

Farm to School Intensity Levels: A Systematic Review and Proposed Measurement Tool

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Farm to school (FTS) activities have recently experienced rapid growth as more schools commit to purchasing local foods, providing education about food, farming, health and the environment, and having school gardens. We systematically review quantitative peer reviewed FTS research presenting both outcome measures and reported FTS inputs. Our findings highlight ambiguity and variability in FTS inputs making any resulting outcomes difficult to generalize for policy makers. We propose a pre-tested intensity measurement tool which has the potential to standardize research in this area.

INTRODUCTION

An estimated 42% of school districts across the United States engaged in farm to school (FTS) activities in 2015 (U.S. Department of Agriculture [USDA], 2016) reflecting substantial growth from less than ten districts participating in such activities in 1990s (National Farm to School Network, 2016). On account of regional diversity, what the USDA defines as FTS programs is quite broad consisting of activities which “center around procurement of local or regional foods, agriculture or nutrition-based educational activities” (USDA, 2016). As such, FTS programs can involve any mix of local/regional food procurement, nutrition education, school gardens, and agricultural literacy (Becot et al., 2017; Joshi, Azuma, & Feenstra, 2008). The intended benefits of such programs are multifaceted ranging from improving student nutrition, providing education (health, nutrition, agriculture, environment), connecting communities, improving the environment, and promoting smaller local farms (Bagdonis, Hinrichs, & Schafft, 2009; Becot et al., 2017; Joshi et al., 2008). As these programs have grown in popularity, so has the desire to evaluate resulting benefits. As of 2009 fewer than five FTS research articles were published in peer reviewed journals (Joshi et al., 2008). Since then, more peer reviewed quantitative research has been completed in this area, but gaps remain in research designed to measure the success of various FTS programs (Becot et al., 2017). A major barrier to FTS evaluation research pertains to the heterogeneous forms in which FTS programs can manifest. Due to this diversity of FTS interventions across sites as well as small sample sizes, to date few study findings are transferable. This article has two objectives. First, it

provides a systematic review of quantitative peer reviewed research pertaining to the integral FTS component of local food procurement. To our knowledge, no systematic review of FTS research has been completed since Joshi, Azuma and Feenstra (2009) surveyed the literature and none focus on how FTS is defined and measured in the quantitative literature. Second it discusses a pre-tested FTS Intensity measurement which has the potential to contribute to standardizing FTS quantitative research.

REVIEW OF THE FTS RESEARCH

Research Review Methods

Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Liberati et al., 2009), we conducted database searches (up to May 2017) in PubMed (including MEDLINE) and EconLit for full length, published articles in the English language. The keyword string used to capture all related studies was “farm to school”. After eliminating duplicate studies, all abstracts were screened by at least two authors using the following inclusion criteria:

- the study includes quantitative analysis of FTS related activities
- the study involves local food procurement among its FTS activities
- the study analyzes specific FTS inputs and outcomes distinct from other factors

Because of its important place in FTS initiatives and policy discussions, we were especially interested in issues pertaining to FTS procurement. To reflect our special interest in procurement we excluded FTS research that focused exclusively on school gardens or other forms of food and farming education. Full text articles were then retrieved and reviewed by two researchers for inclusion. References from reviewed articles which discussed potential quantitative FTS findings were also retrieved and included in our review. For the studies meeting the inclusion criteria, the following information was extracted by two researchers: study sample, aim, FTS variable description and use, and findings. All discrepancies were discussed amongst researchers until consensus was reached.

Research Review Results

A total of 36 articles were initially retrieved through the database searches and seven more were added following a reference review of the 36 initially retrieved articles. After duplicates were removed and abstracts screened, 39 peer reviewed articles were reviewed in full. Of these 39 articles, we excluded 19 that did not use any form of quantitative analysis, three that did not involve FTS procurement, and two that did not measure and present findings on the outcomes related specifically to FTS programming. The remaining 15 articles were included in our analysis. Figure 1 highlights our selection process and Table 1 provides details of the included studies.

FIGURE 1
SEARCH SELECTION PROCESS

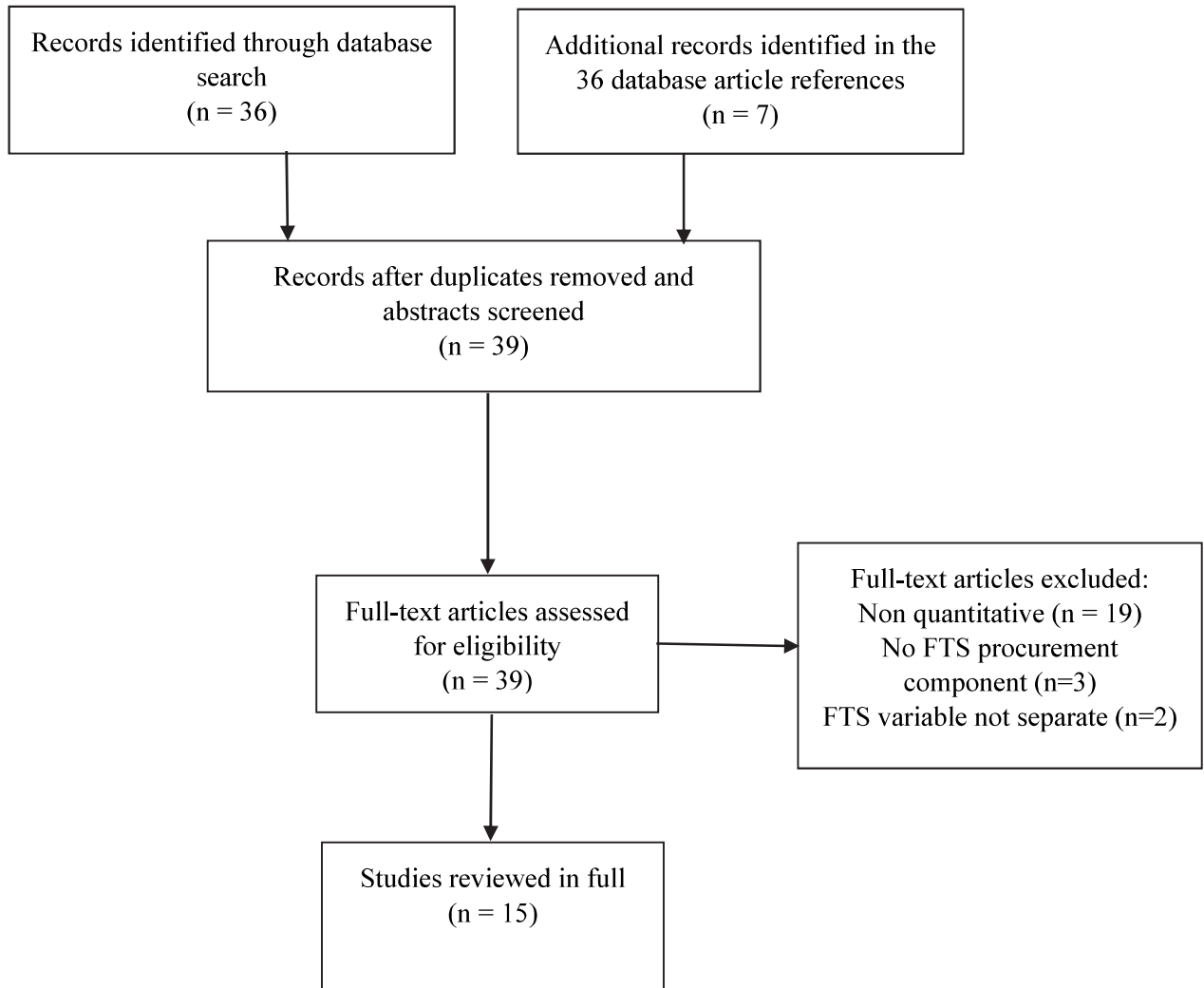


TABLE 1
SUMMARY OF FARM TO SCHOOL (FTS) STUDY CHARACTERISTICS

First author (Year)	Study sample	Aim	Farm to school measurement (use)	Significant findings
Bontrager Yoder (2014)	Wisconsin elementary school students in nine area schools (N=845)	Measure energy intake to assess total-energy and FV sourced energy intake during one meal (school lunch)	Previous years of FTS programming at school (independent)	non-FV energy consumed lower from schools with prior years of FTS programming
Colasanti (2012)	Michigan K-12 schools (N=266)	Measure FTS participation & factors that food service directors deem impact FTS	FTS participation (dependent)	Participation in FTS grew over time period. Budget & cost highly ranked as barriers to growth
Conner (2012)	Vermont farms associated with schools (N=198)	Explore farmers' motivations and distribution practices in FTS partnerships.	Farmer motivations to engage in FTS (dependent)	Farmers with market based motivations are most willing to adopt distribution practices needed to serve school markets.
Hollar (2013)	Oregon and California third to sixth grade students (N=1,485)	Validate instrument that could measure FTS program effectiveness	Proposed measure of FTS success (validation study)	Findings suggest the two Fruit and Vegetable Neophobia Instrument subscales (fruit and vegetable) can be used together or separately.
Lyson (2016)	US states (excluded Hawaii) (N=49)	Explores the effect of legislation and state-level determinants on FTS	FTS participation (dependent)	State affluence & average FTS rate of a regional peers positive predictors of state-level FTS rates
Moss (2013)	Illinois third grade students (N=65)	Analyze the effects of the Coordinated Approach to Child Health (CATCH) nutrition curriculum with a FTS program	FTS services with 2 nutrition classes and one farm tour (independent)	CATCH nutrition curriculum with a Farm to School program positively affected school-aged children's nutrition knowledge and fruit and vegetable consumption behavior
Nicholson (2014)	US public elementary school survey data (N=1,792)	Examine whether FV offerings were more available in school lunches in states with laws requiring/encouraging FTS programs and whether FV availability could be explained by schools opting for FTS programs	FTS participation (independent)	Highest FV availability in schools with FTS programs

First author (Year)	Study sample	Aim	Farm to school measurement (use)	Significant findings
Ohri-Vachaspati (2016)	US public elementary schools over a seven year time period (N=3,956)	Analyze what variables predict the presence of salad bars in elementary schools	FTS participation (independent)	Salad bar prevalence increases with FTS participation
Paxton (2011)	North Carolina third to fifth grade students (N=18)	Validate instrument that could measure FTS program effectiveness	Proposed measure of FTS success (validation study)	Findings suggest the self-report tool can be used as an instrument to assess changes in student attitudes toward FV
Pinard (2013)	Douglas County, Nebraska food service directors, distributors, and local producers (N=57)	Assess the feasibility of, interest in, and barriers to implementing farm to school activities in 7 school districts in Douglas County, Nebraska.	Do workers view FTS programs favorably (dependent)	Interest in pursuing FTS activities increased during the project. Food safety was a major concern
Roche (2012)	Vermont elementary school children (N=632)	Examine the effectiveness of social cognitive theory as a framework for FTS programming	Multiple FTS components: after school education program, summer camp education, met a farmer, taste test, helped at taste test, school community meal, eaten FV self picked (independent)	Gardening/cooking based activities (after school & summer) and knowing farmers are positively related to changes in neophobia and consumption.
Schneider (2012)	US public elementary schools across 47 states (N=1872)	Examine whether FTS programs are more common in public elementary schools in states with a formal, FTS law or with a related, locally grown procurement law	Presence of FTS programs (dependent)	FTS programs were more likely in states with FTS specific laws
Smith (2013)	Illinois food service employees in from 60 schools (N=151)	Examine key variables to explain why many food service workers do not take advantage of FTS opportunities	Decision by food service workers to make local food purchases (dependent)	Perceived "cost of food," "adequate volume," "reliable supply of food quantity," "payment arrangement," and "packing material" largest barriers. Additional food service worker training and education on FTS programs recommended

First author (Year)	Study sample	Aim	Farm to school measurement (use)	Significant findings
Yoder (2015)	Wisconsin third, fourth and fifth graders in eleven schools (N=1,877)	Examine characteristics potentially associated with school lunch fruit and vegetable waste, both overall and pre/post implementation of the Healthy, Hunger-Free Kids Act (HHFKA)	1. Number of years of prior FTS programming 2. FTS items appearing on the main menu v. on the salad bar 3. Locally v. conventionally purchased food (independent)	1. Prior years FTS programming not significant. 2. Waste higher when on main menu vs salad bar pre HHFKA but not post. 3. Conventional vs local advertised food waste difference not significant.
Yoder (2014)	Wisconsin elementary school children (N=1,117)	To assess the effectiveness of Wisconsin Farm to School programs in increasing students' fruit and vegetable (FV) intake.	Prior years of FTS programming (independent)	FV intake improved at schools with more prior years of FTS programming

All 15 of the studies were based in the United States with four analyzing national school data (Lyson, 2016; Nicholson, Turner, Schneider, Chriqui, & Chaloupka, 2014; Ohri-Vachaspati, Turner, Adams, Bruening, & Chaloupka, 2016; Schneider et al., 2012). Six involved data from elementary schools within a single state (Bontrager Yoder & Schoeller, 2014; Moss, Smith, Null, Long Roth, & Tragoudas, 2013; Paxton, Baxter, Fleming, & Ammerman, 2011; Roche et al., 2012; Yoder et al., 2014; Yoder, Foecke, & Schoeller, 2015) and, in one study, two states (Hollar, Paxton-Aiken, & Fleming, 2013). Three studies surveyed food service directors within a particular county (Pinard et al., 2013) or state (Colasanti, Matts, & Hamm, 2012; Smith, Wleklinski, Roth, & Tragoudas, 2013) and one surveyed farmers in a single state (Conner et al., 2012).

As summarized in Table 2, seven of the articles used a measure of FTS programming as an independent variable to explain various outcomes. Six other articles used a form of FTS involvement as dependent variables while two tested potential instruments to estimate FTS program outcomes. Of the seven studies where a measure of FTS served as an independent variable, three used the number of years of FTS programming to analyze its relationship to food waste (not significant) (Yoder et al., 2015), its influence on energy intake from non-fruit and vegetable sources (significant, negative) (Bontrager Yoder & Schoeller, 2014), and its influence on the amount and variety of fruits and vegetables consumed (significant, positive) (Yoder et al., 2014). One study found FTS participation was one of several inputs positively associated with salad bar prevalence in public elementary schools (Ohri-Vachaspati et al., 2016) while another reported that schools with FTS programs had a higher prevalence of fruits and vegetables available (Nicholson et al., 2014). Two additional studies found FTS programs decrease food neophobia (Roche et al., 2012) and increase fruit and vegetable knowledge and consumption (Moss et al., 2013).

TABLE 2
SUMMARY OF INCLUDED FARM TO SCHOOL (FTS) STUDIES

Study Focus	N	Topics
FTS as independent variable	7	FTS programs' influence on food waste, consumption, salad bar/fruit and vegetable prevalence, food neophobia, fruit and vegetable knowledge
FTS as dependent variable	6	Schools' and farmers' willingness to participate in FTS, barriers to FTS, state policy effect on FTS
Validation study	2	Student attitudes and lunch recall instrument validation
Total	15	

Only one (Roche et al., 2012) of the seven studies using a measure of FTS as an independent variable examined different outcomes related to separate FTS components (e.g., foods served vs. education vs. school gardens). Moss et al. (2013) examined one specific FTS combination (FTS offerings with two nutrition classes and a farm tour) while the other five studies used simple FTS variables which did not differentiate between FTS components or consider the intensity of the combined FTS components involved.

Six articles analyzed how various factors impact the existence of FTS programming in schools. Three of these studies examined food service directors' willingness to participate in FTS activities, with one finding an overall increase in willingness to participate during the study period but concerns about food safety was an issue (Pinard et al., 2013). The other two studies found cost, availability, and overall educational aspects of FTS to be major barriers in willingness to participate in FTS activities (Colasanti et al., 2012; Smith et al., 2013). A study by Conner and colleagues (2012) surveyed farmers on their willingness to participate in FTS activities and found that those with more market based motivations (as opposed to social) were more willing to adopt FTS specific distribution practices. Two studies examined FTS prevalence by state and found that FTS programs were more likely in states with FTS-specific state laws (Nicholson et al., 2014), greater state affluence (Lyson, 2016), and more states within their own region with prior FTS adoption (Lyson, 2016).

Two of the included studies did not use FTS variables in their quantitative research but pre-tested instruments that could be used to assess success of FTS programs. Hollar et al. (2013) present findings from a Fruit and Vegetable Neophobia Instrument (FVNI) to measure student attitudes toward new fruits and vegetables building off of the work of the Paxton et al. (2011) which presented a school lunch recall instrument to measure consumption levels.

Discussion of FTS Research Review

While FTS research has grown substantially over the past decade, much work still needs to be done. As shown in Table 1, most of the current studies consist of relatively small sample sizes often within a single state. Acknowledging continued gaps in knowledge about the scale, influencing factors, and overall effectiveness of FTS, all reviewed articles stated the need for further research (Bontrager Yoder & Schoeller, 2014; Becot et al., 2017; Colasanti et al., 2012; Hollar et al., 2013; Moss et al., 2013; Paxton et al., 2011; Roche et al., 2012; Yoder et al., 2014 & 2015). Although this review highlighted two proposed instruments that can aid in the measurement of FTS outcomes, it also demonstrated continuing ambiguity in FTS constructs. Following the broad USDA definition of FTS, most of the studies applied simplistic, often binary measures – “participates in FTS” vs “does not participate in FTS” – to assess the impact of or impact on various outcomes.

Reducing the complexity of FTS to such a binary manner risks producing unreliable, inconclusive, or misleading research results. For example, consider these three different, but all “participating,” school

districts: School District A has a small school garden but does not procure local foods to serve in school meals; School District B tries to serve one local food once a month on Harvest of the Month day; and School District C serves at least one local food most days out of the week, has an after-school garden club, and encourages teachers to take students on farm field trips. Clearly, the different types, extensiveness, and consistency of FTS activities across the districts are likely to produce different outcomes. Although School District A, B, and C are hypothetical cases, they accurately reflect the variability of existing FTS programs across the country. By not taking this variability into proper account in FTS study designs, the collective results and outcomes remain difficult to interpret.

FTS INTENSITY MEASURE

The FTS Intensity measure was developed to address some of the knowledge gaps described above. Specifically, the absence of effective monitoring and evaluation instruments to track and assess FTS progress was the impetus of our collaborative effort, which involved a healthcare economist with experience in FTS research (EV), a nutritionist experienced in FTS policy and program delivery (SK), and a director of a nonprofit organization engaged in FTS initiatives in Western Washington (JP). To both facilitate comparative research and help FTS practitioners monitor progress and improve programs, our objective was to develop a reliable measure capable of capturing the breadth and depth of FTS activities. To overcome the shortcomings of the binary, participates/does not participate constructs used in FTS research to date, we considered the notion of *intensity* to be key. In the interest of consistency and ease, we opted to devise a FTS Intensity measure based on publicly available data from the USDA's FTS census and used the most recent 2015 findings available online (USDA, 2016) to test our concept.

Definition of FTS Intensity

We define FTS Intensity as the level of a school district's engagement in the full range of FTS activities, reflected in the variable presence/absence, frequency, quantity, and diversity of key program elements corresponding to local food procurement, education about local food and farming, and school gardens. Because of the highly variable ways in which school districts define "local" for FTS purposes, we did not include any indicators of localness in our FTS Intensity framework. Our FTS Intensity measure is comprised of four dimensions derived from the USDA FTS census questions:

- participation – # of schools in the district participating in any FTS
- procurement – school districts' local food purchasing practices
- FV presence – specific activities to offer, promote and educate about fruits and vegetables
- Activities – # of different FTS activities implemented by the district

Table 3 provides measurement details for each of these dimensions and identifies the USDA 2015 Farm to School census questions used in each dimension.

FTS Intensity Measurement Procedure

In developing the measurement tool we relied heavily on the co-authors' varied knowledge and experience with FTS implementation and used a consensus approach to define and refine the measure. We initiated the process by reviewing the USDA census questions and indicators independently, with each of us proposing which questions/indicators were appropriate to include in the FTS Intensity measure. Differences in our three propositions were resolved through discussion. After identifying which USDA questions/indicators to include in the measure, we repeated the consensus process to determine categories, weights, and scores to be applied (see Table 3) to each dimension.

To trial the measure, co-author [SK] who is familiar with the national landscape of FTS programs, selected six school districts known to have variably developed FTS programs: two with "minimally" developed programs, two with "moderately" developed programs, and two with "strong" programs. We assumed that "strong" FTS programs have established community partners and strong community support and have been making steady strides in building robust FTS programs over several years. The strongest

FTS programs are comprehensive linking the cafeteria to the classroom, edible gardens, and local farms. “Moderate” FTS programs have demonstrated a strong commitment to strengthening their FTS efforts and have begun to develop community engagement. School districts with “minimal” FTS have fewer years dedicated to the effort and are in the early stages of building community awareness about FTS. To facilitate use of the FTS Intensity measure as a categorical variable with values representing “strong,” “moderate,” and “minimal” levels of FTS programming, we intentionally created an overall score (75) that was divisible by three. If our FTS Intensity measure was sound, we would expect that the “minimal FTS” districts would score between 1 and 25, the “moderate FTS” districts between 26 and 50, and the “strong FTS” districts between 51 and 75.

TABLE 3
FTS INTENSITY MEASUREMENT DIMENSIONS

Dimension	Definition	USDA Question	Categories & Scale	Range
Participation	% of schools in district participating in FTS	#13	<ul style="list-style-type: none"> ● <1% = 0 ● 1-33% = 1 ● 34-66% = 2 ● 67-100% = 3 	0-3
Procurement	1. Obtains local food directly from producer, co-op, farmers market, or Community Supported Agriculture program	#18	<ul style="list-style-type: none"> ● No direct purchases = 0 ● Purchases from local producer = 1 ● Purchases from producer co-op = 1 ● Purchases from farmers market = 1 ● Purchases from CSA = 1 	0-22
	2. % of total food costs for local foods purchases (excluding milk)	#23, #25	<ul style="list-style-type: none"> ● <1% = 0 ● 1-5% = 1 ● 6-10% = 2 ● 11-15% = 3 ● 16-20% = 4 ● 21-25% = 5 ● ≥26% = 6 	
	3. Diversity of local foods purchased out of 12 total options	#20	<ul style="list-style-type: none"> ● Does not purchase the local food = 0 ● Purchases the local food = 1 (12 local foods) 	
FV Presence	1. Frequency of fruit servings	#22	<ul style="list-style-type: none"> ● Never = 0 ● Occasionally = 1 ● Few times/week to monthly = 2 ● Daily = 3 	0-12
	2. Frequency of veggies servings	#22	<ul style="list-style-type: none"> ● Never = 0 ● Occasionally = 1 ● Few times/week to monthly = 2 ● Daily = 3 	
	3. % of schools in district with school gardens	#14	<ul style="list-style-type: none"> ● <1% = 0 ● 1-33% = 1 ● 34-66% = 2 ● 67-100% = 3 	
	4. % of schools in district with salad bars	#15	<ul style="list-style-type: none"> ● <1% = 0 ● 1-33% = 1 ● 34-66% = 2 ● 67-100% = 3 	

Activities	Participation in FTS activities	#27			0-38
	1. Serve local foods in cafeteria		● No = 0	● Yes = 1	
	2. Serve local foods as Smart Snack		● No = 0	● Yes = 1	
	3. Serve local foods in afterschool program		● No = 0	● Yes = 1	
	4. Serve school garden food in cafeteria		● No = 0	● Yes = 2	
	5. Hold taste tests/cook demo in cafeteria		● No = 0	● Yes = 2	
	6. Hold taste tests/demo w/ garden food		● No = 0	● Yes = 2	
	7. Use Smarter Lunchroom strategies		● No = 0	● Yes = 1	
	8. Use cafeteria Food Coaches		● No = 0	● Yes = 1	
	9. Use USDA Team Nutrition materials		● No = 0	● Yes = 1	
	10. Garden/orchard activities in curricula		● No = 0	● Yes = 2	
	11. Garden/orchard activities in after school		● No = 0	● Yes = 2	
	12. Do field trips to farms/orchards		● No = 0	● Yes = 2	
	13. Have farmer visits to school		● No = 0	● Yes = 2	
	14. Promote local FTS themed efforts		● No = 0	● Yes = 1	
	15. Promote local foods at school		● No = 0	● Yes = 1	
	16. Generate media coverage		● No = 0	● Yes = 1	
	17. Host FTS community events		● No = 0	● Yes = 2	
	18. Celebrate FTS month		● No = 0	● Yes = 1	
	19. Integrate FTS concept into ed curricula		● No = 0	● Yes = 3	
	20. Train food service staff		● No = 0	● Yes = 1	
	21. Work w producers on specific product		● No = 0	● Yes = 3	
	22. Implement FTS to reduce food waste		● No = 0	● Yes = 2	
	23. Evaluate changes		● No = 0	● Yes = 3	
				Highest Score Possible	75

FTS Intensity Measurement Pretest Results

Overall, the FTS Intensity measurement performed as expected with all but one of the six school districts producing results falling within the categories assigned to them prior to the pretest (Table 4). The broad range of results, spanning from a score of 20 to 62, demonstrate the promise of the measure to differentiate levels of FTS programming intensity across school districts and over time. Rather than intended to assess the strength of the six districts' FTS programs in 2015, the importance of our findings is in their proof of the FTS Intensity concept. Rigorous validation of the measure, based on close empirical observations and assessment against school district census reports, was beyond the scope of this research, but we do recommend it as a next step in advancing evaluation efforts of FTS programming.

TABLE 4
FTS INTENSITY MEASURE TEST RESULTS IN SIX PURPOSIVELY SELECTED SCHOOL DISTRICTS

School District:	Minimal FTS Programs		Moderate FTS Programs		Strong FTS Programs		Highest Possible Score
	A	B	C	D	E	F	
Participation	2	3	3	3	3	3	3
Procurement	4	11	11	8	12	17	22
FV Presence	5	10	10	10	11	10	12
Activities	9	18	25	27	27	32	38
Total Score	20	42	49	48	53	62	75
Expected Range	1-25		26-50		51-75		1-75

CONCLUSION

A systematic review of peer reviewed quantitative FTS evaluation research suggests that improvements can be made in this area. Specifically, whether used as inputs or as outcomes the FTS variables used in published research have been simplistic measures encompassing a wide variety of activities and intensity levels thus inappropriately lumping schools and districts with substantially different FTS programs and inputs. As a result, research attempting to understand whether or not FTS contributes to improved outcomes related to health, education, the economy, or the environment may have inconclusive or even misleading results.

We propose a more detailed FTS Intensity measure that better reflects different levels of school district involvement in FTS and, in turn, a clearer understanding of the role of FTS programs in achieving various health and education goals. Future research is needed to improve and validate our proposed FTS Intensity tool and to strengthen FTS evaluation research.

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