

The student's response to the Exposure question branches to either a Liking (response yes) or Willingness (response no) follow-up question for each F/V.

5) **Liking:** (Q41-66, parts b) Where students answered "yes" to part a (above), students are asked whether they liked the fruit/vegetable item that they reported tasting. Score responses as:

Yes	No
1	0

To determine a student's Liking score, divide the sum of the responses for the questions in this section (Q41-66, parts b) by the student's Exposure score (= the total number of fruits/vegetables the student tried); finally, express it as a percentage by multiplying by 100. Scores can range from 0 to a maximum of 100.

$$\boldsymbol{Liking} = \frac{\sum(\boldsymbol{yes\ reponses, Q41-66, parts\ b})}{\boldsymbol{Exposure\ score}}\mathbf{x100}$$

6) **Willingness:** *See footnote for old scoring.*[2] New scoring (as of May 2013) involved asking all students whether they would try the 26 specific F/V (Q41-66, parts c).

Yes	Maybe	No
2	1	0

To determine a student's Willingness score, add the sum of all the questions in this section (Q41-66, parts c) and divide by 2. Scores can range from 0 to a maximum of 26.

$$\boldsymbol{Willingness} = \frac{\sum(\boldsymbol{scored\ responses, Q41-66, parts\ c})}{\mathbf{2}}$$

[2] Old scoring: Among the previously not-tasted F/V, students were asked whether they would try it (*yes*, score=2, *maybe*, score=1, *no*, score=0). Additionally, for each F/V students reported trying and liking, they received a score of 2 (because it was assumed that they would try a F/V they had previously tried and liked). The collective sum of all responses was divided by two. Scores can range from 0 to 20.

7) **FV Screener:** There are 13 questions in this section (Q67-69). For a variety of groups of fruit or vegetable items, students are asked to report (a) whether they ate the item(s) in the past day, and (b) if so, how much (a relative amount). Score section (a) responses as:

Yes	**No**
1	0

Section (b) response scoring strategies are included within each subsection below. The Evaluation Team suggests scoring and assessing the information from this FV screener as follows:

- Calculate the percent of students who report having eating *any* food from the subsections (each separately). For example, 85% of students reported eating any fruit in pre-test, and 100% of students reported eating any fruit at post-test; or 25% of students reported eating any legumes in the pre-test, and 30% of students reported eating any legumes in the post-test.) *Compare the percent of students with a subsection total score greater than 0 to the percent of students with a subsection total score of exactly 0.*
- For each subsection, calculate the average relative amount students reported consuming and relate it back to the terms used for that subsection.

FV Screener Subsections:

a. Fruit **(Q67-69)**

i. Ate fruit at all = score > 0, parts *a*

ii. Relative amount: Score responses as:

Response	**"½"**	**"1"**	**"2"**
Q67	0.5	1	2
Response	**"A little"**	**"Some"**	**"A lot"**
Q68-69	0.5	1	2

To determine a student's relative consumption of fruits, add the responses in this subsection and divide by 3.

b. Potatoes **(Q70-71):**

i. Ate potatoes at all = score > 0, parts *a*

ii. Relative amount: Score responses as:

Response	**"A little"**	**"Some"**	**"A lot"**
Q70-71	1	2	3

To determine a student's relative consumption of fruits, add the responses in this subsection and divide by 2.

c. Vegetables **(*non-potato;* Q72-77):**

i. Ate vegetables at all = score> 0, parts *a*

ii. Relative amount: Score responses as:

Response	**"A little"**	**"Some"**	**"A lot"**
Q72-73, 75-77	1	2	3
Response	**"¼ tomato"**	**"½ tomato"**	**"1 tomato"**
Q74	0.25	0.5	1

To determine a student's relative consumption of fruits, add the responses in this subsection and divide by 5.

d. Legumes**:**

i. Ate legumes at all = score > 0, parts *a*

ii. Relative amount: Score responses as:

Response	**"A little"**	**"Some"**	**"A lot"**
Q78-79	1	2	3

To determine a student's relative consumption of fruits, add the responses in this subsection and divide by 2.

References

1. *Farm to School Evaluation Toolkit*. University of North Carolina at Chapel Hill: Center for Health Promotion and Disease Prevention; 2010.

2. Pliner P, Hobden K. Development of a scale to measure the trait of food neophobia in humans. *Appetite*. 1992;19:105–120.

3. Jamelske E, Bika LA, McCarty DJ, Meinen AM. Preliminary Findings from an Evaluation of the USDA Fresh Fruit and Vegetable Program in Wisconsin Schools. *Wis. Med. J.* 2008;107(5):225–230.

4. Wisconsin Department of Health Services- Division of Public Health- NPAOP, Wisconsin Department of Public Instruction, University of Wisconsin Extension. Got Dirt? Garden Toolkit for implementing youth gardens. 2013.

APPENDIX 7. Wisconsin Farm to School Evaluation Survey Tool Scripts, 2010-2011

Block FFQ – 4th graders only

This survey asks questions about the foods you ate last week. As you answer the questions, think about what you ate at home, at school, in snacks, and from restaurants (including fast food). Answer all the questions. For each food, we ask:

How many days did you eat the food last week?

When you ate it, *how much* did you have?

Use the pictures (on the screen or on the separate piece of paper) to help you think about how much you ate.

On the front, only write your evaluation ID number and the date – *do not write your name.*

This survey will take about 30 minutes. If you have questions, ask (*whoever is administering the survey*).

Fall: evaluation ID includes one additional digit at the end of the ID (1**).

Spring: evaluation ID includes one additional digit at the end of the ID (2**).

Student Knowledge & Attitudes survey – 3rd through 5th graders

This survey asks lots of different kinds of questions.

The first part asks what you think about fruits and vegetables, and if you are willing to try new ones.

The second part asks questions about where food comes from and how we eat.

The third part asks questions about specific fruits and vegetables, and whether you have ever tried them before and if you liked them or would try them.

This survey will take about 15 minutes. If you have questions, ask (*whoever is administering the survey*).

Plate Waste Observation

This week, there will be people taking pictures of your lunch trays. When you leave the lunch line, please stop for a couple of seconds to let [*name of AmeriCorps member and/or volunteer*] take a picture of your lunch tray before you sit down to eat. At the end of lunch, we want to take another picture of your lunch tray – so before you dump your leftover food into the garbage, stop at [*this location*] to get another picture taken. Make sure that the piece of tape with a number on it can be seen for both pictures. We are only taking a picture of your food, not your face.

If it's important to tell why the pictures are being taken: The photos will tell us what foods you like and don't like in your lunch today.

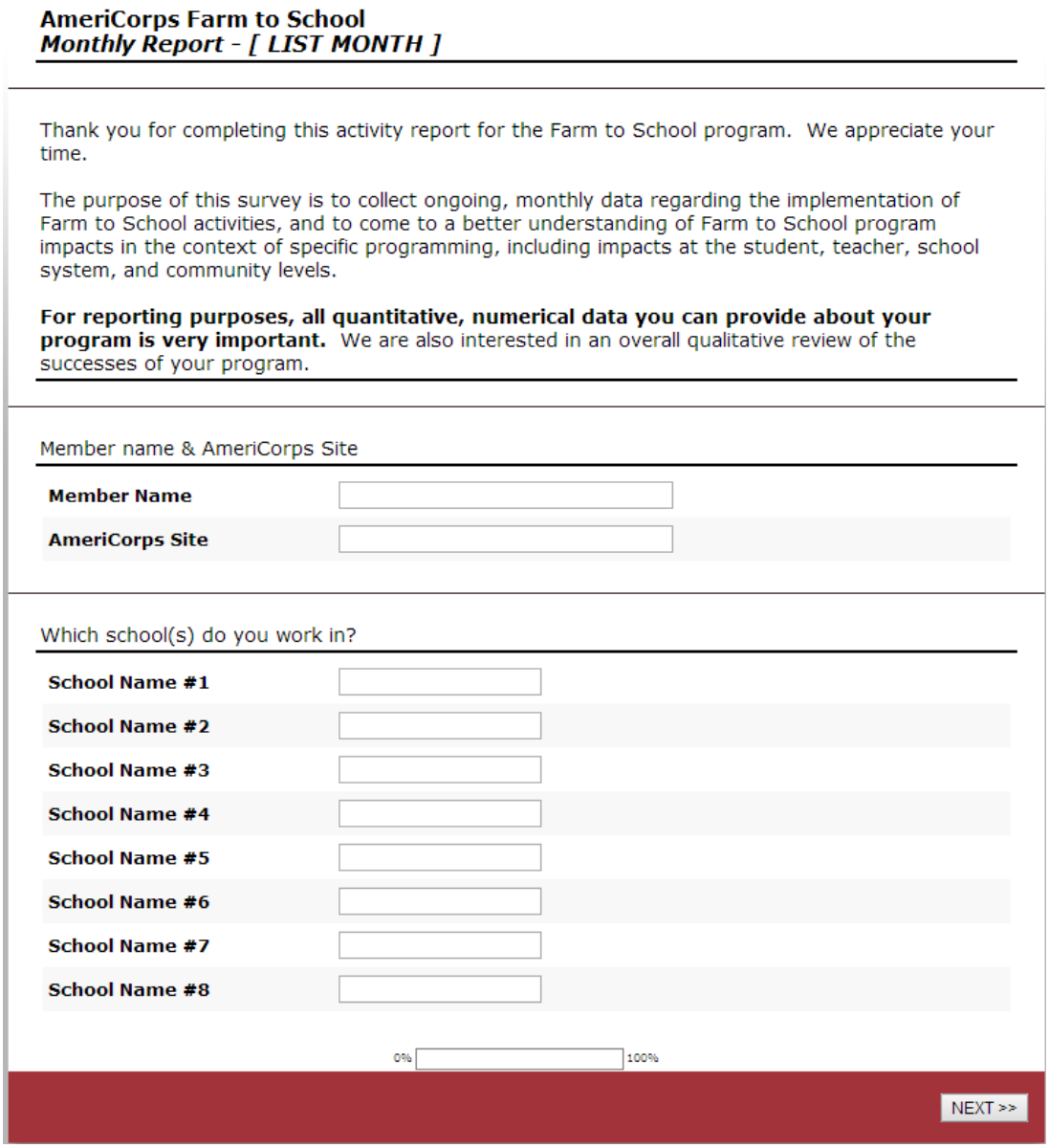
Taking Height/Weight

[If applicable] Today, [*person – school nurse? PE teacher? other?*] is going to measure how tall you are and your weight. We will collect this information to see how the students at this school compare to the rest of the students in Wisconsin schools. We will not put your name with your height and weight, only your evaluation ID number. We want to learn whether the Farm to School programs that we get to do here at [*school name*] make us different from students in schools that don't do Farm to School.

APPENDIX 8. AmeriCorps Farm to School Monthly Activity Report Online Form, 2010-2011

Each month during the 2010-2011 academic year, AmeriCorps members received an email with a link to a online survey where they were asked to provide program activity details for the school(s) in which they conducted Farm to School programming. The following are a series of screen shots of the online platform (Qualtrics).

Screen 1.



AmeriCorps Farm to School
Monthly Report - [LIST MONTH]

Thank you for completing this activity report for the Farm to School program. We appreciate your time.

The purpose of this survey is to collect ongoing, monthly data regarding the implementation of Farm to School activities, and to come to a better understanding of Farm to School program impacts in the context of specific programming, including impacts at the student, teacher, school system, and community levels.

For reporting purposes, all quantitative, numerical data you can provide about your program is very important. We are also interested in an overall qualitative review of the successes of your program.

Member name & AmeriCorps Site

Member Name

AmeriCorps Site

Which school(s) do you work in?

School Name #1
School Name #2
School Name #3
School Name #4
School Name #5
School Name #6
School Name #7
School Name #8

0% 100%

NEXT >>

Screen 2.

Approximately what proportion of your time did you spend on the following duties in the past month?
Please estimate a percentage of your time for all activities that apply. You may not have spent time on each of these activities this month.

Facilitating community and stakeholder meetings	0
Working to recruit and manage volunteers in program activities	0
Identifying local farmer connections for food procurement	0
Identifying local farmer connections for field trips	0
Identifying local farmer connections for presentations	0
Developing relationships with teachers and school staff	0
Preparing F2S curriculum	0
Developing promotional materials for F2S activities	0
Garden development	0
Creating, or assisting in creating, a local fundraiser	0
Teaching students (classroom, summer/after-school program, or lunchroom)	0
Promoting F2S at school events and with other community and school organizations	0
Organizing other F2S related activities (i.e., snack preparation)	0
Participating in trainings, phone conferences	0
Reporting and submitting timesheets	0
Other - please describe:	0
Total	0

Please remember to mail or scan and e-mail any press clippings.

If there are web addresses for articles, please provide them in the boxes below and provide a brief indication of the content.

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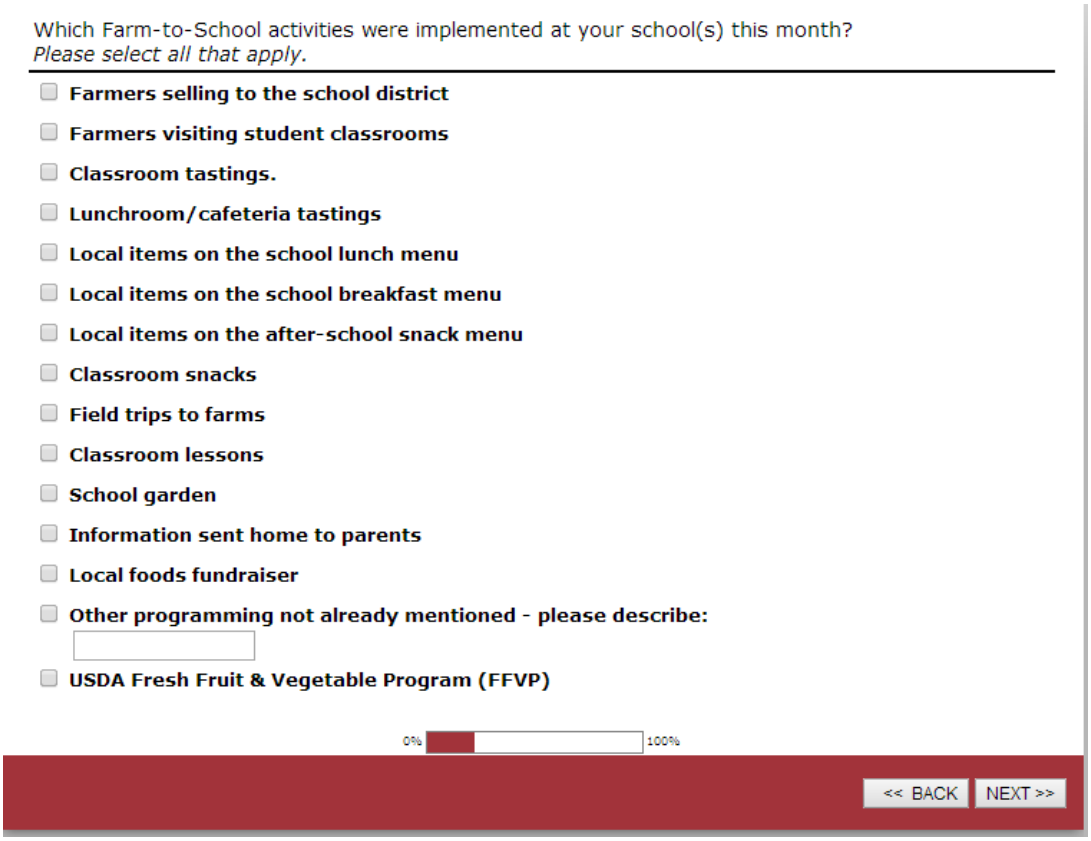
Screen 3. ***The items selected here were used to generate the remainder of the questions. Follow up questions to each of these major activity categories were shown to respondents only for those activities selected below.***



Screen 4, Part 1.

Individual Farmers/Cooperatives selling to schools:

	How many...	
	individual farmers?	cooperatives?

Farmers visiting classrooms:

How many...			How many students heard presentations, by grade?								
... different farmers?	... visits total during this month?	... minutes or hours per visit (per classroom)?	K	1st	2nd	3rd	4th	5th	6th	7th-8th	9th-12th

If you selected more than one grade for farmers visiting classrooms, were there differences in the number or length of visits to each grade? If so, please describe.

Tastings:

How many...		How many students participated in tastings, by grade?								
classroom tastings this month?	lunchroom/ cafeteria tastings this month?	K	1st	2nd	3rd	4th	5th	6th	7th-8th	9th-12th

Please list the foods involved in tastings this month:

List foods in...		Which grades?							
classroom tastings:	lunchroom/ cafeteria tastings:	K	1st	2nd	3rd	4th	5th	6th	7th-8th	9th-12th
		☐	☐	☐	☐	☐	☐	☐	☐	☐

Local items on the school lunch menu:

How many...		
... items this month? (please list)	... times was a local item offered this month?	Which local foods went over well with students?

Local items on the school breakfast menu:

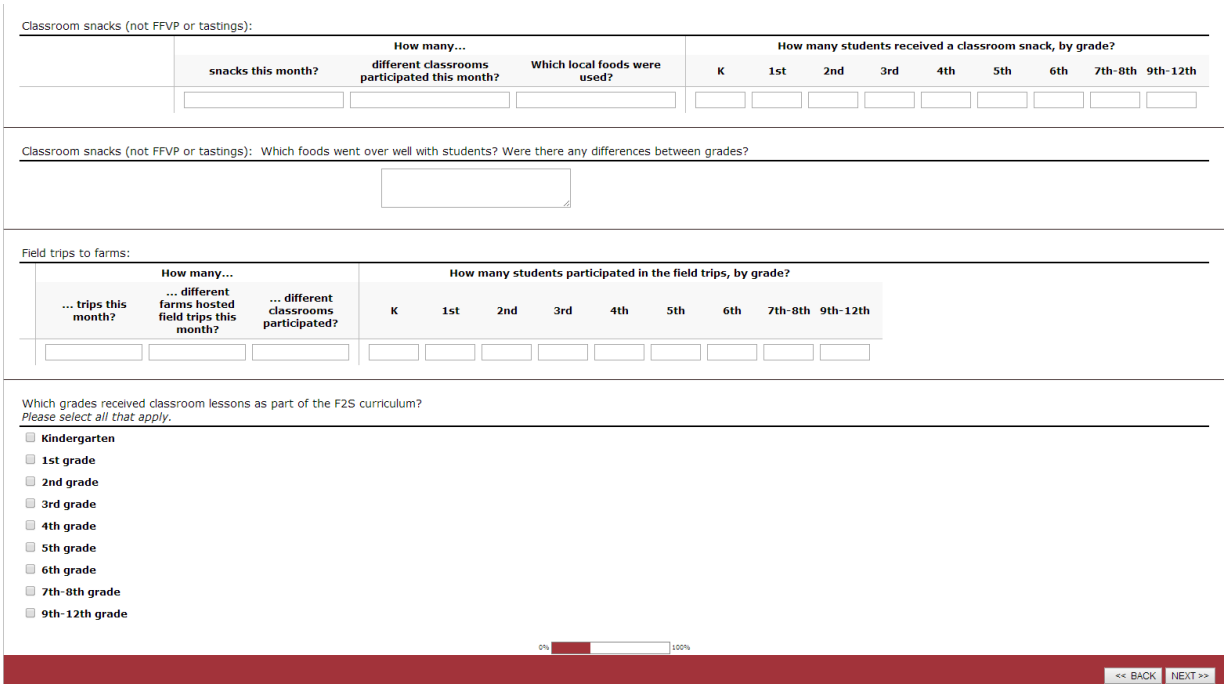
How many...		
... items this month (please list)?	... times was a local item offered this month?	Which foods went over well with students?

Local items on the after-school snack menu:

How many...		
... items this month (please list)?	... times was a local item offered this month?	Which foods went over well with students?

Please list classroom/cafeteria tasting or school meal menu foods that were particular hits with students this month, and share any stories that are impressionable.

Screen 4, Part 2.



Classroom snacks (not FFVP or tastings):

	How many...			How many students received a classroom snack, by grade?								
	snacks this month?	different classrooms participated this month?	Which local foods were used?	K	1st	2nd	3rd	4th	5th	6th	7th-8th	9th-12th

Classroom snacks (not FFVP or tastings): Which foods went over well with students? Were there any differences between grades?

Field trips to farms:

How many...			How many students participated in the field trips, by grade?								
... trips this month?	... different farms hosted field trips this month?	... different classrooms participated?	K	1st	2nd	3rd	4th	5th	6th	7th-8th	9th-12th

Which grades received classroom lessons as part of the F2S curriculum?
Please select all that apply.

- Kindergarten
- 1st grade
- 2nd grade
- 3rd grade
- 4th grade
- 5th grade
- 6th grade
- 7th-8th grade
- 9th-12th grade

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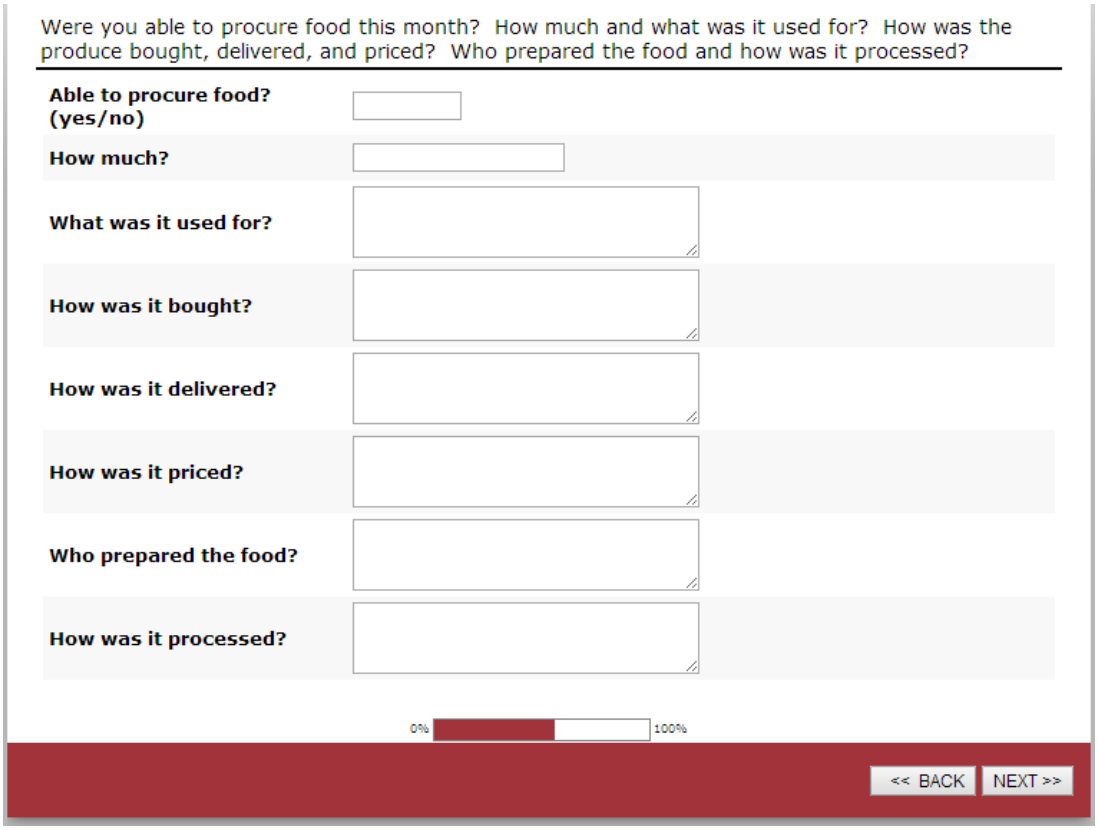
Screen 5. ***For Classroom lessons, one example of what was requested for each grade selected in Screen 4, Part 2 above (showing just 3rd grade)***

Screen 6.


Were you able to procure food this month? How much and what was it used for? How was the produce bought, delivered, and priced? Who prepared the food and how was it processed?
Able to procure food? (yes/no)
How much?
What was it used for?
How was it bought?
How was it delivered?
How was it priced?
Who prepared the food?
How was it processed?
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Screen 7.

Volunteer Recruitment and Management

Examples:

Type	Sample description
Total volunteers	• 1 volunteer – Built two picnic tables for the Gitiganing Restoration Project, 40 hrs • 12 volunteers – Teachers that helped develop a garden curriculum for Washburn school (12*2hrs) – 24 hrs • 6 volunteers – Attending 1 advisory meeting (6*2hrs), 12 hrs
New volunteers	• 1 out of 1 volunteer – Built two picnic tables for the Gitiganing Restoration Project • 2 out of 12 volunteers – Teachers that helped develop a garden curriculum for Washburn school • 1 out of 6 volunteers - Attending 1 advisory meeting
Active community volunteers who are baby boomers	• 1 out of 1 volunteer – Built two picnic tables for the Gitiganing Restoration Project, 40 hrs • 2 out of 12 volunteers – Teachers that helped develop a garden curriculum for Washburn school (2*2hrs) – 4hrs
Hours of service performed	• 76 hours of volunteer service provided leverage for the Ashland and Bayfield County Food System Development to enrich and educate our community on many issues surrounding the food system. The hours that the volunteers provided involved with the Gitiganing Project ensures that community members have access to nutritious organically grown food. Volunteers provided an estimated 24 hours in developing the Washburn Elementary school garden curriculum. The other 6 hours were spent on towards general assistance and organization of the project.

How many TOTAL active community volunteers did you have during this month?

Description (# of volunteers, duties performed, for which program/activity, # of hours)

How many NEW active community volunteers did you have during this month?

Description (# of volunteers, duties performed, for which program/activity, # of hours)

How many active community volunteers did you have during this month who are baby boomers (born from 1946-1964)?

Description (# of volunteers, duties performed, for which program/activity, # of hours)

How many hours of service did your volunteers perform during this month?

Description (# hours of service, provided leverage for which program/project to provide what kind of service [provide narrative data that shows the value of the service hours]), duties performed, for which program/activity, # of hours)

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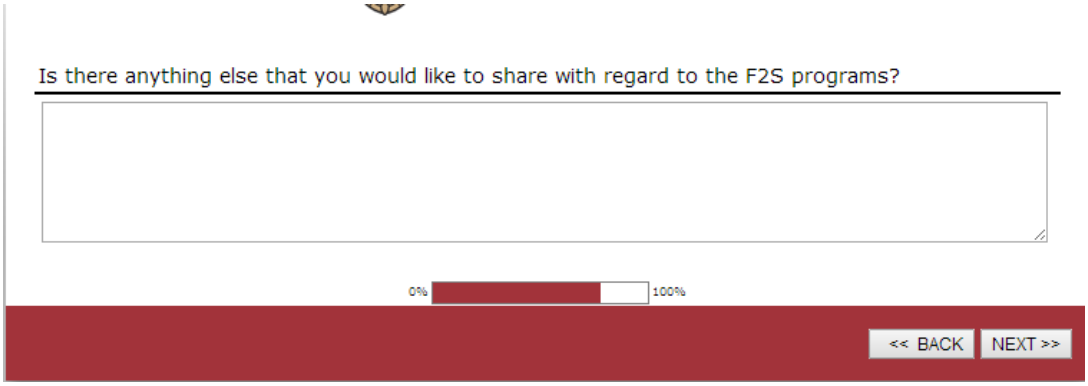
Screen 8.


Is there anything else that you would like to share with regard to the F2S programs?
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APPENDIX 9. List of Manuscripts Submitted and Accepted for Publication

Accepted

1. Fruits and Vegetables Displace, but do not Decrease, Total Energy in School Lunches. *Andrea B. Bontrager Yoder, M.M.; Dale A. Schoeller, PhD. Childhood Obesity*. Accepted 4/29/2014 (in press).
2. Farm to Elementary School Programming Increases Access to Fruits and Vegetables and Increases their Consumption Among Those with Low Intake. *Andrea B. Bontrager Yoder, M.M.; Janice L. Liebhart; Daniel J. McCarty, PhD; Amy Meinen, MPH, RD; Dale Schoeller, PhD; and Tara L. LaRowe, PhD, RD. Journal of Nutrition Education and Behavior*. Accepted 4/28/2014 (in press).

Submitted

3. School Gardens Enhance Academic Performance and Dietary Outcomes in Children. *Claire K. Berezowitz, Ed.M.; Andrea B. Bontrager Yoder, M.M.; Dale A. Schoeller, PhD.* Submitted to *Journal of School Health* 1/22/2014. Revised manuscript submitted June 2014.
4. Effect of Wisconsin Farm to School Programs on BMI *z*-score in Elementary Students. *Andrea B. Bontrager Yoder, M.M, PhD,; Dale A. Schoeller, PhD.* Submitted to *Journal of Obesity* 5/30/2014.
5. Factors Affecting Fruit and Vegetable School Lunch Waste in Wisconsin Elementary Schools. *Andrea B. Bontrager Yoder, M.M., PhD; Leah Foecke; Dale A. Schoeller, PhD.* Submitted to *Public Health Nutrition* June 2014.