The Quality of Lunches Brought from Home to School: A Systematic Review and Meta-Analysis

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Selected Poster prepared for presentation at the 2022 Agricultural & Applied Economics Association Annual Meeting, Anaheim, CA; July 31-August 2

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Background

- The National School Lunch Program (NSLP) serves nutritionally balanced low-cost or free meals to approximately 30 million children each school day.
- About 40% of school-age children bring lunches from home to school.
- While school lunches are required to meet the new meal standards that were implemented in 2012, lunches brought from home are not subject to these standards and not monitored as school lunches are.
- Existing studies that examine the food content and nutritional quality of lunches brought from home to school used primary data collected from specific regions, school districts, schools, and/or grade(s) and are not national representative.

Objectives

To summarize the best available quantitative evidence on lunches brought from home to school by:

- Comparing these lunches to lunches served at school in terms of food content, nutritional quality, and costs
- Identifying factors associated with food choices
- Examining intervention programs aimed at improving the nutritional quality of lunches brought from home.

Methods

Stage 1 - Protocol & Eligibility Criteria:

- Studies examining lunches brought from home to school by K-12th grade children in the US
- Comparing food and nutrients content of lunches brought from home to school to lunches served at school
- Published between 1995 to 2021 in English

Stage 2 - Searches. Searched 6 electronic databases and conducted manual searches framed by PICOS

Stage 3 - Study Selection. Conducted titles, abstract, full-text screenings and Risk of Bias assessments of selected studies which were done by at least two independent researchers

Stage 4 - Data Extraction, Effect Size (ES) Calculation and Meta-Analysis. Cohen's d was selected as the Effect Size. Random effects univariate meta-analysis was done on:

- Prevalence of food groups in lunches brought from home
- Mean content of nutrients in lunches brought from home
- Standard mean difference of nutrients between school lunches and lunches brought from home
- Standard mean difference between intervention and control groups

following Lipsey and Wilson (2001) and Borenstein et al. (2009) in STATA 16

Stage 5 - Synthesis Results. The narrative synthesis approach for systematic reviews was used for the assessment of the robustness of the synthesis following Popay et al. (2006) guidelines and the USDA NEL Conclusion Statement Evaluation Criteria (USDA 2017).

Results

Figure 1. PRISMA Flow Diagram

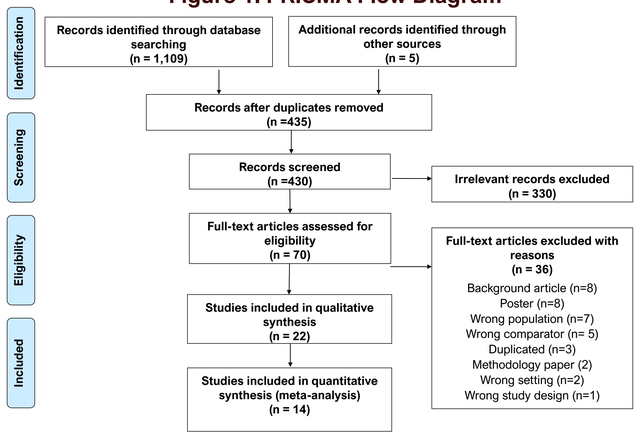
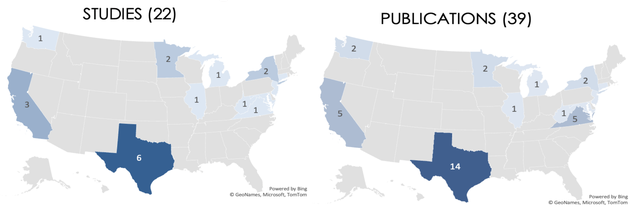


Figure 2. Included Studies



A total of 22 studies that consist of 39 publications were included in qualitative synthesis.

Figure 3. Risk of Bias Assessment of Included Publications

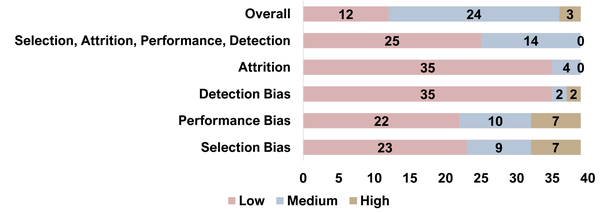
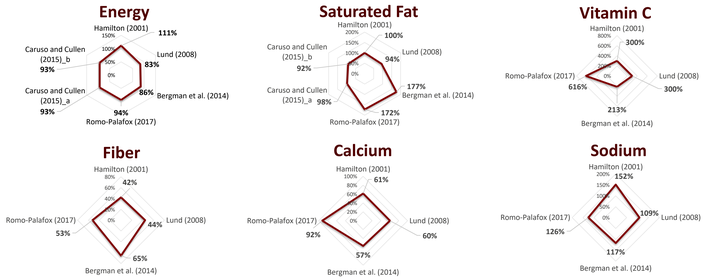


Table 1. Food Content of Lunches Brought from Home, % of meals

Food Items	Hubbard et al. (2014)	Conway et al. (2002)	Farris et al. (2014, 2015)	Johnson et al. (2009)	Johnston et al. (2012)	Evans (2007)	Taylor et al. (2019)	Shukaitis et al. (2021)	Mean (%) Overall (%)
Sandwiches	59.0	70.8				90.0			73.3
Deli Meat Sandwiches		52.5		36.0					44.3
Snacks	42.0	41.6	57.0	42.9		50.0			46.3
Fruit	34.0	46.6	54.0		45.0	64.0	86.0	19.3	49.9
Vegetables	11.0	5.5	17.0		13.0	11.0	35.0	35.1	17.8
Fruit and Vegetables				39.4					39.4
Dairy Food Items	17.0	25.7		16.7	42.0			25.0	25.3
Milk	14.0		20.0	3.2					12.4
Sugar-Sweetened Bev.	24.0		40.0	7.3					23.8
Juices	7.0		10.0	51.7	47.0	38.0			30.5
Water	28.0		16.4						22.2
Desserts and Sweets	28.0		61.0	24.6	60.0				43.4

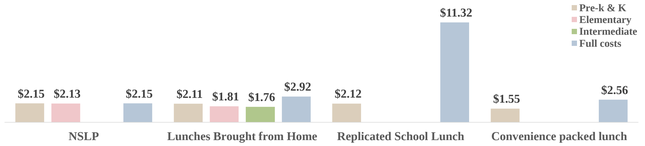
Overall estimation was obtained from random effects univariate meta-analysis

Figure 4. Nutrients Consumed from Home Lunches Compared with Standards



Caruso and Cullen (2015a): elementary school children, Caruso and Cullen (2015b): intermediate school children

Figure 5. Cost of School Lunches and Lunches Brought from Home



Meta-Analysis Results

Table 2. Nutrient Content of Lunches Brought from Home

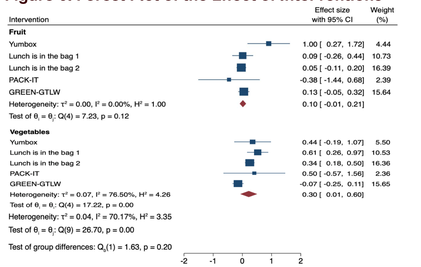
Nutrient	Number of Studies	Overall	95% CI	Prediction interval
Energy (kcal)	11	624.72	[592.0, 657.5]	[507.4, 748.1]
Total Fat (%)	8	25.27	[20.2, 30.3]	[6.5, 44.0]
Saturated Fat (%)	10	8.64	[7.4; 9.9]	[3.9, 13.4]
Carbohydrates (%)	6	79.96	[69.3, 90.6]	[41.0, 118.8]
Protein (g)	8	19.13	[16.1, 22.2]	[8.1, 30.2]
Iron (mg)	7	3.10	[2.6, 3.6]	[1.5, 4.7]
Calcium (mg)	8	238.01	[192.4, 283.7]	[78.6, 397.4]
Fiber (g)	7	4.99	[4.1, 5.9]	[1.6, 8.4]
Vitamin A (mcg)	8	235.97	[142.8, 329.2]	[-76.1, 548.0]
Vitamin C (mg)	7	32.09	[23.8, 40.4]	[3.3, 60.9]
Sodium (mg)	10	977.24	[901.2, 1053.3]	[709.2, 1245.2]

Table 3. Standard Mean Difference of Nutrients between School Lunches and Lunches Brought from Home, Cohen's d

Nutrient	Number of Studies	Overall	95% CI	Prediction interval
Energy (kcal)	5	-0.20	**[-0.30, -0.09]**	[-0.37, -0.03]
Total Fat (%)	6	-0.52	[-1.6, 0.57]	[-5.13, 4.09]
Saturated Fat (%)	6	-0.65	[-1.67, 0.36]	[-3.56, 2.25]
Carbohydrates (%)	5	-0.37	**[-0.58, -0.16]**	[-1.03, 0.30]
Protein (g)	5	0.78	**[0.32, 1.23]**	[-0.93, 2.48]
Iron (mg)	5	0.34	[-0.17, 0.85]	[-1.61, 2.29]
Calcium (mg)	5	0.85	**[0.12, 1.59]**	[-1.99, 3.70]
Fiber (g)	5	0.15	[-0.25, 0.55]	[-1.33, 1.64]
Vitamin A (mcg)	5	0.45	**[0.18, 0.72]**	[-0.50, 1.40]
Vitamin C (mg)	5	-0.18	[-0.60, 0.24]	[-1.74, 1.39]
Sodium (mg)	5	0.39	**[0.22, 0.56]**	[-0.11, 0.89]

Bolded CI values reflect significant a difference between School Lunches and Lunches Brought from Home

Figure 6. Forest Plot of the Effect of Interventions



Discussion and Conclusions

- Overall, lunches brought from home were less nutritious than lunches served at school and do not meet the school meal standards. There exists a limited number of studies on the consumption and waste from lunches brought from home to school.
- Lunches brought from home to school are significantly high in calories and carbohydrates and contain significantly less Vitamin A, protein and calcium compared to lunches served at school.
- Intervention programs have the potential of improving the food and nutritional quality of lunches brought from home, especially for vegetables. However, due to a few number of existing studies, high risk of bias of included studies, and gaps in the literature for both the geographic regions the studies were conducted and type of schools, the evidence is still suggestive and requires further research.
- More research is needed to understand parents and children's preferences for lunches brought from home to school.
- Further research is needed with more standardized data collection and reporting methods to fill regional and thematic gaps in the existing knowledge and help develop effective strategies and interventions that can provide parents with simpler and cost-effective ideas and promote children's enrollment in school meal programs.

Acknowledgements

This research was funded by Alliance for Potato Research and Education