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Testing the Effects of Two Field-to-Fork Programs on the Nutritional Outcomes of Elementary School Students from Diverse and Lower-income Communities

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Investigators.

1 **ABSTRACT**

2 The purpose of this quasi-experimental study was to evaluate the effects of two farm-to-school
3 programs, specifically the Field-to-Fork Multi-visit Program ($N = 264$) and the Field-to-Fork
4 After-school Club ($N = 56$), on nutritional outcomes of elementary school students (3rd-5th grade)
5 from urban, diverse, and lower-income communities. Data were collected via self-report surveys
6 measuring: (1) knowledge of recommendations for daily fruit and vegetable intake; (2) fruit and
7 vegetable consumption; (3) knowledge of cooking a healthy recipe using vegetables; and (4)
8 desire for farm fresh foods at school. Statistical analyses included McNemar's and Wilcoxon
9 signed rank tests. The proportion of students knowing how to cook a vegetable rich recipe
10 increased with both programs (Multi-visit Program $p < .001$; After-school Club $p = .002$).
11 Vegetable consumption increased with the After-school Club ($p = .002$). Farm-to-school
12 programming can increase knowledge of cooking vegetable rich recipes and vegetable intake
13 among elementary school students from diverse, urban, and lower-income communities.

14 **Keywords:** farm-to-school, nutrition, garden-based education, school-aged children

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1 **Testing the Effects of Two Field-to-Fork Programs on the Nutritional Outcomes of**
2 **Elementary School Students from Diverse and Lower-income Communities**

3 Maintaining a healthy dietary pattern, including the consumption of a variety of fruits and
4 vegetables, is consistently associated with better health outcomes and reduced risk of chronic
5 diseases throughout the lifespan, yet children in the United States (U.S.) eat substantially fewer
6 fruits and vegetables than is recommended (U.S. Department of Agriculture and U.S.
7 Department of Health and Human Services, 2020). On average, children and adolescents eat 0.54
8 cup-equivalents per 1,000 calories (CEPC) of vegetables per day falling far short of the target
9 1.16 CEPC of vegetables per day and 0.60 CEPC of fruit per day compared to the target of 0.93
10 CEPC of fruit per day (Office of Disease Prevention and Health Promotion [ODPHP], n.d.).
11 These statistics are concerning because healthy dietary patterns during childhood, including
12 adequate fruit and vegetable consumption, are vital to the prevention of obesity (Bray et al.,
13 2018), and are ultimately associated with eating patterns later in life (Movassagh et al., 2017).
14 Furthermore, the prevalence of childhood obesity in the U.S. has increased over the past few
15 decades with 18.4% of school-aged children qualifying as obese in 2016 (Hales et al., 2017).

16 Childhood obesity disproportionately affects certain demographic groups within the U.S.
17 population. For example, school-aged children of color, specifically Hispanic or Latino children
18 and non-Hispanic Black children, experience disproportionately higher rates of obesity compared
19 to children in the U.S. as a whole (ODPHP, n.d.). Additionally, children of lower socioeconomic
20 status have an increased likelihood of being overweight or obese compared to children from
21 households of higher socioeconomic status (Williams et al., 2018). There is evidence that the
22 COVID-19 pandemic worsened childhood obesity rates, especially among lower-income
23 populations and children of color (Jenssen et al., 2021).

1 School nurses have the necessary knowledge, skillset, and holistic understanding of the
2 social determinants of health to be leaders in the development of policies and strategies in their
3 schools, districts, and communities to address the increasing rates of childhood obesity (National
4 Association of School Nurses [NASN], 2016; 2018). As such, school nurses and other school
5 health professionals play a critical role in advocating for, designing, implementing, and
6 evaluating school-based programs to improve school-based nutrition services and school
7 environments to support healthy dietary choices among children (NASN, 2017). This role aligns
8 with the Whole School, Whole Community, Whole Child (WSCC) approach that emphasizes the
9 importance of collaboration among schools and communities for the development of policy that
10 leads to healthy school aged children (NASN, 2017; ASCD & Centers for Disease Control and
11 Prevention, 2014).

12 In response to the increasing rates of childhood obesity and consistent with the WSCC
13 approach, over 42,000 schools across the U.S. have implemented farm-to-school policies and
14 programming (National Farm to School Network [NFSN], n.d.). Farm-to-school programs aim to
15 educate children and their families about agriculture and nutrition, increase availability of locally
16 grown fresh foods, and strengthen local communities and food systems. While farm-to-school
17 programs vary in their specific components, the National Farm-to-School Network defines such
18 programs as incorporating at least one of the following: (1) use of local foods in schools for
19 lunches, snacks, or taste testing, (2) activities for students to learn about agriculture, food, and/or
20 nutrition, and (3) school-based gardens for experiential student learning opportunities (NFSN,
21 n.d.). Researchers have found that children who grow their own food are more likely to express a
22 preference for and/or consume fruits and vegetables (Gatto et al., 2017; Kim & Park, 2020).
23 There is also increasing empirical evidence supporting the use of hands-on garden-based

1 nutrition education programs, such as school-based gardens, to increase preferences for and
2 consumption of fruits and vegetables among youth (Savoie-Roskos et al., 2017). Despite the
3 potential benefits of garden-based learning and increasing farm-to-school policies, socio-
4 economic inequities remain in the presence of school-based gardens to support such educational
5 opportunities. Specifically, the prevalence of school-based gardens is lower among schools
6 serving communities with higher portions of low-income families (Turner et al., 2016).

7 There is also limited empirical evidence of the effects of farm-to-school programming
8 designed for schools serving racially and ethnically diverse, urban, and lower-income
9 communities (Greer et al., 2019). Two empirical studies of farm-to-school programs for racially
10 and ethnically diverse and lower-income communities are the LA Sprouts (Davis et al., 2016)
11 and TX Sprouts (Davis et al., 2021) programs. Both programs provided culturally appropriate
12 educational lessons and hands-on activities related to gardening, nutrition, and cooking for
13 predominantly lower-income and Hispanic and/or Latino elementary school students (Davis et
14 al., 2016). The LA Sprouts program was a 12-week after-school program that increased student
15 nutrition and gardening knowledge but did not affect student self-efficacy or attitudes towards
16 cooking or gardening among the sample (Davis et al., 2016). While the students in both the
17 control and intervention group decreased their vegetable intake, the intervention group had a
18 smaller decrease in their intake than the control group. The program also improved student body
19 mass index and waist circumference among the intervention group (Gatto et al., 2017). The TX
20 Sprouts program offered 18 in-class student lessons delivered by hired educators plus nine
21 monthly lessons for parents and families delivered outside of school hours. This program
22 increased vegetable intake among the students (Davis et al., 2021).

1 Empirical studies testing farm-to-school programs designed to reach non-Hispanic Black
2 youth in lower-income areas are even more limited. Evans et al. (2012) found that a multi-
3 component garden-based intervention increased fruit and vegetable consumption among an
4 ethnically diverse (59% Hispanic; 16% African American) and predominantly lower-income
5 (70% low-income) sample of middle school students in Texas. Knapp et al. (2019) explored the
6 perceptions of school-based kitchen garden programs among low-income, African American
7 children and parents from New Orleans, Louisiana. The school-based gardening programs were
8 well-received. Participants expressed an appreciation for the development of food related life
9 skills, for nutrition and health knowledge, and for the role the programs had on families, schools,
10 and the community.

11 While most empirical evidence supports farm-to-school programs, such as educational
12 school gardens, as having a small positive influence on vegetable intake, the evidence remains
13 mixed (Khan & Bell, 2019; Savoie-Roskos et al., 2017). There is significant variation in the
14 specific components included in farm-to-school programs, as well as the logistics of
15 implementing the programs. For example, differences exist in the setting (in-class, school-
16 garden, community garden, or farm), timing (during the school day versus after-school), and
17 dosage (frequency and duration of lessons, experiences, and visits) of the activities and programs
18 (Savoie-Roskos et al., 2017). Prescott et al. (2020) analyzed data from the 2015 Farm-to-School
19 Census questionnaire and concluded that the most common farm-to-school components included:
20 promoting foods produced at school, serving locally produced foods in the cafeteria, taste testing
21 of local foods, visiting farms or orchards, and changing the lunchroom environment (Prescott et
22 al., 2020). Research supports the use of comprehensive, multi-component programs to increase
23 fruit and vegetable intake among youth (Muzaffar et al., 2018; van den Berg et al., 2020). Multi-

1 component programs also led to increases in factors theorized to predict and affect fruit and
2 vegetable intake, such as increased self-efficacy for eating fruits and vegetables, increased
3 knowledge of fruits and vegetables, and decreased preference for unhealthy foods among youth
4 (Evans et al., 2012).

5 The variation in the implementation of farm-to-school programs, continued mixed
6 findings, and limited research evaluating programs designed for diverse, urban, and lower-
7 income communities, highlights the need for further testing of innovative, multi-component
8 farm-to-school education programs designed to reach populations at an increased risk for
9 obesity. Therefore, the purpose of this program evaluation research was to evaluate the effects of
10 two farm-to-school programs designed for elementary school students from diverse, urban, and
11 lower-income communities on the following nutritional outcomes: (1) knowledge of
12 recommendations for daily fruit and vegetable intake; (2) fruit and vegetable consumption; (3)
13 knowledge of cooking a healthy recipe using vegetables; and (4) desire for farm fresh foods at
14 school.

15 **METHODS**

16 The Food Literacy Project, Inc., established in 2006, is a [location deleted to maintain
17 blind review]-based 501c3 nonprofit organization with a mission of cultivating food justice
18 through increasing access to healthy foods in under resourced areas, providing experiential
19 education programs for youth focused on nutrition, agriculture, and the food system, and
20 empowering youth to create change in their own lives, families, and communities (The Food
21 Literacy Project, n.d., “Mission & Vision”). As part of the organization’s programming, the Food
22 Literacy Project collaborates with local public schools to provide two farm-to-school programs
23 for elementary school students: (1) the Field-to-Fork After-school Club and (2) the Field-to-Fork

1 Multi-visit Program. Both programs offer experiential learning opportunities designed to
2 improve food literacy, food access, and dietary behaviors of children from diverse, urban, and
3 lower-income communities.

4 A quasi-experimental, pretest-posttest design was used to evaluate the effects of the
5 Field-to-Fork Multi-visit Program and the Field-to-Fork After-school Club. The programs were
6 multi-component, experiential learning programs implemented in collaboration with the local
7 public elementary schools. The Multi-visit Program provided six in-class lessons (30 – 45
8 minutes per lesson) plus two to three farm field trips (2 – 4 hours each) for elementary school
9 students. The After-school Club was a voluntary program delivered after school hours. This
10 program consisted of 8- to 10-weekly sessions for the elementary school students (up to 2.5
11 hours each) and included a 4- to 5-week Family Engagement Series tailored for caregivers and
12 parents. The program designs were grounded in Social Cognitive Theory (Bandura, 1998) and
13 emphasized improving self-efficacy as well as personal (e.g., knowledge, attitudes), behavioral
14 (e.g., practice and skills), and environmental (e.g., social expectations among peers and/or
15 family, access to farm-fresh produce) determinants of farm-fresh produce preparation and
16 consumption. Educational experiences were based in the Flow Learning™ principles of Cornell
17 (2015) using strategies such as playfulness and meaningful content, enhancing receptivity
18 through the senses, hands-on experiences with nature, and reflection sharing. Significant cultural,
19 access, and language considerations were given to the specific needs of these populations
20 throughout the development process.

21 **Participants**

22 Four public, Title I urban elementary schools located within a large Midwestern school
23 district participated in the research study. All schools were located in neighborhoods with high

1 poverty rates (range: 18.4% - 37.6%) and low rates of educational attainment with only 7.9% to
2 12.6% of the communities obtaining a bachelor's degree (U.S. Census Bureau, 2019). In
3 addition, these neighborhoods experienced disproportionately high rates of chronic illnesses such
4 as cancer as well as higher rates of all-cause mortality compared to the metro area as a whole
5 (Center for Health Equity, 2017). The neighborhoods surrounded an urban farm in one of the
6 most diverse areas in the city, in which 8.5% of the population was foreign-born, reflecting the
7 area's status as a prime resettlement area for immigrants and refugees (Center for Health Equity,
8 2014; 2017). Most of the students in the participating elementary schools qualified for free or
9 reduced lunch (range: 72%-94%). The schools had diverse demographic characteristics including
10 student bodies of 275-592 students, 27%-79% African American, 10%-43% White, 1%-25%
11 Hispanic, and 4%-17% other ethnicities (Jefferson County Public Schools, 2018; 2019).
12 Participants in the research study consisted of third to fifth grade students from the four schools
13 during the 2017-2018 and 2018-2019 academic years. The After-school Club also incorporated
14 caregivers of the participating students through the Family Engagement Series.

15 **Procedure**

16 The Field-to-Fork Multi-visit Program and the Field-to-Fork After-school Club provided
17 educational lessons and hands-on activities designed to increase knowledge and appreciation for
18 the Field-to-Fork key concepts, such as nutrition and health, the food system, horticulture, and
19 cooking and preparing healthy recipes made from fresh foods (culinary lessons). Both programs
20 included regular taste testing of locally grown produce along with the culinary components.

21 All lessons were provided by the Food Literacy Project educators whose educational and
22 professional backgrounds included public health and health education and a commitment to the
23 promotion of diversity, equity, and inclusion. Families of participants in both programs were

1 regularly informed of additional family engagement activities offered at the Food Literacy
2 Project's outdoor classrooms at their urban and residential farming locations. Details specific to
3 each program are described below.

4 The evaluation study protocol including a waiver of documentation of informed consent
5 was approved by the University of (removed for peer review) Institutional Review Board.
6 Consent procedures and documents were created in collaboration with the participating public
7 school district. Parents and guardians of children in the Field-to-Fork Multi-visit Program
8 received study information with an option to not participate in the evaluation portion of the
9 program. Parents and guardians of children in the Field-to-Fork After-school Club received study
10 information during an in-person information session with an option to not participate in the
11 evaluation portion of the program.

12 *Field-to-Fork Multi-visit Program.* The Multi-visit Program provided six in-class lessons
13 (30 – 45 minutes per lesson) plus two to three field trips to the local urban farm (2 – 4 hours
14 each) spread throughout the academic year. Farm field trip experiential learning settings included
15 the sensory garden, barn, farm fields, and picnic areas. Field-to-Fork key concepts were
16 reinforced through interactive and engaging hands-on educational activities linked to the core
17 content subject areas (e.g., science and language arts). The lessons incorporated the use of
18 school-gardens when available and applicable, although this was a minor component of the
19 program. School administrators, staff and teachers and Food Literacy Project educators
20 coordinated extension assignments such as creative writing and creating poetry, short stories,
21 reflective narratives, and art for each lesson to further integrate lessons with core content.
22 Recipes from the culinary lessons and information on farmers markets and other resources for

1 finding local produce were sent home to parents and caregivers. See Table 1 for a sample
2 program overview including key concepts and activities for each session.

3 *Field-to-Fork After-school Club.* The After-school Club consisted of 8- to 10-weekly
4 sessions (up to 2.5 hours each) conducted outside of normal school hours at the partner schools.
5 Some club sessions took place at the urban farm within walking distance of one of the partner
6 schools. In addition to covering the Field-to-Fork key concepts taught in both programs, the
7 After-school Club lessons and activities were also designed to increase social support and
8 develop leadership, teamwork, and communication skills to help students become drivers of
9 change for healthy lifestyles within their families and schools. For example, each week, students
10 took home a healthy recipe along with samples of fresh seasonal produce allowing them to
11 prepare the vegetable rich meal at home with their families. In addition, the program supported
12 the launch and/or maintenance of school gardens and helped to cultivate an invested cohort of
13 students and teachers who provided sustainable leadership in maintaining and enhancing the
14 gardens.

15 Parents and caregivers of the students were encouraged to attend the complementary 4- to
16 5-week Family Engagement Series as part of the 8- to 10-week program. During these Family
17 Engagement sessions, additional tailored education and activities were provided that emphasized
18 nutrition, healthy foods, gardening, farming, and cooking for the caregivers. Parents and
19 caregivers were also provided fresh locally grown produce grown on the farms and other pantry
20 items donated by a local natural food market and wellness center to create the new recipes
21 together as a family at home. Also, to increase outreach and flexibility for the families, a single
22 parent or caregiver did not have to commit to the entire series. This meant that more than one

1 parent or caregiver could attend the program with a single child. See Table 2 for a sample
2 program overview including key concepts, recipes, and activities for each club session.

3 **Instrumentation**

4 Data were collected via paper and pencil surveys administered to students during the
5 2017-2018 and 2018-2019 academic years. Student participants of both programs received the
6 same questionnaires. Knowledge of the recommendations for fruit and vegetable intake from the
7 5-2-1-0 recommendation (Rogers & Motyka, 2009) was measured using single item questions:
8 (1) “How many total servings of fruit and vegetables should you eat each day?” with answer
9 options “0 servings,” “1-2 servings,” “3-4 servings,” or “5 or more servings” (correct answer).
10 Fruit intake was measured using the question, “Yesterday, did you eat ANY fruit? Do not count
11 fruit juice.” with answer options of “No, I did not eat any fruit yesterday,” “Yes, I ate one fruit
12 yesterday,” “Yes, I ate two fruits yesterday,” and “Yes, I ate three or more fruits yesterday.”
13 Similarly, vegetable intake was measured by the question, “Yesterday, did you eat ANY
14 vegetables? Vegetables are salads; boiled, baked, and mashed potatoes; and all cooked and
15 uncooked vegetables. Do not count french fries or chips.” Response options mirrored that of the
16 fruit intake question. Knowledge of how to cook a healthy recipe using vegetables and desire to
17 have farm fresh vegetables available at school were measured by the following questions with
18 “Yes/No” response options: “Do you know how to cook a healthy recipe using vegetables?” and
19 “Would you like to have fresh foods from a vegetable farm available at your school?” Parent and
20 caregiver demographic data were collected via paper and pencil surveys for descriptive purposes
21 during the Family Engagement Series.

22 **Data Analysis**

1 Descriptive statistics including frequencies and percentages were calculated for sample
2 characteristics and major variables. Students who concurrently participated in both programs (n
3 = 15) were excluded from the analysis. Chi-square and Fisher's exact tests were used to test for
4 differences in proportions of baseline measures between those who completed the program and
5 those who did not. Pre- and post-program proportions were compared using McNemar's Test for
6 dichotomous outcome variables (e.g., knowledge of recommendations, knowledge of cooking
7 healthy recipes using vegetables, and desire for farm fresh produce available at school).
8 Wilcoxon signed rank test was used to compare pre- and post-program scores for ordinal
9 outcome variables (e.g., fruit and vegetable consumption). Statistical analysis was conducted
10 using SPSS Statistical Software version 26. Statistical significance was set at $p < .05$.

11 RESULTS

12 Field-to-Fork Multi-visit Program

13 The Multi-visit Program sample included 264 students, ages 7 to 10, a slight majority of
14 whom were female (53%) and Black or African American (56%) (Table 3). The baseline survey
15 was completed by 316 students; 264 of those students also completed the post survey (16.5%
16 attrition). There were no significant differences in baseline measures of major outcome variables
17 by completion group.

18 At the end of the program, the proportion of students who reported knowing how to cook
19 a healthy recipe using vegetables ($n = 173$ [68.7%]) was significantly higher than at baseline ($n =$
20 135 [53.6%]; $p < .001$). There was no significant effect of the program on student knowledge of
21 fruit and vegetable recommendations; student fruit and vegetable consumption; or student desire
22 for farm fresh foods available at school.

23 Field-to-Fork After-school Club

1 The sample from the After-school Club included 56 students, ages 7 to 11; 66% of the
2 students were female, 38% identified as Black or African American, and 13% identified as
3 Hispanic or Latino (Table 3). The baseline survey was completed by 92 students; 56 of those
4 students also completed the post survey (39.1% attrition). There were no significant differences
5 in baseline measures of major outcome variables by completion group.

6 Among the sample of caregivers ($N = 88$; age range = 16 - 71 years) in the Family
7 Engagement Series, 46.5% identified as white, 39.5% Black or African American, and 9.3%
8 Hispanic or Latino. Furthermore, a total of seven different languages were spoken among the
9 caregivers, with almost one-fifth (19.5%) of the caregivers reporting speaking Spanish ($n = 9$,
10 10.3%) or other languages ($n = 8$, 9.2%; Arabic, Vietnamese, Albanian, Karem, Zomi). Parent
11 and caregiver demographic characteristics are displayed in Table 4. Parents and caregivers
12 attended at least one session but did not have to commit to the entire family engagement series.
13 Consequently, more than one parent or caregiver per child could attend throughout the program,
14 resulting in a higher number of parents and caregivers sampled than children in the program.

15 Student vegetable consumption increased from pre- to post-program ($Z = -3.148$, $p =$
16 $.002$); the greatest increase occurred in the proportion of students who ate 3 or more servings of
17 vegetables ($n = 4$ [7.1%] vs. $n = 18$ [32.1%]). The proportion of students who reported eating no
18 servings of vegetables per day decreased from 30.4% ($n = 17$) pre-program to 16.1% ($n = 9$)
19 post-program. The percentage of students who reported knowing how to cook a healthy recipe
20 using vegetables also increased from pre- to post-program ($n = 27$ [50.9%] vs. $n = 43$ [81.1%], p
21 $= .002$). However, the program had no effect on fruit consumption, desire for farm fresh foods at
22 school, or student knowledge of recommendations for daily fruit and vegetable intake. See Table
23 5 for details.

1 **DISCUSSION**

2 Given the school nurse's role as a leader in the development of school and community
3 policies and programs that support the health and wellbeing of all children (NASN, 2017), it is
4 important for nurses to understand the evidence supporting farm-to-school programs. Previous
5 research findings have indicated that school nurses are eager to gain more knowledge and
6 experience with these programs (Muckian et al., 2017). Furthermore, advocates for increasing
7 the adoption of fresh fruits and vegetables in schools recommend empowering school nurses to
8 lead in forging partnerships with farm-to-school programs (Schultz & Thorlton, 2019). In this
9 manuscript, we provided a detailed overview of two farm-to-school programs along with
10 empirical evidence regarding their effects on: (1) student knowledge of recommendations for
11 daily fruit and vegetable intake; (2) student fruit and vegetable consumption; (3) student
12 knowledge of cooking a healthy recipe using vegetables; and (4) student desire for farm fresh
13 foods available at school. Both programs provided multi-component, experiential learning to
14 students from four urban elementary schools serving lower-income and racially and ethnically
15 diverse communities. In total, the programs reached 320 unique elementary school students from
16 the ages of 7 to 11 during the 2017-2018 and 2018-2019 academic years. The After-school Club
17 also included parents and caregivers who were similarly diverse in race and ethnicity.

18 **Knowledge of cooking healthy recipes**

19 The Multi-visit Program and the After-school Club had significant positive effects on the
20 number of students who reported knowing how to cook a healthy recipe using vegetables. Both
21 programs had several features that likely contributed to their success in improving this outcome
22 including evidence and theory-based lessons, school garden-based learning experiences, and
23 culinary experiences with taste testing. Substantial portions of content were devoted to teaching

1 the students how to prepare healthy, vegetable rich recipes followed by taste testing of these
2 recipes. Culinary components are common among farm-to-school programs and often involve
3 cooking classes or demonstrations, in-class nutritional education, meal preparation activities, and
4 taste testing sessions (Muzaffar et al., 2018). While it is difficult to parse out the effects of
5 incorporating such a focus on learning how to cook vegetable rich recipes, previous research that
6 evaluated the impact of farm-to-school programming with culinary components had promising
7 results. Such programming incorporating culinary components has been associated with
8 increased vegetable preferences, willingness to try new foods, vegetable consumption, and
9 gardening and nutrition knowledge (Kim & Park, 2020), along with improved self-efficacy for
10 cooking among youth (Jarpe-Ratner et al., 2016; Kim & Park, 2020). Furthermore, evidence
11 supports psychosocial factors related to cooking such as attitude, motivation, and self-efficacy as
12 predictors of increased vegetable intake among low-income elementary school students (Landry
13 et al., 2019). This evidence suggests that improving factors such as knowledge and self-efficacy
14 related to cooking with vegetables may be a contributing factor for improving the dietary
15 patterns of children.

16 **Fruit and vegetable consumption**

17 Students who participated in the After-school Club significantly increased their intake of
18 vegetables per day after participating in the program. The largest changes were seen in a
19 decrease in the number of students who reported eating zero vegetables per day and an increase
20 in the number of students who reported eating three or more vegetables per day, as previously
21 discussed. There was no significant increase in fruit servings per day, which was not surprising,
22 as there was more emphasis on vegetables than fruits throughout the program. Similar results
23 regarding fruits have been found in larger studies of farm-to-school programs, such as by Jones

1 and colleagues (2015) who studied the effects of farm-to-school programs on consumption of
2 fruits and vegetables across 18 schools (12 farm-to-school programs; 6 matched control schools)
3 in South Carolina and found that while the students in the schools with farm-to-school programs
4 consumed more vegetables, they also ate slightly fewer fruits (Jones et al., 2015).

5 The After-school Club consisted of 8 to 10 weekly sessions located at the schools with
6 some participants attending sessions at a local urban farm within walking distance of one of the
7 partner schools. While this may appear to be a significant time commitment, the duration of this
8 program was shorter than other well-known programs, such as the 12-week after school LA
9 Sprouts program (Davis et al., 2016). The program was a voluntary program offered outside of
10 normal school hours which likely drew upon individuals and families who were interested in the
11 Field-to-Fork topics such as food, nutrition, and horticulture.

12 The After-school Club had direct parental/caregiver involvement through the Family
13 Engagement Series which included tailored education, discussions, and culinary experiences
14 with taste testing of recipes. The involvement of parents and caregivers was a strength of this
15 program as there is substantial evidence supporting parental involvement in health education
16 programs for children (Knapp et al., 2019; Spears-Lanoix et al., 2015). Similarly, parental
17 support for and parental role-modeling of health behaviors are related to child health behaviors
18 (Bassul et al., 2020; Hartson et al., 2018). In fact, the family and home environment have been
19 found to account for 50% of the variance in child fruit and vegetable consumption (Gross et al.,
20 2010). Given the racial and language diversity of the children's caregivers in this study, the
21 implications of their involvement in programming are important. Research findings from a recent
22 school-based gardening intervention for low-income, diverse, urban school children underscored
23 the cultural and community significance that immigrant families can bring when collaborating in

1 gardening opportunities (Greer et al., 2019). Including families and caregivers in the After-school
2 Club may have served as an important reinforcing factor in vegetable consumption behavior
3 among children, further supporting that family and community engagement in farm-to-school
4 programming can be instrumental in supporting a culture of health (Robert Wood Johnson
5 Foundation, 2018).

6 Another strength of the After-school Club and Family Engagement Series was the
7 inclusion of fresh, local produce for the children and their caregivers to take home with them to
8 practice creating the new recipes at home. This increased access to fresh produce in the
9 household without increasing financial strain on the family and it provided additional
10 opportunities to practice cooking healthy, vegetable rich recipes. Furthermore, it created an
11 opportunity for the family to practice cooking healthy recipes together, theoretically creating a
12 home environment that encourages the consumption of fruits and vegetables (Ong et al. 2016).

13 The Multi-visit Program, which consisted of six in-class lessons and two to three farm
14 field trips spread throughout the academic year, did not increase fruit or vegetable intake among
15 the students. However, there was a general trend with the portions of students eating 2 servings
16 and 3 or more servings of vegetables appearing to increase at the end of the intervention. In
17 contrast to the After-school Club, the Multi-visit Program delivered a much less intense and less
18 frequent intervention over a longer time. Eight to nine learning experiences throughout the
19 academic year may not have been frequent enough messaging to affect long-term behavioral
20 outcomes, despite the comprehensive nature of the program including education, hands-on
21 activities, cooking activities with taste testing, and farm-field trips. Extension assignments were
22 provided for teachers to incorporate and reinforce key concepts within the core curriculum,
23 however, use of these assignments was not measured.

1 Despite most evidence supporting a small but positive influence of farm-to-school
2 programs on dietary patterns (Savoie-Roskos et al., 2017), it is also sometimes the case that
3 farm-to-school programs do not have significant overall effects on dietary patterns or only show
4 a benefit for a sub-group of students (Bontrager et al., 2014). There are several evidence-based
5 strategies that could improve the potential effects of the Multi-visit Program on fruit and
6 vegetable consumption of students. One commonly used farm-to-school strategy that should be
7 considered in future programming is the incorporation of local produce into cafeteria prepared
8 meals and snacks, as well as environmental changes within the cafeteria that support healthier
9 food choices. These strategies increase access to locally grown fresh produce on a regular basis
10 while also providing more frequent and consistent health promotion messaging. For example,
11 weekly snacks at school created using locally grown fresh produce has been shown to increase
12 preferences for fruits and vegetables among children over a 4-month period (Triador et al.,
13 2015).

14 Another evidence-based strategy that could be incorporated into future implementations
15 of the Multi-visit Program is direct parental engagement or enhanced indirect parental
16 involvement. There is evidence that indirect parental involvement such as having children share
17 their school-garden experiences with their parents at home and including a weekly newsletter
18 with tips, recipes, and home activities can affect parental value of fruit and vegetable
19 consumption as well as increase fruit and vegetable availability at home (Heim et al., 2011).
20 Although the Multi-visit Program included some messaging home to parents, it was much less
21 frequent and less comprehensive. Further investigation is needed to determine if incorporating
22 these strategies into the Multi-visit Program could increase the effectiveness of this program on
23 nutritional outcomes.

1 **Knowledge of recommendations and desire for farm fresh foods**

2 There was not a significant increase in knowledge of the recommendations for daily fruit
3 and vegetable intake. While the information was a part of the programs' overall core content,
4 memorizing the recommendations was not the major focus of the experiential programs. Thus, it
5 was not surprising that this detailed knowledge was not retained over the long study periods,
6 particularly with such a young sample.

7 There was also no significant difference in the proportion of students who desired farm
8 fresh vegetables available at school before and after the intervention; however, the proportions of
9 students who reported wanting farm fresh vegetables at school at baseline was 88% and 96%, for
10 the Multi-visit Program and the After-school Club, respectively. With such high proportions of
11 students already desiring to have farm fresh vegetables available at school, statistically
12 significant improvement would have been challenging to achieve. The baseline results alone
13 highlight the natural interest of students in having farm fresh foods available at their schools.

14 **Limitations & Future Research**

15 The data were collected using simple, single item questions making them extremely user-
16 friendly; however, higher quality measures such as food frequency questionnaires, food diaries,
17 or observable food intake should be considered for future studies. Suggestions for future studies
18 include measuring self-efficacy of cooking healthy recipes, which is an important psychosocial
19 predictor of behavior, and measuring body mass index or waist circumference to determine if
20 improvements in vegetable and fruit intake translate into obesity prevention and treatment.

21 The sample sizes were small, particularly for the After-school Club, and attrition rates
22 were 16.5% for the Multi-visit Program and 39.1% for the After-school Club. This was not
23 surprising, given the length of the programs and the chronic absenteeism for the elementary

1 schools participating in the programs (range: 18% - 23%) (Jefferson County Public Schools,
2 2020). The high chronic absenteeism at the included elementary schools reflects the inherent
3 difficulty in reaching some youth, especially for long-term interventions. Further investigation is
4 needed to determine the effects and sustainability of these programs with larger samples.

5 The parents and caregivers involved in the program were not required to commit to
6 attending the entire series. Given the significant number of after-school hours required by the
7 program, it was anticipated that requiring a commitment from a single parent or caregiver for the
8 entire series would put undue time, access, language, or transportation strain on parents and
9 caregivers, especially if they were caregiving for other members of the family or community.
10 Having this flexibility potentially increased the number of unique parents and caregivers reached
11 by the program, but it also limited our ability to collect reliable data and determine changes in
12 parental and caregiver outcomes over time as well as analyze pre- and post- parent-child dyad
13 data. Therefore, parental and caregiver data were limited to descriptive demographic
14 information. Given the diversity of languages spoken by parents and caregivers, a language
15 barrier could have interfered with participation in the programming. Lastly, following this
16 evaluation, the program was delivered virtually due to the COVID-19 pandemic. Further
17 evaluation is needed to determine the effects of virtual delivery on accessibility, engagement,
18 sustainability, and outcomes, particularly for the After-school Club and Family Engagement
19 Series.

20 **Conclusion**

21 Healthy eating, including adequate consumption of fruits and vegetables, is an important
22 lifestyle factor for the prevention and management of childhood obesity. Farm-to-school
23 programs have demonstrated promise in improving mediators of fruit and vegetable intake

1 (Berezowitz et al., 2015), as well as increasing the consumption of fruits and vegetables among
2 children (Savoie-Roskos et al., 2017). Findings from this study of two multi-component,
3 experiential learning farm-to-school programs for third to fifth grade students from four
4 elementary schools located in diverse, urban, and lower-income communities showed that both
5 the Field-to-Fork Multi-visit Program and the Field-to-Fork After-school Club produced an
6 increase in knowledge of cooking healthy, vegetable rich recipes among the students, while the
7 After-school Club that included a substantial Family Engagement Series increased vegetable
8 intake among the students as well.

9 School nurses are health leaders in the schools and communities they serve. As such, they
10 are in the unique position to create school environments and community collaborations that
11 support healthy nutrition among students and a culture of health in the community (NASN, 2015;
12 2018). Understanding the evidence supporting farm-to-school programs will help school nurses
13 engage in this mission to advocate for, design, and implement culturally sensitive programs,
14 policies, and partnerships to improve the health and well-being of their students.

15

16 **Human Subjects Approval Statement**

17 The evaluation study protocol was approved by the University of (removed for peer review)

18 Institutional Review Board.

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Draft

1 Appendix

Table 1: Multi-visit Program Overview

Visit	Core Concepts
1. In-Class Visit 1	Parts of a seed, what a seed needs to grow, and what to expect at the farm
2. Field Trip to Farm 1	Culinary lesson, taste testing, plant parts, role of worms, composting, building soil, and edible plant parts
3. In-Class Visit 2	Eating a balanced diet (My Plate), food groups, food choice, and food diaries
4. Field Trip to Farm 2	Culinary lesson, seasonality, winter crops, and environmental citizenship
5. In-Class Visit 3	Scientific observations, role of worms in ecosystem, and food web
6. In-Class Visit 4	Seasonality, what seeds need to grow, how to prep and plant spring garden beds
7. In-Class Visit 5	Food systems, local food, processed food, food miles, and map reading
8. Field Trip to Farm 3	Nutrition, harvesting, culinary lesson - cooking recipe from scratch, and tasting tour
9. In-Class Visit 6	Reflection letter writing - what I have learned...

Table 2: After-school Club and Family Engagement Series Overview

Visit	After School Club Core Concepts and Recipes with Sample Produce	Family Engagement Lessons and Recipes with Sample Produce
1.	Introduction, farm tour & safety Recipe: Fresh tomato salsa, black bean hummus	Not applicable
2.	Seasonality, planting the garden Recipe: Super salads, homemade honey mustard	Not applicable
3.	Healthy food choices, planting the garden Recipe: Squash quiche	Not applicable
4.	Making art from the garden Recipe: Beet smoothies	Not applicable
5.	Healthy beverage choices, nutrition labels Recipe: Black bean brownies	Not applicable
6.	Garden day, role of worms, composting Recipe: Butternut squash pizza	Culinary demonstration Recipe: Rainbow cougar salad
7.	Physical activity: Zumba Recipe: Purple beet pancakes	Family gardens and planting herb seeds Recipe: Cajun kick pumpkin seeds
8.	Seed dispersal Recipe: Cauliflower wings with health ranch	Nutrition Recipe: Pumpkin smoothie
9.	Gardening and meal planning Recipe: sweet potato, black bean, kale quesadillas	Yoga Recipe: Sweet potato fries with honey mustard
10.	Skit planning, food prep, and celebration Recipe: Seasonal surprise	Skits and celebration Recipe: Seasonal surprise

1 **Table 3:** Characteristics of the Participants

Variable	Multi-visit Program (<i>N</i> = 264)	After-school Club (<i>N</i> = 56)
	<i>n</i> (%)	<i>n</i> (%)
Age		
7	3 (1%)	1 (2%)
8	131 (50%)	14 (25%)
9	123 (47%)	21 (38%)
10	7 (3%)	17 (30%)
11	0 (0%)	3 (5%)
Grade		
3 rd	150 (57%)	18 (32%)
4 th	109 (41%)	19 (34%)
5 th	0 (0%)	19 (34%)
Gender		
Male	124 (47%)	19 (34%)
Female	140 (53%)	37 (66%)
Race or Ethnicity		
White	79 (30%)	21 (38%)
Black or African American	149 (56%)	21 (38%)
Hispanic or Latino	20 (8%)	7 (13%)
Asian or Pacific Islander	3 (1%)	2 (4%)
Other	20 (8%)	9 (16%)

2

3

4

1 **Table 4:** After-school Club - Family Engagement Series Caregiver Demographics

Variable	Family Engagement Series (<i>N</i> = 88)
	<i>n</i> (%)
Gender (<i>N</i> = 88)	
Male	26 (29.5%)
Female	62 (70.5%)
Race or Ethnicity (<i>n</i> = 86)	
White	40 (46.5%)
Black or African American	34 (39.5%)
Hispanic or Latino	8 (9.3%)
Asian or Pacific Islander	5 (5.8%)
Other: Albanian	1 (1.2%)
Languages Spoken at Home (<i>n</i> = 87)	
English	78 (89.7%)
Spanish	9 (10.3%)
Other: (Arabic, Vietnamese, Albanian, Kareem, Zomi)	8 (9.2%)

2

1 **Table 5:** Results of Multi-visit Program and After-school Club

Variable	Multi-visit Program (N = 264)			After-school Club (N = 56)		
	Pre-test	Post-test	<i>p</i> -value	Pre-test	Post-test	<i>p</i> -value
Knowledge of Recommendations						
5 or more servings of fruits and vegetables per day	93 (36.0%)	82 (31.8%)	.272 ^a (<i>n</i> = 258)	16 (29.1%)	21 (38.2%)	.424 ^a (<i>n</i> = 55)
Dietary Behaviors						
Fruit Consumption						
0 servings	56 (21.2%)	65 (24.6%)	.138 ^b (<i>n</i> = 264)	6 (10.7%)	9 (16.1%)	.480 ^b (<i>n</i> = 55)
1 serving	61 (23.1%)	66 (25.0%)		14 (25.0%)	9 (16.1%)	
2 servings	61 (23.1%)	58 (22.0%)		19 (33.9%)	15 (26.8%)	
3 or more servings	86 (32.6%)	75 (28.4%)		17 (30.4%)	22 (39.3%)	
Vegetable Consumption						
0 servings	87 (33.0%)	89 (33.7%)	.276 ^b (<i>n</i> = 264)	17 (30.4%)	9 (16.1%)	.002 ^b (<i>n</i> = 55)
1 serving	73 (27.7%)	54 (20.5%)		16 (28.6%)	16 (28.6%)	
2 servings	41 (15.5%)	51 (19.3%)		19 (33.9%)	12 (21.4%)	
3 or more servings	63 (23.9%)	70 (26.5%)		4 (7.1%)	18 (32.1%)	

Other

Knowledge of cooking a healthy recipe using vegetables	135 (53.6%)	173 (68.7%)	<.001 ^a (<i>n</i> = 252)	27 (50.9%)	43 (81.1%)	.002 ^a (<i>n</i> = 53)
Desire to have farm fresh vegetables at school	225 (87.5%)	209 (81.3%)	.061 ^a (<i>n</i> = 257)	51 (96.2%)	48 (90.6%)	.453 ^a (<i>n</i> = 53)

1 ^aMcNemar Test

2 ^bWilcoxon Signed Rank Test

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Draft