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School Breakfast Programs With Implementation of Farm to School Have No Influence on Body Weight Among 3rd and 4th Grade Students

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ABSTRACT

Objectives

To examine the association between frequency of breakfast consumption and body mass index (BMI) among elementary students participating in a traditional School Breakfast Program (SBP) in a school district that is implementing a Farm to School (F2S) program compared to those participating in a traditional SBP without F2S.

Methods

This cross-sectional study matched ten schools with a traditional SBP, five with F2S (A) and five without F2S (B). Third- and fourth-grade students (n=1031) were recruited for study participation. Demographic information, frequency of breakfast participation, and anthropometric data were collected. BMI and frequency of breakfast consumption over a ten-day period, excluding non-school days, were stratified by frequent eaters (7-10), occasional eaters (3-6), and skippers (0-2).

Results

No significant difference in BMI-for-age between F2S (A) and traditional SBP (B) was observed. There was also no significant correlation between BMI or BMI-for-age and breakfast participation observed. This data suggests that there is no relationship between F2S participation and BMI-for-age and no correlation between breakfast consumption and BMI-for-age among third- and fourth-grade students. Hispanic and Latino students were more likely to qualify for free and reduced lunch ($p<0.001$). Free and reduced school meals students were more likely to be overweight or obese than students that qualify for paid school meals ($p<0.001$). In both districts, students that were offered breakfast in the classroom were 30% more likely to participate than students offered breakfast in the cafeteria.

Applications to Child Nutrition Professionals

Based on this limited study, a F2S program alone is unlikely to be an effective strategy to prevent/reduce childhood overweight and obesity unless fully implemented. Future strategies should focus on lower socio-economic status students and minority groups due to their increased rates and predisposition of overweight and obesity. Offering breakfast in the classroom may be a positive method of increasing breakfast participation in all types of school breakfast programs.

Keywords: schools, farm-to-school, breakfast, childhood obesity, classroom breakfast

INTRODUCTION

Childhood overweight and obesity remain a persistent concern nationally. Although the current prevalence of childhood obesity has slowed to 17% (Ogden, Carroll, Kit, & Flegal, 2014), a large

percentage of children may be impacted physically, emotionally, socially, and even academically from the detrimental effects of overweight and obesity (Fryar, Carroll, & Ogden, 2012; Schwimmer, Burwinkle, & Varni, 2003; Fox & Farrow, 2009; Geier, Foster, Womble, McLaughlin, Borradaile, 2007; Heshmat, Larijani, Pourabbasi, & Pourabbasi, 2014; Biro & Wien, 2010). Consequences are not limited to childhood years; overweight and obese children often enter middle adulthood with more severe forms of chronic diseases such as diabetes, cardiovascular diseases, and select cancers, contributing to an overall diminished quality of life (Juonala, Magnussen, Venn, Dwyer, & Burns, 2010; Dietz, 1998; Biro & Wien, 2010; Singh, Mulder, Twisk, van Mechelen, & Chinapaw, 2008; Weiss, Dziura, Burgert, Tamborlane, & Taksali, 2004). Beyond the physical health concerns, these conditions often co-exist with food insecurity, poverty, and hunger, creating a web of political and health issues requiring national attention (Hoelscher, Kirk, Ritchie, Cunningham-Sabo, & Academy Positions Committee, 2013; Healthy People, 2015; State of Obesity, 2015).

Due to the multifaceted cause of obesity, there is an array of recommended strategies targeting childhood overweight and obesity proposed by various health organizations. These include, but are not limited to: early child- and school-based interventions, policy-based interventions, and food marketing interventions (Hoelscher et al., 2013; Institute of Medicine [IOM], 2004; Healthy People, 2015; Centers for Disease Control & Prevention [CDC], 2014). With 44.5 million meals served daily, the National School Lunch Program (NSLP) and School Breakfast Program (SBP) provide a promising platform to increase nutritional health and health awareness among children and adolescents.

School food components, which are federally regulated by the U.S. Department of Agriculture (USDA), were recently updated in 2012 as mandated by the Healthy, Hunger-Free Kids Act (HHFKA) (HHFKA, 2010). This act required schools to provide more fruits and vegetables, whole grains, and reduce the sodium content to improve the nutritional quality of school meals. Other school-based interventions include regulating beverage and vending machine choices, promoting increased physical activity, and implementing Farm to School (F2S) programs (Briggs, Fleischhacker, Mueller, American Dietetic Association, & School Nutrition Association, 2010).

The F2S program is a nationwide initiative to include more locally produced foods such as fruits and vegetables, dairy, meat, and grain products within school meals. Almost half of the nation's schools claim to have a F2S program, with over $15 million federal dollars spent on initiating and sustaining the programs (National Farm to School Network, 2016; Farm to School Census, 2015). The F2S program is collectively presented with relevant educational components, such as farm tours, school gardens, and interactive events encouraging students to think about where their food comes from, and while this would not affect the number of fruits and vegetables offered within the NSLP and SBP, it may lead to increased consumption. Currently, the program is a recommended strategy to prevent or reduce childhood obesity by the IOM (Hoelscher et al., 2013; Farm to School Census, 2015), though very few studies have examined the relationship between F2S participation and body mass index (BMI) to date (LaRowe, Bontrager, Knitter, Meinen, & Liebhart, 2012; Joshi, Azuma, & Feenstra, 2008).

The effects of the F2S program, which may be especially visible when measuring breakfast consumption habits as a relationship between regular breakfast consumption and a healthy body weight, have been identified by numerous studies (Schwimmer et al., 2003; Kleinman, Hall, Green, Korzec-Ramirez, & Patton, 2002; Widenhorn-Muller, Hille, Klenk, & Weiland, 2008;

Murphy, Pagano, Nachmani, Sperling, & Kane, 1998; Adolphus, Lawton, & Dye, 2013; Deshmukh-Taskar, Nicklas, O'Neil, Keast, & Radcliffe, 2010; Pereira, Erickson, McKee, Schrankler, & Raatz, 2011; Kant, Andon, Angelopoulos, & Rippe, 2008; Rampersaud, Pereira, Girard, Adams, & Metzl, 2005; McCrory, & Campbell, 2011; Gleason, & Dodd, 2009). While it is unlikely that students would consume a greater amount of fruits and vegetables at breakfast, if the student is participating in the SBP, it is likely the student is also participating in the NSLP where they would have a greater exposure. Ultimately, as discussed in O'Neil's research commentary in 2014 (O'Neil, Byrd-Bredbenner, Hayes, Jana, & Klinger, 2014), the definition of breakfast affects the strength of the observed association between breakfast consumption and body weight. The SBP, due to its highly regulated nature, is likely to demonstrate this inverse relationship, while promoting healthy lifestyle behaviors that may reinforce lasting maintenance of a favorable body weight.

This study aimed to explore whether regular participation in the SBP amplifies the proposed benefits between F2S and body weight status. As the F2S movement continues to grow, it is valuable to understand how the program may affect childhood obesity, specifically in regards to breakfast, as it has been highly correlated with reduced risk for obesity. The original study hypothesis was that regular breakfast consumption and F2S participation would have a favorable effect on body weight status in children.

METHODOLOGY

Study Design

This study was a cross-sectional design assessing the effect of frequent breakfast consumption and F2S participation on BMI among third- and fourth-grade students. The study protocol was reviewed and approved by Central Washington University's Human Subjects Review Program prior to collection of any data. All guardians were mailed study information and were provided with opt out forms, envelopes, and postage if they did not want their child to participate. Assent was attained from students prior to data collection. Students were informed that they could choose to opt out at any time.

Study Sample

The study sample included ten randomly selected elementary schools, from highly similar adjacent school districts in Central Washington. Five with F2S programs (A), and five with traditional SBP (B) were selected. Third- and fourth-grade students (N=1,031) were recruited for participation. This age group was selected due to two or more probable years of F2S participation. Furthermore, this age group is less likely to be as affected by peer social influence of school meal participation compared to older children (Adolphus et al., 2013). All third- and fourth-grade students within districts were eligible for participation in this study.

Data Collection

Demographic data. Demographic data was collected from each district office and through statewide public reports. Ethnicity, mean age, and individual, district, and state-wide free and reduced lunch participation rates were assessed.

Anthropometric data. Anthropometric data (height [cm] and weight [kg]) were collected by trained investigators and co-investigators following standardized procedures in a private location. Standing height was measured using a portable stadiometer (Charder HM200P Portstad) to the nearest 0.1 cm. Weight was measured using a portable, digital display floor scale to the nearest 0.1 kg (Detecto SlimPRO Digital Low Profile). All equipment was calibrated prior

to use with a standardized weight. Participants were asked to remove heavy clothing; footwear remained on for all subjects. Participants were unable to see their recorded measurements; height and weight were kept confidential and not shared with other subjects. The Children's BMI Tool for Schools was then utilized to compute BMI-for-age (CDC, 2015).

School breakfast participation data. School breakfast participation information was retrieved from the databases at each school; Mealtime by the CLM Group Inc. at district A and NutriKids Point of Sale (POS) System by Heartland Payment Systems at district B. Breakfast participation was recorded for a consecutive ten-day span, excluding non-school days. Only frequency of breakfast participation at school was recorded; meal components or nutrients consumed were not recorded. Frequency of school breakfast participation was organized into three groups; skippers (0-2 meals), occasional eaters (3-6 meals), and frequent breakfast consumers (7-10 meals). A randomly assigned participant identification number coded all data collected; only the study's primary investigator had access to this data.

Data Analyses

Summary statistics (means, standard deviations, ranges) were calculated for baseline characteristics (SBP participation, ethnicity, age, and weight status). BMI-for-age was calculated using anthropometric data collected and birthdates provided by district office database. The software used for analysis was the CDC's group BMI calculator, English v1.1 (CDC, 2015). Chi-square tests were used for NSLP and SBP eligibility, ethnicity, age, and weight status sample comparisons. Independent 2-sample t-tests were used to compare BMI-for-age between the two districts by grade, sex, SBP consumption frequency and free-reduced meal eligibility. One-way ANOVA was used to compare BMI-for-age and SBP participation frequency groups. In a *post-hoc* analysis, the effect of the location of breakfast was also assessed. The SPSS 20.0.0.0 software was used for analyses. Significance was set at $p=0.05$.

RESULTS AND DISCUSSION

The total sample consisted of 568 students who qualified for free-breakfast, 99 students who qualified for reduced-breakfast, and 364 students who purchased their breakfast. In contrast to the study hypothesis, there was no difference in BMI-for-age among third- and fourth-grade students regardless of participation in a traditional SBP or a SBP with a F2S program. There was also no relationship observed between BMI and breakfast participation frequency.

Socioeconomic Status and Ethnicity

No significant differences in summary statistics between districts were demonstrated; indicating a highly homogenous sample (Table 1). The majority of students at each district qualified for free- or reduced-breakfast, demonstrating a similar socioeconomic status (SES) distribution ($p = 0.48$). However Hispanic/Latino students (comprising 71.3% of the sample who qualified for free and reduced breakfast) were more likely than non-Hispanic white students to qualify ($p < 0.0001$). Other ethnicities were not included in this statistical analysis due to their very small prevalence within the sample.

The overall sample had a similar ethnic profile with no significant differences noted. Hispanic/ Latino students comprised a large portion of the sample. Though the majority of the entire sample had normal BMI-for-age (n=527), a greater proportion of Hispanic/Latino students were classified as obese/overweight (65.3% and 60.8%, Districts A and B, respectively) compared to non-Hispanic white students (36.4% and 34.3%, Districts A and B, respectively $p < 0.0001$).

Table 1. ***Demographic Information for Elementary Students in Two School Districts***

	District A (F2S)	**District B (SBP)**
NSLP & SBP Eligibility	% (n)	% (n)
Free	56.6 (288)	53.5 (280)
Reduced	8.3 (42)	10.9 (57)
Paid	35.0 (178)	35.5 (186)
Ethnicity	% (n)	% (n)
Hispanic or Latino	53.1 (270)	49.9 (261)
Non-Hispanic White	43.7 (222)	46.2 (242)
Age	*M* ± *SD*	*M* ± *SD*
Years	9.2 ± 0.8	9.1 ± 0.8
Weight Status	% (n)	% (n)
Underweight	2.5 (13)	1.3 (7)
Normal	50.6 (257)	55.8 (292)
Overweight	19.7 (100)	17.5 (91)
Obese	29.9 (137)	25.4 (133)
N Total	508	523

Status ranked according to CDC standards. BMI-for-age is an index of weight-for-height that is based on a normal distribution of the national population. Underweight (<5%), normal (5-85%), overweight (85-95%), and obese (>95%). None of the above measures was statistically significantly different between District A and District B.

Table 2. ***Comparison of Normal BMI-for Age Score Percentiles for Elementary Students in Two School Districts by Grade and Gender, Breakfast Frequency, and NSLP/BSP Eligibility.***

	Normal BMI-for Age Score Percentiles	
	District A *M* % ± *SD*	**District B** *M* % ± *SD*
Grade Level		
3rd Grade Girls	68.5 ± 30.3	72.6 ± 24.4
3rd Grade Boys	71.3 ± 27.9	75.0 ± 24.0
4th Grade Girls	69.0 ± 27.9	71.3 ± 26.5
4th Grade Boys	73.0 ± 28.5	73.9 ± 25.6
Breakfast Frequency		
Skippers	69.4 ± 29.2	71.0 ± 27.1
Occasional	75.8 ± 26.72	75.7 ± 24.9
Frequent	70.9 ± 26.8	76.4 ± 19.5
NSLP/SBP Eligibility		
Free	74.5 ± 26.5	76.3 ± 24.1
Reduced	66.4 ± 34.5	72.6 ± 24.9
Paid	65.1 ± 29.5	68.6 ± 26.1

Status ranked according to CDC standards. BMI-for-age is an index of weight-for-height that is based on a normal distribution of the national population. Underweight (<5%), normal (5-85%), overweight (85-95%), and obese (>95%). None of the above measures was statistically significantly different between District A and District B.

Anthropometric Data

No significant differences were found between weight status and school districts (Table 1). Of the entire sample, 26% were classified as obese based on BMI-for-age; much higher than the national average of approximately 17% (CDC, 2015). This discrepancy between our sample and the national population may have attenuated the F2S program's ability to positively affect body weight status.

No significant differences were found between BMI-for-age and grade or gender. Though BMI-for-age averages were slightly less in all categories in District A, all mean BMI-for-age scores fell within normal weight status percentiles (5^{th} < 85^{th} percentile-for-age; Table 2); although it should be noted that they were much higher than the expected average of 50%.

No significant differences were found between districts when stratified by breakfast frequency consumption. As Table 2 illustrates, skippers, occasional eaters, and frequent eaters all had mean BMI-for-age scores within normal weight status percentiles (5^{th} < 85^{th} percentile-for-age), although again, this was markedly above the average of 50%.

With complete sample analysis of all participants in both districts, statistically significant relationships were observed between students who qualified for free breakfast and lunch and overweight and obesity status (p<0.001), as well as between students who purchased breakfast and a normal BMI-for-age status (p<0.001). This supports previous literature (Timlin, Pereira, Story, & Neumark-Sztainer, 2008) suggesting SES status is inversely correlated with BMI. When districts were compared, no significant difference was found between free and reduced meal eligibility and BMI-for-age (Table 2).

School Breakfast Location

A *post-hoc* analysis indicated that children who consumed breakfast in the classroom had greater participation in the SBP regardless of whether the school had implemented a F2S program. In both school districts, students were 30% more likely to consume breakfast at school if it was served in the classroom rather than the cafeteria (p< 0.05; data not shown). However, BMI-for-age was not statistically different among classroom and cafeteria eaters. Of the classroom breakfast eaters, 51.6% qualified for free school meals, making the SES distribution of classroom breakfast eaters similar to the entire sample (51.1%).

Previous studies suggest offering breakfast in the classroom is a positive nutritional reinforcement as well as a potential strategy to increase academic performance and behavior (Food Research and Action Center, 2016; Adolphus et al., 2013). Adolphus et al. (2013) reviewed 21 studies analyzing habitual breakfast consumption and children and adolescent academic performance; they concluded participation in school breakfast positively impacted test scores. The effect was more apparent if breakfast met >20-25% of daily caloric needs, and the SBP is required to provide an estimated 25% of daily needs. In addition to positive academic and behavior outcomes, increased habitual breakfast participation within the classroom is likely to have a positive effect on childhood BMI. Although not demonstrated in this study, numerous studies have illustrated an inverse relationship between breakfast consumption and BMI (Affenito, 2007; Baldinger, Krebs, Muller, & Aeberli, 2012; Merten, Williams, & Shriver, 2009; Szajewska, & Ruszyczynski, 2010; Timlin et al., 2008).

In contrast, some researchers argue breakfast in the classroom is an unfavorable addition of excess calories for children that may be consuming breakfast both at home and school (Van

Wye, Seoh, Adjoian, & Dowell, 2013). During a SBP study, it was noted that over 20% of students consumed more than one breakfast. Of the double breakfast consumers, almost half (46%) consumed a nutritionally substantive breakfast prior to consuming school breakfast (Bernstein, McLaughlin, Crepinsek, & Daft, 2004). However, in Bernstein's study, no anthropometric data were collected to determine a potential positive or negative influence on BMI. Wang et al. measured weight gain over two academic years and assessed breakfast habits; the authors concluded that even those students who consumed breakfast at home as well as at school had more favorable BMIs than those who skipped breakfast all together, which further supports the role of breakfast in maintaining a healthy body weight $(p < 0.05)$ (Wang, Schwartz, Shebl, Read, & Henderson, 2016).

Strengths and Limitations

This study hypothesized that with F2S exposure an effect on BMI would be measurable, but without subjective data analysis, it is impossible to determine if attitudes towards food or dietary behaviors have changed or improved. This research was also unable to account for possible missed school days that would alter the data collected on frequency of school breakfast participation. The history and level of involvement in F2S related programs were also not measured in our study, although District A implemented F2S in 2010 and is thought to be well established. Variance may occur by teacher, school year, or schools within district. Lastly, limited information on educational level, demographics, anthropometric data, or health behavior of the legal guardians was not obtained, nor was data on actual food consumed, all of which may significantly influence childhood BMI status.

A strong factor contributing to the statistically insignificant effect of the F2S program on body weight found in this study was likely related to the high percentage of students classified as obese and at a lower SES, both known risk factors for childhood obesity (Timlin et al., 2008). Significant results may have been more likely with a population with average obesity rates. Despite the noted limitations, this research is one of very few studies that evaluated F2S and BMI-for-age. Other strengths include: the large sample size; the high proportion of Hispanic/Latino students; and two homogenous populations that provided an excellent platform to control for extraneous variables. The region of Central Washington is an agricultural hub, allowing the schools accessibility to grains, legumes, dairy, vegetables, orchard fruits, and meats locally. The same task would prove more challenging to a more urban school or a district in a less bountiful region.

CONCLUSIONS AND APPLICATION

Although originally thought to be a promising strategy, study results showed no significant effect on childhood BMI between participation in a F2S SBP compared to a traditional SBP. The sample population had a higher prevalence of obesity than the national average (26% vs. 17%). This likely skewed the findings, but emphasizes the need for these high-risk populations to be a primary focus of future childhood obesity interventions.

Additionally, it is likely the foods served within the NSLP and SBP have little variance between districts due to strict regulations schools must already follow (HHFKA, 2010). With increased fruit and vegetable offerings among all schools due to HHFKA, it is improbable that F2S programs are in fact serving more fruit and vegetables than other schools. If in fact, F2S programs serve more fruit and vegetables, it is unknown if students are consuming more of them or contributing to greater overall food waste.

The F2S Network recommends a complete F2S program consist of procurement, education, and school gardens, but does not have detailed objectives (Food Research and Action Center, 2009). The current study found no relationships between implementation of a F2S program and a healthy body weight; however, it is likely the educational components have a greater impact on a child's nutritional choices. Based on our findings, it is recommended that the educational components of F2S programs be expanded and more defined, as this component of F2S is likely a stronger contributor to child dietary habits than food served at NSLP and SBP alone. It is recommended that all schools, not just schools with F2S programs, develop and implement a standard nutrition curriculum. Additionally, in populations with markedly higher rates of obesity, such as our sample, a greater emphasis should be placed on nutrition education. It would be beneficial for schools to be aware of their school's obesity rates to align with this recommendation.

Another recommendation is that a detailed history of F2S involvement should be conducted to explore which aspects of F2S curriculum are most effective. For example, it would be helpful to know roughly how many school hours students spend learning or working in the school garden, how many field trips each student participates in, and hours of nutrition curriculum and nutrition-related events the child is exposed to each year. Nationally, F2S programs have vast variability between programs, making it difficult to determine its true effect without more comprehensive measurement and analysis. The F2S program in our study was likely to vary among season, year, schools within each district, grade level, and teacher. Nationally, programs range by ingredients purchased, volume of food purchased, promotion of the program, and extent of involvement in complementary educational components, all of which make comparing and measuring effects of programs challenging. This study revealed the need for school-based interventions, such as F2S, to be continuously evaluated and defined. Future studies may consider surveying students on attitudes and experiences after involvement in such programs, in addition to evaluating BMI.

In this study, a significant relationship between breakfast consumption and BMI was not observed, contrary to the study hypothesis. Although our sample's prevalence of obesity was higher than the national average, breakfast skippers in the sample had a mean normal, but above average BMI-for-age. There was, however, a significant relationship between location of breakfast and participation. The SBP provides a platform to address and improve our nation's food security status and the childhood obesity epidemic, while reinforcing healthy behaviors like habitual breakfast participation. Considering the positive effects of habitual breakfast as evidenced by previous research, school nutrition programs may elect to shift breakfast to the classroom instead of the cafeteria to extend on those benefits. Previous studies have also noted universal breakfast as a potential opportunity to increase food security, decrease hunger, increase meal participation, increase school attendance, and enhance academic achievement (Leos-Urbel, Schwartz, Weinstein, & Corcoran, 2013; No Kid Hungry, 2014). A new Washington State House Bill will require schools to offer Breakfast After the Bell, an effort to provide students adequate time to eat (HB 1508-S), creating an opportune time to research such programs. Additionally, programs like universal breakfast and breakfast in the classroom should also be further evaluated and supported, especially in high-risk populations. Both types of SBPs could significantly increase meal participation while simultaneously reducing stigma that may be associated with school breakfast consumers. School nutrition staff and teachers may consider working together to offer breakfast in the classroom in hopes of providing optimal health and success for their school's student population.

In conclusion, the potential effectiveness of F2S programs as a promising obesity prevention or reduction was not illustrated by this limited study. This finding is likely related to the high obesity and low SES prevalence in the sample analyzed. Results showed that participation in school breakfast did not significantly impact BMI-for-age. Breakfast participation increased significantly when breakfast was served in the classroom versus the cafeteria. This information may be beneficial for schools to not only increase breakfast participation rates but also enable more students to habituate breakfast, which has been historically associated with maintenance of a healthy body weight. Future classroom based interventions, like breakfast in the classroom, fruit and vegetable curriculum, and food system based lesson plans may be more favorable than food service-only based interventions, though external factors, such as SES, continue to clearly influence a child's body weight. Results from this study suggest the need for strong intervention and specific prevention methods to target this already high-risk population.

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