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Evaluation of Together We Inspire Smart Eating: pre-school fruit and vegetable consumption

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Abstract

This study examined nutrition intervention curriculum, *Together We Inspire Smart Eating* (WISE). WISE is a research-based, nutrition promotion curriculum specifically designed for pre-school children from families with limited resources. The design was non-randomized treatment/control with standardized pre-/post-test assessments. Children ($n = 268$) in six Head Start centers received weekly food experiences from educators trained in WISE. Children ($n = 258$) in nine Head Start centers received weekly food experiences structured at the discretion of the educators untrained in WISE. Parents in both conditions ($n = 268$ WISE classroom, $n = 258$ comparison) were interviewed by educators twice over the school year using a data collection tool, The Family Map Inventory. Analyses using full information maximum likelihood controlling for pre-intervention consumption and key demographic characteristics were used to predict consumption at post-intervention assessment. Results indicated children in WISE centers consumed healthier food at home than children in non-WISE classrooms. The study suggested that WISE curriculum is an effective method to improve children's diets in at-risk environments.

Key messages

- The intervention, *Together, We Inspire Smart Eating* (WISE), was developed as an evidence-based curriculum and offers advantages over other pre-school programs targeting healthy consumption by young children.
- Parents of children enrolled in WISE classrooms reported increased consumption of fruits and vegetables after a year of participation in the intervention.
- When compared with children in classrooms without WISE intervention, children in classrooms that implemented WISE consumed more fruits and vegetables controlling for pre-intervention consumption, child and family characteristics.

Introduction

Pre-school children often have diets high in empty calories [1]. Further, pre-school children often do not consume recommended levels of fruits and vegetables (F/V) [2, 3]. Unhealthy consumption, in particular low consumption of fruit and vegetables and high consumption of empty calories, is a likely contributor for pre-school obesity among children from low-income families [4]. This has led to an array of efforts to increase young children's consumption of healthy foods as a strategy to address the problem of childhood obesity [5].

Establishing food preferences early, before age 8, is an especially important time to intervene to promote healthy diets giving the persistence of preferences into adulthood [6–8]. Targeting pre-school programs for nutrition interventions is important

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given the dominate role the school environment has in the lives of children. Many children, particularly those living in poverty, spend more than 30 h a week in pre-school eating breakfast, lunch, and snacks [9]. As a result many children receive the majority of their meals in the school setting [10, 11]. Further, life-long consumption habits and food preferences can be established in early childhood [2, 7] That is, consumption at early ages predicts consumption in adulthood [6, 8].

An effective intervention approach may be to target changes in adult practices in the home and childcare setting of the pre-school child. Interventions targeting pre-school educators and parents have the opportunity to improve the quality of pre-school diet, target the most at-risk children, and educate adults. Federal efforts to improve nutrition standards in pre-school recognize the potential for childcare programs as intervention settings [9]. For example, the US federal program, Child and Adult Care Food Program (CACFP), provides meals and snacks in center-based care with at least 25% of children eligible for free or reduced lunch [9]. US Head Start performance standards related to nutrition services include provisions for up to two thirds of daily nutritional needs [12]. These standards also require programs to promote prevention of childhood obesity by integrating developmentally appropriate, research-based initiatives in the classroom and family routines [12].

To comply with these standards and to increase consumption of F/V, some early childhood programs allocate time specifically for 'food experiences'. We use the phrase 'food experience' to describe opportunities for children to examine food with guidance from adults separate from normal meals and snacks. For example, in Head Start, these times are intended to allow sensory exploration and encourage children to try new foods [13–15]. Unfortunately, early educators often lack the tools and training to easily and effectively implement these food-focused experiences [16]. As a result, it is likely that many 'food experiences' do not meet the intent of the standards to increase consumption of healthy foods like F/V (e.g. Head Start standard 1302.44.a.2). On the other hand, interventions directed toward pre-school children have been shown to be effective in improving eating habits [17, 18]. In particular, interventions that include multiple components including nutritional education for the adults delivering the intervention, hands-on exposures with cooking of new foods for children and education of parents [19, 20].

This study evaluated a classroom curriculum developed for pre-school children and designed to increase the consumption of F/V in the home. Specifically, we examined the consumption of F/V at home. The intervention, *Together, We Inspire Smart Eating* (WISE), was developed as an evidence-based curriculum to structure weekly food experiences in early childcare settings [21]. WISE was developed specifically for programs and schools serving children from low-income backgrounds. Besides Head Start programs, the curriculum has been implemented in non-Head Start early childcare, in home visiting programs, and adapted for older children served by the Fresh Fruit and Vegetable Program up to age 8 years. However, this study focused on pre-school children attending Head Start.

WISE was designed to provide early exposure to F/V [36] and was centered around weekly hands-on exposures (i.e. food experiences). WISE-core components and their evidence base are presented in Table I. WISE offers advantages over other food curriculums by supporting weekly food interactions for the full academic year targeting cost-effective, readily available F/V that are grown in the United States For example, WISE is based on weekly tasting activities for 8 months compared with shorter curriculums such as the 12 week 'Food Friends' [37] and 16-week tasting activities of Learning About Nutrition through Activities—LANA that targets novel foods such as Kiwi [38]. Although there is an argument for exposing children to food not often grown in the community, and therefore, novel; pre-school children from low income families typically have not experienced the cost-effective, readily available F/V that are grown in the United States [1]. WISE progresses children through basic sensory exposures to F/V (e.g. smell, lick, feel, taste) at the beginning of the month to simple, low-cost recipes throughout the month (e.g. homemade

Table I. *Evidence base for WISE: educator behavior link to outcomes*

Component	Outcomes	Type of evidence
Positive Educator feeding support (e.g. no pressure to eat, cues children to hunger)	Children learn to self-regulate and listen to their body's cues -are less likely to develop food aversions and more likely to taste new foods.	Randomized controlled trials (RCT), Quasi-Experimental Trials; American Dietetic Assoc. (ADA) Guidelines; Head Start guidelines[a]
Appropriate Educator modeling (e.g. eats food, talks positively)	Children are more likely to try new foods and eat healthy foods served.	Quasi-Experimental Trials, Systematic review; ADA guidelines[b]
Multiple, hands-on exposures to F/V	Repeat exposure results in increased intake and liking of F/V for children.	RCTs, Quasi-Experimental Trials, Systematic review[c]
Behavioral economics (i.e. use of a mascot) to promote F/V	Children are more likely to select foods associated with characters.	RCT, Quasi-Experimental Trials, Systematic review[d]

Notes: [a][22–27]; [b][26, 28–30]; [c][31–33]; [d][34, 35].

applesauce, carrot sticks with fresh bean dip, green smoothies, green beans with fresh yogurt dip). All recipes are designed to involve children in hands-on preparation.

WISE was designed to integrate into existing classroom programing, e.g. as a station during circle time. WISE was designed to integrate into other academic activities rather than be presented as a separate activity like other programs [37]. WISE targets children's agricultural literacy and can be integrated into a school garden but does not require garden activities like Early Sprouts [39]. This article presents the results of a prospective, quasi-experimental study of WISE in Head Start settings.

Materials and methods

Study design and participants

This study is a quasi-experimental, pre-post intervention study with a non-randomized comparison group. This study represented data from families served by 15 centers administrated by one large Head Start program in a rural, southern state. Centers were designated as treatment ($n = 6$) or control ($n = 9$) based on location because of travel budget constraints. With one exception, centers located near the research staff were assigned to intervention. The exception was a site that was co-located with the Head Start administrative offices and was assigned to control. Excluding this center from WISE intervention reduced the interaction with agency staff and the WISE implementation. This reduced the risk of accidental dissemination to non-intervention sites. At all centers, family eligibility criteria were identical, procedures to recruit families, and center policies were identical as all centers were administrated by the same parent agency. All children were provided 'food experiences' per Head Start recommendations to provide children with a variety of experiences with foods. Control sites provided experiences based on the agency minimal recommendations, which allowed educators to design and implement 'food experiences' on their own. There were no quality standards in place for control classrooms food experiences. Examples of experiences in the control group include make-your-own pizzas, fruit salads, jello and soup. However, we did not systematically record or analyze the dietary quality of control group food experiences.

Parents ($n = 526$, $n = 268$ WISE classroom, $n = 258$ comparison) were blinded to their intervention status. They were interviewed using a standardized assessment tool by educators twice in 2014–15 by the childcare program using the family map inventories (FMIs) to screen families for a range of environmental risks. Educators interviewed the child's primary caregiver before intervention and after intervention activities. The first assessment was during school enrollment, typically in the summer before the fall sessions began, and again in the spring of the school year between late

February and March. The FMI tool (described in Measures Section) was modified to include dietary food frequency questions specific to the WISE intervention. The study was approved by the Institutional Review Board at the University of Arkansas for Medical Sciences and conducted in accord with prevailing ethical principles.

WISE curriculum and teacher training

WISE was developed in 2 phases. In Phase 1, we gathered stakeholder input through focus groups and interviews on ways to implement evidence-based obesity prevention practices [40] with a focus on nutrition. This informed the structure of the curriculum and training content. During interviews, we found that most children were not typically offered inexpensive and easily available F/V such as tomatoes, greens, and berries. This confirmed our review of the literature that these would be 'novel' and unfamiliar to our target population. In Phase 2, we piloted WISE-PK in 10 classrooms, developed and refined a fidelity tool, and completed a time series evaluation [52].

The curriculum mascot, Windy Wise, is a barn owl puppet who 'travels' between the classroom and rural and urban farms. Windy Wise led chants on 'trying' and visited the classroom at least weekly. Typically, Windy 'lived' in the classroom on a 'nest' so that parents would notice. Windy Wise was developed to draw on economic principles that use character mascots to encourage children's excitement for F/V and to try new foods [42]. Based on these economic principles, Windy was intended to excite children resulting in discussion WISE foods and events with parents. Windy delivers weekly photos and letters about F/V from the farm. Farmer letters were sent home in backpacks to parents. Each month Windy focuses on one of eight F/V.

On a weekly basis, educators provide children with hands-on, food preparation experiences in small groups to maximize children's engagement with the foods. WISE units provide the teacher with a suggested lesson plan schedule, suggestions for integration into educational activities (e.g. math, reading), and hands-on 'recipes'.

Parents received traditional information (backpack delivery) and education delivered via Facebook [43]. The WISE Facebook page allowed ongoing education and interaction between educators, parents, and project experts. Research staff posted Facebook content in the 'voice' of Windy. Posts varied by content and time. Teachers were encouraged to post pictures to the Facebook page including, but not limited to, WISE activities. Enrollment in the WISE Facebook component varied by classroom and center as did parent engagement after enrollment (e.g. 'like' a post); however about 40% of parents had some participation [43].

Educator training (6 h) was standardized, hands-on, and supported key best-practice messages. Training was based on adult learning theories [44, 45] and included active instruction, monitoring, and feedback. Educators explored their role in child nutrition, discussed food attitudes and beliefs, practiced using WISE, and identified resources to connect with and educate families. Teachers were trained in two cohorts (2013–14—two centers; 2014–15—four centers) by research staff using a standard protocol and manual. Both cohorts implemented WISE in 2014–15.

Measures

FMIs were used by the Head Start program to screen, assess and engage families. Child fruit and vegetable consumption was assessed using the FMI with additional items. The FMIs were semi-structured interviews, composed of twelve modules that assesses key aspects of the family and home environment that are important for healthy development in children [46, 47, 58]. The FMI is routinely used by the childcare program as a tool to engage families in the identification of service need and family strengths. Although there are exceptions, participation is part of programing and the FMI is typically completed unless the family leaves the program. The FMI aided childcare providers in systematically identifying areas of family environment concern and strength. Typically, educators use FMI results to target intervention, referral, and support parents in reducing risk conditions (e.g. daily routines,

nutrition, safety issues) or promote conditions associated with child well-being (e.g. supervision).

This study focused on the module assessing basic needs that includes a section to assess food consumed in the home. Three of 10 items were used (Table III) with the standard lead-in of 'About how often does your child eat a food from the following groups? Do not count foods eaten at child-care centers'. Response options range on a five-point scale from more than one-per-day to none. Response codes were adjusted to reflect the amount consumed in a week with midpoints used for ranges (e.g. More than 1 a day = 10, Once a day = 7). Reported test-retest reliabilities for the risk areas covered in this module range from 6 to 95% [47].

The FMI was modified to specifically ask about WISE foods in a format similar to the Food Frequency Questionnaire [48]. Parents were asked: 'In the last month, how often have you seen your child eat at least a bit of:' followed by the seven vegetables and three fruits targeted by WISE. Response options range on a nine-point scale from more than two-per-day to never (i.e. 1 = Never, 2 = 1 × per month or less to 9 = 2 + x per day). Responses were adjusted to reflect consumption within a month. Three summary scores were computed as the mean frequency of consumption of all F/V (10 items), vegetables (7 items) and fruit (3 items) as seen in Table IV.

Statistical plan

Preliminary analyses examined distributional assumptions and bivariate comparisons. Categorical comparisons and preliminary bivariate analyses were conducted using χ^2 tests and independent t-tests. Preliminary analyses showed that measures of consumption were skewed. In particular, the measures of WISE foods with skewness statistics ranging from 2.4 to 5.5. To adjust, a log transformation was taken of all consumption variables (+1 to avoid zero) [49].

Full information maximum likelihood (FIML) was used to estimate regression models predicting child dietary outcomes. FIML uses all available data and provides the least bias estimates in multiple regression models with missing data compared with other commonly used methods such as pairwise or listwise deletion [50]. FIML estimates were computed using SAS (9.4). Bonferroni adjustments were used to adjust for multiple comparisons [51].

Results

Parents ($n = 526$) were interviewed at least once. Most (85.4%) parents interviewed were the biological mother; 7.1% were the biological father; 7.5% were another relative including grandparent ($n = 18$), adoptive parent ($n = 5$), stepparent ($n = 7$) or someone else ($n = 4$). Most parents lived with a partner/spouse (57.4%), and were 24 years of age or older (75.1%). About half of parents were working (49.0%), and about half of children were female (49.6%).

Children in treatment sites differed from comparison children on some characteristics (Table II). Children in treatment sites were more likely to be younger than 48 months (46.3%, χ^2 [1, $n = 495$] = 22.5, $P < 0.001$), of Latino background (36.9%, χ^2 [1, $n = 486$] = 33.4, $P < 0.001$) or minority family (47.4%, χ^2 [1, $n = 526$] = 68.7, $P < 0.001$), have less than a high school degree (28.5%, χ^2 [1, $n = 446$] = 16.1, $P < 0.001$) and less likely to have experienced homelessness in the last year (13.5%, χ^2 [1, $n = 470$] = 19.9, $P < 0.001$) than comparison children.

A review of available data (Table III) at follow-up assessment compared with baseline assessment suggests a meaningful level of missing data (>10%). This was due, in part, to the loss of one WISE/treatment site's follow-up data to a fire that destroyed the

Table II. *Parent and child characteristics by comparison and WISE groups*

Characteristic	Comparison	Treatment
Sample Size (n)	258	268
Child Female	49.6%	51.3%
Child between 36 and 48 months*	67.5%	46.3%
Child White*	86.0%	52.6%
Child Latino*	13.9%	36.9%
Parent no High School degree*	15.9%	28.5%
Family Homeless in last year*	30.5%	13.5%
Parent working	47.2%	52.6%

Notes: *$P < 0.01$, total sample sizes range from 446 to 526.

Table III. *Comparison of baseline and follow-up assessment of fruit and vegetable consumption at home by intervention status*

	Comparison			WISE		
	n	Mean	SD	*n*	Mean	SD
Family Map F/V per Week[a]						
Dark green or orange/yellow vegetables						
Baseline Assessment	252	5.93	3.19	266	5.74	3.11
Follow-up Assessment	156	6.10	3.07	164	6.54	2.96
Fruits like apples, oranges, bananas, grapes, peaches						
Baseline Assessment	253	7.81	2.34	267	7.70	2.48
Follow-up Assessment	156	8.10	2.08	165	8.27	1.96
Sugary sweets like cakes and candy, or sugary drinks						
Baseline Assessment	250	4.22	2.90	264	4.22	2.62
Follow-up Assessment*	155	4.36	2.48	164	3.71	2.61
WISE Target Foods per month[b]						
Seven WISE Vegetables						
Baseline Assessment**	210	4.73	6.54	228	3.26	3.45
Follow-up Assessment	157	4.82	7.54	163	3.73	4.10
Three WISE Fruits						
Baseline Assessment**	210	9.99	11.63	228	7.35	7.22
Follow-up Assessment	157	8.63	10.19	163	8.48	7.17

Notes: [a]Five categories extrapolated to weekly intake. [b]Nine categories extrapolated into monthly intake. *$P < 0.05$; **$P < 0.01$ listwise deletion.

Table IV. *Standardized FIML estimation estimates from regression analysis predicting follow-up consumption ($n = 526$)*

Construct	Estimate	(SE)	*t*-value
Family Map Original Items			
Dark green or orange/yellow vegetables like greens, carrots, broccoli, squash, sweet potatoes	0.11	(0.050)	2.12*
Fruits like apples, oranges, bananas, grapes, peaches, applesauce	0.05	(0.058)	0.79
Sugary sweets like cakes and candy, or sugary drinks like soda and sports, or juice and other fruit drink	−0.16	(0.050)	−3.27**
WISE Target Foods			
Seven WISE Vegetables: Tomatoes, sweet potatoes, carrots, bell peppers, spinach, greens, green beans	0.02	(0.044)	0.49
Three WISE Fruits: Apples, strawberries, blueberries	0.12	(0.047)	2.74**

Notes: All analyses controlled for child pre-intervention consumption, gender ethnicity, and race, primary caregiver education, housing stability, employment status. *$P < 0.05$; **$P < 0.01$.

center ($n = 51$). In a comparison of families missing the follow-up assessment, no differences were found for treatment status, race/ethnicity, child gender, homelessness and parent education level or employment status.

As seen in Table III, children in the comparison group consumed more WISE foods (all 10 foods combined) at baseline than children in WISE centers ($t[436] = 3.33$, $P = 0.001$). As seen in Table III, this was true for both F/V. That is, children in WISE centers consumed less of the targeted WISE vegetables ($t[436] = 2.96$, $P = 0.003$) and WISE fruits at baseline than children at non-WISE centers, ($t[436] = 2.87$, $P = 0.004$). Simple independent *t*-tests using listwise deletion indicated three mean differences across treatment and comparison groups. Children in WISE centers consumed less sugary sweets at follow-up than children in non-WISE centers ($t[386] = 2.3$, $P = 0.024$).

Five regression models were estimated using FMIL with results shown in Table IV (with Bonferroni adjustments). All analyses controlled

for child pre-intervention consumption, gender ethnicity and race, primary caregiver education, housing stability, employment status. Results indicated that, using the general consumption of vegetables from the original Family Map tool, parents reported their children in WISE classrooms ate more vegetables at the end of the school year compared with reports by parents of children not in WISE classrooms ($P = 0.03$). Using this same questions format, WISE parents reported children also eating fewer sweets than children not in WISE classrooms ($P = 0.001$). When asked about specific WISE target foods, parents of children experiencing WISE reporting seeing their child eat WISE fruits more often than parents of children not in WISE classrooms ($P = 0.006$).

Discussion

The WISE fruit and vegetable intervention and curriculum resulted in improved reports of dietary intake in the home of pre-school children compared with children in classrooms where educators were not trained in WISE. The curriculum was designed with a strong parent component that provided multiple opportunities for classroom activities to filter home. WISE design included components intended to maximize children's interaction with foods and excite them about the experiences. These hands-on experiences were designed to give children successful, non-stressful experiences with the target food. Educators were trained to emphasize the role of adults to model healthy behaviors and stress 'try' rather than 'eat'. The WISE curriculum was structured to encourage integration into academic activates. Educators were encouraged to note when WISE food were presented at other meals.

Although the raw increases for F/V were small between the groups (effect sizes = 0.13–0.16), the increase within groups was more impressive. For example, the baseline assessment of vegetables indicates that the WISE group consumed fewer vegetables at baseline. By the follow-up assessment, this group had increased and, by some measures, exceeded the comparison group. WISE parents also reported less consumption of sugary sweets than parents in non-WISE classrooms. This suggested shifts in the dietary environment of the home that extend beyond the targeted foods.

The pattern of findings with the FMI original questions and additional WISE specific food frequency questions may warrant further research. For vegetables the significant findings were linked to the general question of 'dark green. . . like greens, carrots'; however, for fruits the increase for the WISE group reached significance when parents were asked about the specific three WISE fruits. This suggests an increase of vegetable consumption in general, but not the specific WISE vegetables; but, the reverse for fruit. It is interesting to note that the FMI fruit examples (e.g. bananas) are not typically locally grown and may be less accessible. Although the FMI examples did include WISE vegetables.

WISE was also designed to reduce the variation and minimize the workload for educators related to food experiences. We designed WISE to be integrated into existing activities (e.g. center time, science lessons) and provided resources to allow educators to select from an array of clearly developed activities. Farmer letters were printed and available to send home to parents. Although the educator was encouraged to post to the classroom Facebook page, the curriculum provided weekly posts from Windy. Details of the Facebook aspect of this intervention can be found in other publications [43].

A novel approach to sharing nutrition information with parents in the WISE curriculum is access to regular nutrition related posts on Windy Wise Facebook [43]. Parents living in poverty face unique barriers to accessing education, attending in-person workshops and getting information sent home from pre-school [53, 54]. The Facebook component met this need so that adults could control the timing, focus and extent of the information. That is, fitting with social learning theory, adults living in chronic adversity may benefit from immediate access to information on their schedule [55]. This was useful, in part, because families in poverty access social media in similar rates as more affluent families [56].

Another aspect of the WISE curriculum that was designed to engage parents is the use of the curriculum mascot, Windy Wise. Windy's role in WISE was based on behavioral economics theory and used to translate children's excitement into conversations with family [42, 57]. Although the technique of paring food with cartoon characters is often used in efforts to encourage children to eat less-healthy foods, the technique is less common for healthy options.

Although the study is limited in the lack of randomization to treatment group, analyses included pre-WISE consumption and an array of demographic characteristics of the child and family. The validity of parent report is always a concern. However, the FMI was designed to reduce social acceptability bias and to provide accurate information when administered by a pre-school educator [47]. Interviews with FMI interviewed results in parents and educators collaboration to provide families with needed referrals, education and supports. This is thought to lead to truthful responses. The tool has been found to be useful and valid [46, 58]. An additional limitation is the lack of consumption assessment at the childcare center. However, the assessment of consumption was based on that which the parent saw or served.

Conclusion

WISE is a promising, research-based curriculum designed specifically for pre-school children served for programs targeting families with few resources. Our results suggested that WISE is useful in improving the diet in the home. Given the importance of fruit and vegetable intake for predicting child weight, WISE may also contribute to obesity prevention in at-risk children. Future longitudinal studies should explore this possibility.

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Conflict of interest statement

L.W.-M., T.S. and UAMS have a financial interest in the technology discussed in this presentation/publication. These financial interests have been reviewed and approved in accordance with the UAMS conflict of interest policies.

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