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The Effect of Universal-Free School Breakfast on Milk Consumption and Nutrient Intake

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Abstract: The US Department of Agriculture's (USDA's) School Breakfast Program (SBP) is a federally assisted meal program designed to provide students in public and nonprofit private schools access to breakfast. Universal-free school breakfast works well at schools that have a high percentage of low-income students and can be served in the cafeteria before school or with an alternative service delivery model, like Breakfast in the Classroom (BIC). The purpose of this study was to examine the effect of BIC on milk consumption and how that consequently affects the nutrient intakes of third through fifth graders.

Keywords: Universal-Free School Breakfast, Milk, Shortfall Nutrient Intake

Background

Eating breakfast is associated with positive outcomes for children including increased nutrient intake (Bhattacharya, Currie, and Haider 2004) and milk intake (Condon, Crepinsek, and Fox 2009), enhanced cognitive performance and memory (Mahoney et al. 2005;), and improved academic performance (Hoyland, Dye, and Lawton 2009; Kleinman et al. 2002; Murphy et al. 1998). The US Department of Agriculture's (USDA's) School Breakfast Program (SBP) is a federally assisted meal program designed to provide students in public and nonprofit private schools access to breakfast. Children living in households with income that is at or below 130 percent of the federal poverty level are eligible for free school meals and children living in households with income between 130 and 185 percent of the federal poverty level qualify for reduced-price meals. While SBP increases access to breakfast for children who may not eat breakfast otherwise, the program is underutilized with only half of low-income children participating for every 100 participating in school lunch, nationally (Hewins and Burke 2015).

One approach to increasing participation in school breakfast is to offer universal-free school breakfast at no charge to all students, regardless of their household income (Crepinsek et al. 2006). Universal-free school breakfast works well at schools that have a high percentage of low-income students and can be served in the cafeteria before school or with an alternative service delivery model, like Breakfast in the Classroom (BIC). With BIC, students eat breakfast in their classrooms after the start of the school day. This reduces barriers to participation, including stigma and needing to arrive at school before the bell rings. School districts that implement BIC often see an increase in breakfast participation. In a USDA study of the effectiveness of BIC, schools that served BIC had higher breakfast participation rates (65%) than other settings such as the cafeteria (28%) (Bernstein et al. 2002).

In addition to needed improvements in the accessibility and convenience of school breakfast, many children do not meet the recommended number of dairy servings: only between 33 and 50 percent of American children (Cook and Friday 2005). Milk is a standard component of school meals, and schools that participate in SBP and the National School Lunch Program (NSLP) must offer eight fluid ounces of milk at each meal. Milk varieties offered include low-fat (one percent), fat-free plain milk or fat-free flavored milk ("Fact Sheet: In School Breakfast Program" 2012). Condon, Crepinsek, and Fox (2009) found that approximately 75 percent of students who ate school breakfast drank milk daily, compared to only 53 percent of students who did not regularly eat school breakfast. Because eating school breakfast can increase regular milk consumption, it can yield numerous nutritional benefits. Studies suggest that improved milk

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consumption may be crucial for meeting the recommended levels of shortfall nutrients (Nicklas, O'Neil, and Fulgoni 2009). The Dietary Guidelines for Americans 2010 identify calcium, vitamin D, potassium, and dietary fiber as nutrients "low enough to be of public concern" ("Dietary Guidelines for Americans: 2010" 2010, 40). Additionally, intake of key nutrients have shown to be comparable among both plain-milk and flavored-milk drinkers but were significantly lower for milk nondrinkers (Murphy, Douglass, and Johnson 2008).

School breakfast is an important factor in ensuring that all children have the energy they need to begin the school day, and milk is one nutritious component of school breakfast that lends important nutrients to children's diets. There is a paucity of research focused specifically on how BIC influences students' milk consumption and nutrient intake. Therefore, the purpose of this study was to examine the effect of BIC on milk consumption and how that consequently affects the nutrient intakes of third through fifth graders.

Methods

Sample Design

The sample consisted of third through fifth graders in five elementary schools in a large Texas school district over two academic years: 2011–12 and 2012–13. Data were combined over both years from two treatment schools that implemented BIC and three control schools that implemented the means-tested, cafeteria-based SBP (Non-BIC). We compared the amount and type of milk consumed by each student at each meal by school breakfast program type (Non-BIC, BIC) and then compared nutrient intakes by the type of milk consumed per student and per breakfast meal.

Data Collection

The study protocol and instruments were reviewed and approved by the Baylor University Institutional Review Board, and informed consent was obtained before collecting any primary data from students. Students with signed parental consent and child assent forms were identified by their district-generated identification numbers. Each participant was given a lanyard with a card that had his or her identification number printed on it. The student identification numbers were recorded by the data collectors.

Primary student level nutrient intake data were collected by trained data collectors. Data collectors traveled to the elementary schools and interviewed students over a three-day period in the spring of 2012 and the spring of 2013. The quantity of food items consumed at each meal was recorded using a 24-hour dietary recall tool. Students were asked to recall what they ate from the time they came home from school the day before until the time of the interview. A dialogue script, prompting methods, and drawn food proportion sizes were used to promote accuracy of responses.

In addition to the 24-hour dietary recalls, before and after digital pictures were taken of each participant's breakfast and lunch meals consumed at school over a three-day period. Nutrient compositions were analyzed using the Digital Food Image Analysis (DFIA) (Echon 2012), "a technology based nutrient and recipe analysis system" designed to minimize random selection errors and "features improvements in data collection methodologies, nutrient database query, and estimation of dietary intake" (Echon 2014, Methodology section, para. 3, cited from Echon 2013) (also known as School Food Image Analysis which has slightly different data collection methods).

Coding

Breakfast was considered to be any food item that was consumed from the time the student woke up until the time of the interview (before lunch). If the student drank plain white milk (and not flavored) at least once during the three-day period, the student was identified as a plain-milk drinker. Similarly, if the student drank flavored milk (and not plain) at least once during the three-day period, the student was identified as a flavored-milk drinker. If the student drank both plain and flavored milk during the three-day period, the student was identified as a combination-milk drinker. We kept this category separated because of the relatively high volume of combination-milk drinkers and to enable a comparison with plain- and flavored-milk drinkers.

Milk type classifications were adapted from Murphy and colleagues: "Flavored milk was defined as either ready-to-drink flavored fluid milk or flavored milk prepared from plain-fluid milk and flavored syrups or powder" (Murphy, Douglass, and Johnson 2008, 632). Fat content varied for both plain and flavored milk, and each was included in the classifications.

A significant number of data cleaning and transformation steps were executed to correct naming and structural conflicts so that the data files could be integrated and matched by students' district-generated identification numbers. The data files were then manually inspected and analyzed to detect and correct data quality problems and facilitate instance matching and integration.

Data Analysis

First, we analyzed the distribution of types of milk drinkers by school breakfast program type and then conducted a test of differences in nutrient intake means by type of milk drinker. The nutrient intake means were averaged over each meal, each day, and therefore represent a three-day, 24-hour mean for each selected nutrient. This study focused on the nine essential nutrients found in milk: calcium, potassium, phosphorus, protein, vitamins A, B-12, and D, riboflavin, and niacin ("Dairy's Unique Nutrient Combination" 2009), three of which are shortfall nutrients (calcium, vitamin D, and potassium).

For the first analysis, the school breakfast program type was determined at the school level. In other words, if a student attended a BIC school, they were classified in the treatment group, regardless of *if* or *where* they actually ate breakfast (i.e. home). In order to account for this nuance, we conducted a secondary analysis to determine the distribution of types of milk consumed *per breakfast* by actual location (home, cafeteria, or classroom). Similar to the first analysis, we then conducted a test of differences in nutrient intakes by type of milk consumed at each breakfast.

Therefore, the data were analyzed in two parts: 1) milk intake and nutrient consumption per student (three-day average where n=students) and 2) milk intake and nutrient consumption per breakfast meal (where n=breakfast meals). If a participant was interviewed during both years, they were treated as two separate cases. Data analysis was performed using the Statistical Analysis Software package (SAS Institute Inc., Cary, NC) and IBM SPSS Statistics version 20 (SPSS IBM, New York, USA).

Results

This study examines the impact of a universal-free school breakfast program, Breakfast in the Classroom (BIC), on milk consumption and shortfall nutrient intake by elementary-aged, low-income students. The analysis was based on the data collected via dietary recalls and DFIA. Data over a two-year period were used for a total of 459 students. Three hundred students attended schools that implement BIC and the remaining 159 students attended schools that implement the traditional, means-tested, cafeteria-based SBP (Non-BIC). For both school years, the data show most students in the Non-BIC and BIC groups were Hispanic (81.1% and 74.0%, respectively) and eligible for free or reduced-price meals combined (93.7% and 93.7%, respectively).

Table 1: Demographic Characteristics of Participants for SY 2011–12 and 2012–13

		Non-BIC		*BIC*	
		N	*%*	*N*	*%*
Sex	*Male*	71	44.7	158	52.7
	Female	88	55.3	142	47.3
	Total	*159*	*100.0*	*300*	*100.0*
Race	*Hispanic*	129	81.1	222	74.0
	Black	25	15.7	59	19.7
	Other	3	1.9	4	1.3
	White	2	1.3	15	5.0
	Total	*159*	*100.0*	*300*	*100.0*
Lunch Status	*Free*	139	87.4	269	89.7
	Reduced-Price	10	6.3	12	4.0
	Full Pay	10	6.3	19	6.3
	Total	*159*	*100.0*	*300*	*100.0*

Breakfast Participation

School breakfast participation rates were calculated for the treatment and control schools. The total number of breakfast meals served was divided by the number of days in the school year to generate the average daily participation (ADP). The ADP was divided by the total school enrollment to calculate the breakfast participation rate (these are school-level, aggregate participation rates and not participation rates reflective of the study sample alone). The BIC schools' average breakfast participation rate was notably (more than 50%) higher than the average of Non-BIC schools.

Table 2: Overall School Breakfast Participation Rates by School Breakfast Type and Year

School Year	*School Breakfast Participation Rate*	
	Non-BIC %	*BIC %*
SY 2011–12	30.6	73.7
SY 2012–13	30.2	73.0

Milk Consumed over 24 Hours

To investigate the relationship between school breakfast program type (Non-BIC, BIC) and type of milk drinker (none, plain, flavored, combination), the number of participants within each category was recorded. There is a significant association between the type of milk drinker and the school breakfast program type and is summarized in Table 3. Students in BIC schools were more likely to be flavored-milk or combination-milk drinkers than students in Non-BIC schools. Conversely, students in Non-BIC schools were more likely to not drink milk, or if they did, they were more likely to choose plain milk than students in BIC schools.

Table 3: Type of Milk Drinker by School Breakfast Program Type

Type of Milk Drinker	*Non-BIC*		*BIC*			
	n	%	n	%	χ^2	*p*
Milk non-drinker	16	10.1	7	2.3**	14.93	0.002
Plain-Milk Drinker	34	21.4	53	17.7**		
Flavored-Milk Drinker	64	40.3	141	47.0**		
Combination-Milk Drinker	45	28.3	99	33.0**		
Total	*159*	*100.0*	*300*	*100.0*		

n=students
Includes combination of students interviewed in school years 2011–12 and 2012–13.
Data include students who skipped breakfast or ate breakfast at a restaurant.
***p<0.01*

To test the effect of the type of milk drinker on the amount of nutrients consumed, nutrient quantities were analyzed with a one-way ANOVA. The results (see tables 4 through 7) showed significant differences in four key nutrients: vitamins A, B-12, D, and calcium. A Bonferroni post hoc test showed that milk non-drinkers had an overall significantly lower intake of the four nutrients when compared to the other milk drinker types. Additionally, flavored-milk drinkers had a significantly higher intake of vitamin D (IU and mcg) than plain-milk drinkers.

Table 4: Vitamin A (IU)—Bonferroni Methods for Multiple Pairwise Comparisons of Mean Intake for Four Types of Milk Drinkers

Groups	*Difference Between Means*	*Bonferroni 95% CI*
(None, Plain)	-767.24	(-1519.71, -14.76)*
(None, Flavored)	-762.72	(-1468.46, -56.99)*
(None, Combination)	-761.12	(-1481.79, -40.47)*
(Plain, Flavored)	4.52	(-406.13, 415.17)
(Plain, Combination)	6.12	(-429.67, 441.91)
(Combination, Flavored)	1.6	(-350.55, 347.35)

n=students
**p<.05; **p<0.01; ***p<0.001*
None (n=23); Plain (n=87);Flavored (n=205); Combination (n=144)
Total=459 students

Table 5: Vitamin B-12—Bonferroni Methods for Multiple Pairwise Comparisons of Mean Intake for Four Types of Milk Drinkers

Groups	*Difference Between Means*	*Bonferroni 95% CI*
(None, Plain)	-0.761	(-1.35, -0.17)**
(None, Flavored)	-0.83	(-1.39,-0.28)***
(None, Combination)	-0.82	(-1.38, -0.25)**
(Plain, Flavored)	-0.07	(-0.39, 0.25)
(Plain, Combination)	-0.05	(-0.39,0.29)
(Combination, Flavored)	-0.02	(-0.29, 0.25)

n=students
**p<.05; **p<0.01; ***p<0.001*
None (n=23); Plain (n=87); Flavored (n=205); Combination (n=144)
Total=459 students

Table 6: Vitamin D (IU)—Tamhane Methods for Multiple Pairwise Comparisons of Mean Intake for Four Types of Milk Drinkers

Groups	*Difference Between Means*	*Bonferroni 95% CI*
(None, Plain)	-58.00	(-88.90, -27.07)***
(None, Flavored)	-78.68	(-107.67, -49.68)***
(None, Combination)	-70.82	(-100.43, -41.22)***
(Plain, Flavored)	-20.69	(-37.57, -3.82)**
(Plain, Combination)	-12.84	(-30.75, 5.06)
(Combination, Flavored)	-7.85	(-6.49, 22.19)

n=students
**p<.05; **p<0.01; ***p<0.001*
None (n=23); Plain (n=87); Flavored (n=205); Combination (n=144)
Total=459 students

Table 7: Calcium—Bonferroni Methods for Multiple Pairwise Comparisons of Mean Intake for Four Types of Drinkers

Groups	*Difference Between Means*	*Bonferroni 95% CI*
(None, Plain)	-196.69	(-408.63, 15.24)
(None, Flavored)	-238.91	(-437.68, -40.14)**
(None, Combination)	-219.52	(-422.50, -16.54)*
(Plain, Flavored)	-42.21	(-157.88, 73.45)
(Plain, Combination)	-22.82	(-145.57, 99.92)
(Combination, Flavored)	-19.39	(-117.68, 78.89)

N=students
**p<.05; **p<0.01; ***p<0.001*
None (n=23); Plain (n=87); Flavored (n=205); Combination (n=144)
Total=459 students

Milk Consumption at Breakfast

In addition to comparing milk intake by school breakfast program (Non-BIC, BIC), a second analysis was performed to determine associations in the type of milk consumed (none, plain, flavored, combination) at each breakfast and the exact location the breakfast was eaten (cafeteria, classroom, home). This allows us to examine the differences in type of milk consumed at each unique breakfast meal and account for the students who ate breakfast at home. In the following tables (tables 8 through 10), N is the total meals. There is a significant association between the type of milk consumed and the breakfast location (see Table 8). Meals without milk were more likely to be consumed in the cafeteria (Non-BIC). Meals with plain milk and combination milk were more likely to be consumed at home. Meals with flavored milk were more likely to be consumed in the classroom (BIC).

Table 8: Type of Milk Consumed by Breakfast Location

Consumed at Meal	*Cafeteria*		*Classroom*		*Home*			
	n	*%*	*n*	*%*	*n*	*%*	χ^2	*p*
None	4	12.1	3	1.6	6	4.4	57.46	<.001
Plain	8	24.2	23	12.0	44	32.1		
Flavored	9	27.3	103	53.7	24	17.5		
Combination	12	36.4	63	32.8	63	46.0		
Total	*33*	*100.0*	*192*	*100.0*	*137*	*100.0*		

n=breakfast meals
Includes combination of students interviewed in school years 2011–12 and 2012–13.

A one-way ANOVA examined significant differences in the mean intake of the nine essential nutrients at breakfast by type of milk consumed. The results of the ANOVA (see Tables 9 and 10) show significant differences in two key nutrients: vitamins B-12 and D. Similar to the results of the ANOVA for milk drinkers, the results showed an overall significantly lower intake of the two nutrients at breakfast meals without milk. Conversely, there was a higher intake of the nutrients at breakfast meals in which any kind of milk was consumed.

Table 9: Vitamin B-12—Bonferroni Methods for Multiple Pairwise Comparisons of Mean Intake for Four Types of Milk Served

Groups	*Difference Between Means*	*Bonferroni 95% CI*
(None, Plain)	-1.67	(-3.24, -0.11)*
(None, Flavored)	-1.18	(-2.67, 0.31)
(None, Combination)	-1.37	(-2.86, 0.13)
(Plain, Flavored)	0.49	(-0.37, 1.36)
(Plain, Combination)	0.31	(-0.57, 1.18)
(Combination, Flavored)	0.19	(-0.54, 0.91)

n=breakfast meals
**p<.05*
None (n=13); Plain (n=75); Flavored (n=136); Combination (n=362)
Total=586 meals

Table 10: Vitamin D (IU)—Bonferroni Methods for Multiple Pairwise Comparisons of Mean Intake for Four Types of Milk Served

Groups	*Difference Between Means*	*Bonferroni 95% CI*
(None, Plain)	-97.4	(-153.92, -40.89)*
(None, Flavored)	-80.55	(-134.19, -26.91)*
(None, Combination)	-92.29	(-146.08, -38.49)*
(Plain, Flavored)	16.85	(-14.37, 48.08)
(Plain, Combination)	5.12	(-26.37, 36.60)
(Combination, Flavored)	11.74	(-14.25, 37.72)

n=breakfast meals
**p<.05*
None (n=13); Plain (n=75); Flavored (n=136); Combination (n=362)
Total=586 meals

Discussion

This study examines the estimated impact of universal-free BIC on milk consumption and subsequent shortfall nutrient intake by third through fifth graders in select schools in a large, Texas independent school district. Our results suggest that BIC schools had higher breakfast participation rates than Non-BIC schools. While accessibility of a school breakfast program (determined at the district or school level) is crucial, various methods for promoting and increasing actual participation in breakfast should be considered (Bartfeld and Kim 2010). While addressing efficacy of BIC in relation to breakfast participation is beyond the scope of this study, it is presumed that three distinct features increase breakfast convenience and therefore participation: 1) offered free to all students; and 2) offered to students after the bell rings; and 3) offered in the classroom. Multiple studies have confirmed that the structure and logistics of school breakfast, such as in-class breakfast, is important in promoting and sustaining participation (Bartfeld and Kim 2010).

Increasing participation in school breakfast increases access to and consumption of nutritious components of breakfast such as milk. This study suggests that BIC students were more likely to drink milk than Non-BIC students over 24 hours. Specifically, BIC students were more likely to drink flavored-milk and a combination of flavored and plain milk over 24 hours. Classroom and home were the most prevalent breakfast locations where milk was consumed. Overall, a very small number of students did not consume milk, and flavored milk at breakfast was more likely to be consumed in the classroom. Notably, breakfasts without milk were more likely to be consumed in the cafeteria, and breakfasts with plain and combination milk were more likely to be consumed at home. Consumption of combination milk implies students drank both plain and flavored milk at breakfast indicating that students who eat breakfast at home may drink more milk. We hypothesize that the home and classroom are spaces where there is sufficient time to consume breakfast, including milk, unlike the environment of the cafeteria. This further illustrates the importance of breakfast program structure in schools and the need to promote breakfast participation through convenient delivery models, such as in-class breakfast.

This study suggests that students that drank milk at some point over 24 hours had higher intake of four nutrients and flavored milk drinkers had significantly higher intake of vitamin D. Moreover, students who drank milk at breakfast consumed more vitamins B-12 and D than those who did not. This finding is supported by other research that suggests that milk drinkers are more likely to consume the recommended amount of key nutrients (Ballew, Kuester, and Gillespie 2000; Bowman 2002; Johnson, Panely, and Wang 1998). Further, Niklas, O'Neil, and Fulgoni (2013) demonstrate that "the percent contribution of flavored and white milk to total intake of the shortfall nutrients and nutrients of concern was consistently higher among the 2 to 8 year olds." (731). In other words, milk drinkers are consuming essential milk nutrients that milk non-drinkers may be missing out on, and flavored milk is a preferred choice among students that eat breakfast in the classroom.

Limitations

Some limitations should be considered. The generalizability of findings is limited because the sample was not randomized due to the nature of the program accessibility. However, the schools were matched closely demographically by race and socio-economic status. There are some inherent limitations to utilizing the 24-hour dietary recall with children. First, the reported food items served and consumed by the student may or may not represent typical meal patterns when put in context of a typical week or month. Second, underreporting is also a potential caveat as it is more prevalent among heavier children (Fisher et al. 2000). Nonetheless, up to three days of recall data were used which could promote more accuracy than a one-day recall alone. Because of the limited scope of data that could be retrieved directly from the school district, several variables regarding household characteristics could not be considered in the analysis. Limitations aside, DFIA is an accurate nutrient and recipe analysis system (Echon 2014). Using innovative analytical techniques, DFIA improved the accuracy of nutrition information greatly (from 15–70% to 94–99%) as compared with questionnaire-based techniques alone (i.e. food frequency questionnaires and 24-hour dietary recalls) (Echon 2013).

Conclusion

School breakfast is an important factor in ensuring that all children have the energy they need to begin the school day, and milk is one nutritious component of school breakfast that lends important nutrients to children's diets. However, participation in school breakfast is less than participation in school lunch, and too many children are not meeting the recommended amount of dairy and nutrients per day. This study among others suggests that BIC is an innovative way to increase participation in school breakfast and therefore increase intake of essential milk nutrients.

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Food Studies: An Interdisciplinary Journal explores new possibilities for sustainable food production and human nutrition. It provides an interdisciplinary forum for the discussion of agricultural, environmental, nutritional, health, social, economic and cultural perspectives on food. Articles range from broad theoretical and global policy explorations, to detailed studies of specific human-physiological, nutritional and social dynamics of food. The journal examines the dimensions of a "new green revolution" that will meet our human needs in a more effective, equitable and sustainable way in the twenty-first century.

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