


# The Child and Adult Care Food Program and young children's health: a systematic review

Erica L. Kenney ,\* Kyla Tucker,\* Rachel S. Plummer, Carol Mita, and Tatiana Andreyeva

**Context:** The Child and Adult Care Food Program (CACFP) is a federal nutrition program that supports young children's nutrition. Its potential impacts on child well-being have not been summarized. **Objective:** The objective of this review was to summarize the evidence for the impact of CACFP on children's diet quality, weight status, food insecurity, and cognitive development. **Data Sources:** Databases searched included MEDLINE, CAB Abstracts, Web of Science Core Collection, ERIC, PsycInfo, Dissertations & Theses Global (Proquest), EconLit, NBER, and the USDA's Economic Research Service (ERS), from database inception to November 12, 2021. Studies were included if the sample drew from child care programs serving children between the ages of 2 years and 18 years and if a comparison group of nonparticipating programs was included. **Data Extraction:** Two reviewers independently extracted data on study design, year(s) of data collection, region, sample size, participant demographics, outcomes, and risk of bias. **Data Analysis:** Due to the heterogeneity of the studies, a narrative synthesis was used. **Results:** Nineteen articles were reviewed, most of which had been published since 2012. Seventeen used cross-sectional designs. Twelve evaluated foods and beverages served; 4 evaluated dietary intake; 4 evaluated the child care nutrition environment; 2 evaluated food insecurity, 1 evaluated weight status; none evaluated cognitive outcomes. Studies typically found either a small beneficial association with CACFP or no significant association. **Conclusion:** Currently, evidence for an association between CACFP and children's health is inconclusive, though it is slightly suggestive of a benefit for some dietary quality outcomes. More research, with stronger study designs, is needed. **Systematic Review Registration:** A protocol for this systematic review was registered with the PROSPERO systematic review protocol registry (PROSPERO 2021 CRD42021254423).

Affiliation: E.L. Kenney and R.S. Plummer are with the Department of Nutrition, Harvard T.H. Chan School of Public Health, Boston, Massachusetts, USA. E.L. Kenney and K. Tucker are with the Department of Social and Behavioral Sciences, Harvard T.H. Chan School of Public Health, Boston, Massachusetts, USA. C. Mita is with the Countway Library, Harvard Medical School, Boston, Massachusetts, USA. T. Andreyeva is with the Department of Agricultural and Resource Economics, University of Connecticut, Storrs, Connecticut, USA. T. Andreyeva is with the Rudd Center for Food Policy and Health, University of Connecticut, Hartford, Connecticut, USA.

Present address: K. Tucker is now with the Office of Student Wellbeing, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA. R.S. Plummer is now with the Cambridge Economic Opportunity Committee, Cambridge, Massachusetts, USA.

\*These authors contributed equally to this review.

Correspondence: E.L. Kenney, Department of Nutrition, Harvard T.H. Chan School of Public Health, 665 Huntington Ave, Boston, MA 02115, USA. E-mail: ekenney@hsph.harvard.edu.

**Key words:** CACFP, child care, diet quality, food insecurity, preschool child, nutrition policy.

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## INTRODUCTION

Early childhood is an important period for the development of eating habits and healthy growth trajectories.<sup>1</sup> Because diet-related chronic diseases are major contributors to morbidity and early mortality,<sup>2</sup> identifying strategies for prevention, as well as critical periods for prevention in the life course, is essential. Intervening in early childhood, when eating habits are developing,<sup>3</sup> may be an especially effective preventive strategy.

Child care is an important space for early childhood interventions. This is both because child care programs reach a majority of young children in the U.S.—around two thirds of children under 5 years of age attend a child care center, pre-school, or other type care outside the home<sup>4</sup>—and because these programs often serve meals and snacks to children during the day. Crucially, these programs can also be influenced by a range of state and federal policies that can ensure health-promoting standards are followed.<sup>5</sup> The Child and Adult Care Food Program (CACFP) is one such powerful policy mechanism to influence food choices available in participating child care settings.

CACFP is a federal food assistance program overseen by the United States Department of Agriculture (USDA), which provides reimbursements to child care providers—including those who provide out-of-school care for school-aged children—for meals and snacks served.<sup>6</sup> Breakfast, lunch, supper, and snacks are eligible for reimbursement and must adhere to specific nutrition standards to meet the dietary needs of young children. The nutrition standards for CACFP, which were updated in 2017, are based on the Dietary Guidelines for Americans.<sup>7,8</sup> The size of the reimbursements varies by recipient income, such that meals served to children in lower-income households are reimbursed to child care providers in larger amounts than meals served to children in higher-income households. Before the COVID-19 pandemic's disruptions to child care programs, about 4.7 million children received meals and snacks through CACFP.<sup>9</sup>

There is substantial evidence that other food assistance programs with nutritional standards, including the National School Lunch Program, the School Breakfast Program, and the Special Supplemental Nutrition Program for Women, Infants, and Children, can positively impact children's well-being across a range of outcomes, including healthier diet quality,<sup>10–13</sup> reduced obesity risk,<sup>14–17</sup> and reduced food insecurity.<sup>18,19</sup> It is less clear, however, whether CACFP participation has a similarly beneficial impact. Research on CACFP's impacts has been limited and often conducted using small, localized samples, making it difficult to

draw overall conclusions about the program's effectiveness.

The purpose of this systematic review was to synthesize the existing research on CACFP to better understand its potential impact on diet quality, food insecurity, healthy weight, and academic outcomes in young children. By focusing exclusively on studies that contrast CACFP-participating programs with those that do not participate, this study seeks to consolidate the body of evidence from multiple small studies on the potential implications of this program for children's diet quality, food security, health, and well-being.

## METHODS

### Literature search

This systematic review adhered to the PRISMA reporting guidelines<sup>20</sup> and included peer-reviewed and gray literature published from database inception through November 12, 2021. The study team searched for studies that discuss the impact of CACFP on the quality of child care meals and snacks and on children's dietary intake, weight status, food insecurity, and academic outcomes using the following databases: MEDLINE/PubMed (National Library of Medicine, National Center for Biotechnology Information), CAB Abstracts (C.A.B. International, Web of Science, Clarivate), Web of Science Core Collection (Clarivate), ERIC (Education Resources Information Center, EBSCO), PsycInfo (American Psychological Association/EBSCO), Dissertations and Theses Global (ProQuest), EconLit (ProQuest), NBER (National Bureau of Economic Research), and the USDA's Economic Research Service (ERS). Controlled vocabulary terms were not used due to the specific focus on a single program. See [Figure S1](#) in the Supporting Information online for the exact search terms used in each of the databases, and the corresponding result numbers. The search strategies were designed and executed by a librarian (C.M.). No publication date or language limits were applied for the search, which was completed as of November 12, 2021. All included studies were scanned by the authors for additional titles cited in the article's sources. The article screening process was managed using Covidence, systematic review management software.<sup>21</sup>

### Eligibility criteria

Included studies met the following criteria: (i) sample included only children greater than or equal to 2 years old and less than 18 years old and in the United States

**Table 1 PICO criteria for inclusion of studies**

Parameter	Criterion
Population	Children aged 2 years–18 years in the United States (individual level); child care programs in the United States (program level)
Intervention/ exposure	Attendance in a child care program participating in the Child and Adult Care Food Program(CACFP) (individual level); participation in the CACFP (program level)
Comparison	Children not attending a child care program participating in CACFP (individual level); child care programs not participating in CACFP (program level)
Outcomes	Diet quality, food security status, body-mass index, or cognitive development (individual level); nutritional quality of meals served (program level)

or, if focused on child care program-level food quality outcomes, included only programs serving these age groups; (ii) the exposed group attended a child care program of any type that participates in CACFP (or, for studies focused on program-level outcomes, the exposed programs participated in CACFP); and (iii) the comparator group did not attend a child care program that participates in CACFP, ie, they attended a child care program that does not participate in CACFP, or do not attend child care outside the home at all (Table 1) (or, for studies focused on program-level outcomes, there was a comparator group of nonparticipating programs). Studies were excluded if (i) the study population was older than 18 years of age; (ii) the study evaluated other food assistance programs or nutrition programs for children, unless they assessed participation in multiple programs, including CACFP; or (iii) the study did not have a comparator group attending child care programs who did not participate in CACFP. Following the removal of duplicates, 2 authors (K.T. and R.P.) independently screened all titles, abstracts, and full-texts. Five disagreements about study exclusions at the abstract screen stage and 5 at the full-text stage were resolved by a third author (E.L.K.).

After study selection, data were extracted independently by 2 authors (K.T. and R.P.), with any disagreements resolved by a third individual (E.L.K.). Data were extracted on the study design, year(s) of data collection, geographic region, sample size, participant demographics (including age, race/ethnicity, and family income), losses to follow-up and other exclusions if applicable, length of exposure to CACFP, outcomes and timing of measurement, and other information to assess for risk of bias.

Additionally, each study was assessed for risk of bias using the National Institutes of Health (NIH) quality assessment tool for observational cohort and cross-sectional studies.<sup>22</sup> Two authors (K.T. and R.P.)

completed the quality assessment tool independently for each study, ranking them as having high, moderate, or low risk of bias. Any disagreements about the risk-of-bias assessment were resolved by a third researcher (E.L.K.). Considerations when assessing the risk of bias included the research question or objective, study populations, participation rate, inclusion and exclusion criteria, sample size justification and power description, exposure and outcome measures, and confounding variables measured.

### Data synthesis

No studies used generalized metrics to describe food served or food consumed, such as the Healthy Eating Index. Thus, data on food served and consumed was summarized by food group and total energy. Data on all other outcomes were also summarized qualitatively. Due to the heterogeneity of the study designs and outcome definitions, a meta-analysis was not possible. Therefore, studies were summarized according to state or geographic region, study design, sample size, risk of bias, and data collection method, as well as the different outcomes assessed, in tabular form.

## RESULTS

The initial search identified 406 citations across 8 databases, of which 205 were removed as duplicates, leaving 201 titles and abstracts screened (Figure 1). Fifty articles were selected for the full-text review after the title and abstract screening process identified 151 irrelevant articles; 19 of these met all inclusion criteria and were included in the narrative synthesis.

### Study characteristics

Almost all studies in the review (17 out of 19) utilized a cross-sectional design either comparing children exposed to CACFP with children unexposed to CACFP, or presenting information on foods served from centers participating in CACFP compared with nonparticipating centers (Table 2).<sup>23–39</sup> Only 1 study used a longitudinal design,<sup>40</sup> and 1 study utilized a pre-experimental design.<sup>41</sup> Two of the 19 studies were dissertations and not peer reviewed at the time of manuscript preparation.<sup>38,41</sup> Most studies (17) were published between 2012 and 2021,<sup>23–25,27–34,36–38,41</sup> while 2 studies were published in the late 1990s.<sup>26,35</sup> Four of the 19 studies were conducted at a national level, 2 studies were conducted across multiple states in the Midwest,<sup>34,39</sup> 2 studies were conducted across multiple states in the southeast,<sup>29,41</sup> 3 studies were conducted in Connecticut,<sup>23–25</sup> 2 studies were conducted in Mississippi,<sup>28,35</sup> 2 studies were

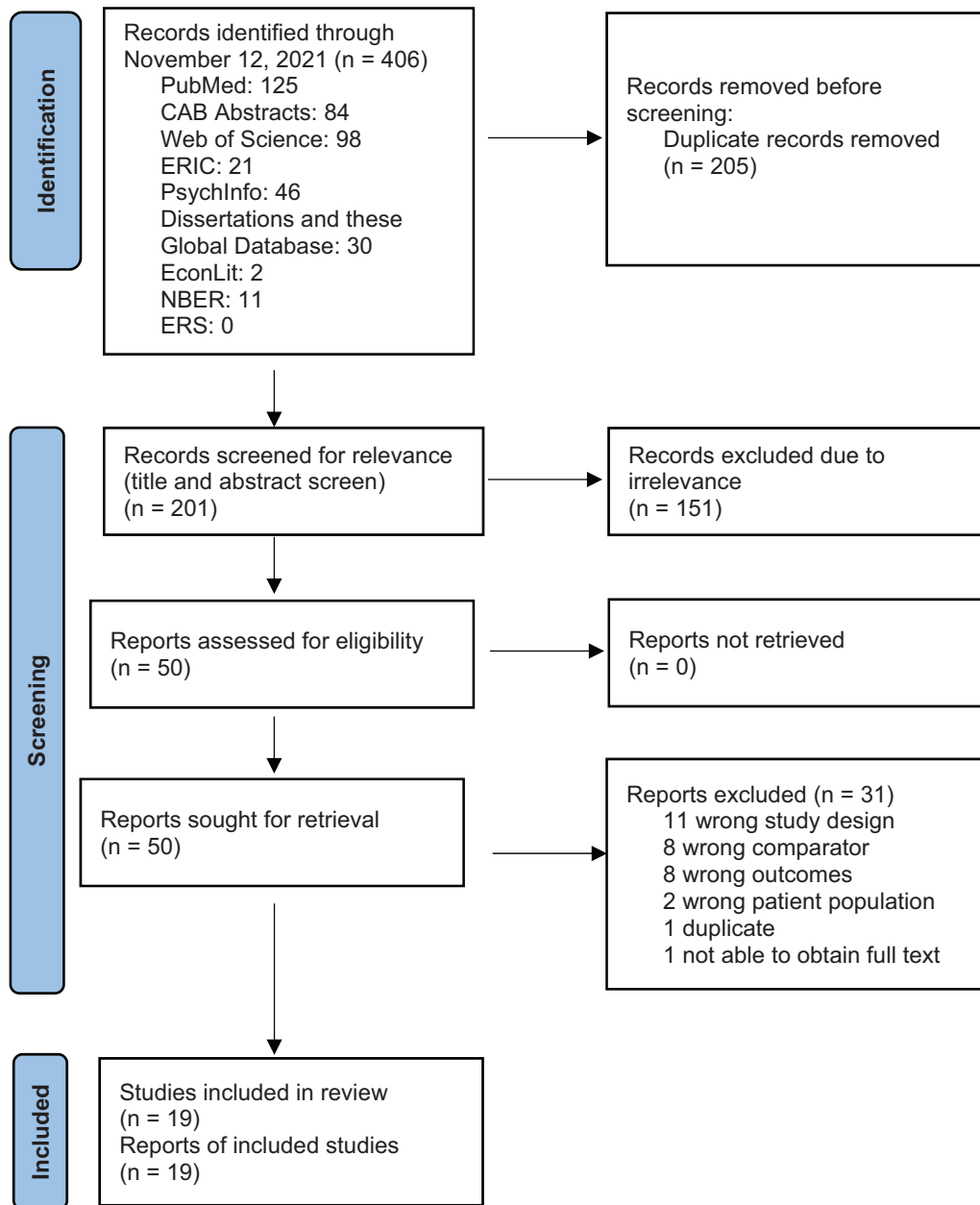


Figure 1 Flow diagram of the literature search process.

conducted in California,<sup>31,37</sup> and 1 study was conducted in each of the following states: Georgia,<sup>27</sup> Minnesota,<sup>40</sup> Nebraska,<sup>36</sup> New York,<sup>26</sup> and South Carolina.<sup>38</sup>

One study examined body mass index (BMI) as an outcome;<sup>33</sup> 2 studies examined household food insecurity<sup>32,33</sup>; 3 studies examined measures of the overall nutrition environment,<sup>29,39,40</sup> and no studies evaluated cognitive or academic outcomes. Eleven studies compared foods and beverages served to children in CACFP-participating versus nonparticipating child care programs without evaluating children's

consumption,<sup>23,25,27,28,31,34,35,37–39,41</sup> 2 studies compared foods and beverages actually consumed by children,<sup>26,30</sup> 1 study compared both foods served and consumed,<sup>24</sup> 1 study compared foods consumed and other child-level metrics,<sup>33</sup> and 1 study only measured child-level food insecurity.<sup>32</sup> For 10 of the studies, measurement of these outcomes was conducted using self-reported survey or interview data from child care program directors.<sup>23,27–29,31,34,36,37,39,40</sup> Of the remaining studies, 2 collected outcome data using self-report methods in addition to copies of menus collected directly from programs,<sup>35,38</sup>

**Table 2 Characteristics of studies included in the systematic review of association between the Child and Adult Care Food Program and child health (n = 19)**

Reference	State/ Geographic Region	Outcomes evaluated	Study design	Number of CACFP child care programs	Number of non- CACFP child care programs	Number of children, CACFP exposed	Number of children, non-CACFP exposed	Risk of bias	Data collection method
Andreyeva et al, 2018 <sup>24</sup>	Connecticut	Food served and consumed	Cross-sectional	53	44	468	370	Medium	Researcher obser- vation of food consumption
Andreyeva and Henderson, 2018 <sup>23</sup>	Connecticut	Food served	Cross-sectional	87	256	N/A	N/A	High	Self-report by provider
Andreyeva et al, 2021 <sup>25</sup>	Connecticut	Food served	Cross-sectional	114	86	N/A	N/a	Medium	Analyzed from menu submitted
Bruening et al, 1999 <sup>26</sup>	New York	Food consumed	Cross-sectional	1	1	20	20	High	Researcher obser- vation of food consumption
Cotwright et al, 2019 <sup>27</sup>	Georgia	Food served	Cross-sectional	653	321	N/A	N/A	High	Self-report by provider
Erinosho et al, 2018 <sup>28</sup>	Mississippi	Food served	Cross-sectional	56	77	N/A	N/A	High	Self-report by provider
Erinosho et al, 2018 <sup>29</sup>	Georgia, Kentucky, Mississippi	Food served	Cross-sectional	261	86	N/A	N/A	High	Self-report by provider
Glenn et al, 2021 <sup>30</sup>	National	Food consumed	Cross-sectional	217	N/A	1468	N/A	Medium	Food diaries sub- mitted by parents
Gurzo et al, 2020 <sup>31</sup>	National	Food served	Cross-sectional	479	201	N/A	N/A	High	Self-report by provider
Heflin et al, 2015 <sup>32</sup>	National	Other child level metrics	Cross-sectional	872	878	N/A	N/A	Medium	Self-report by parents on core food security model
Korenman et al, 2012 <sup>33</sup>	National	Food consumed and other child level metrics	Cross-sectional	N/A	N/A	1850	2200	Medium	Self-report by provider
Liu et al, 2016 <sup>34</sup>	Midwest	Food served	Cross-sectional	127	58	N/A	N/A	High	Self-report by provider
Loth et al, 2019 <sup>39</sup>	Minnesota and Wisconsin	Food served	Cross-sectional	468	135	N/A	N/A	High	Self-report by provider
Nanney et al, 2018 <sup>40</sup>	Minnesota	Nutrition score/ best practices	Longitudinal cohort study	131 (56 centers, 75 family homes)	84 (72 centers, 12 family homes)	N/A	N/A	High	Self-report by provider

(continued)

Table 2 Continued

Reference	State/ Geographic Region	Outcomes evaluated	Study design	Number of CACFP child care programs	Number of non- CACFP child care programs	Number of children, CACFP exposed	Number of children, non-CACFP exposed	Risk of bias	Data collection method
Oakley et al, 1995 <sup>35</sup>	Mississippi	Food served	Cross-sectional	69	23	N/A	N/A	High	Reported by provider mean energy and nutrient content of menus according to participation in CACFP
Ritchie et al, 2012 <sup>37</sup>	California	Food served	Cross-sectional	CACFP centers n=104; CACFP homes n=65	Non-CACFP centers n=88; non-CACFP homes n=38	N/A	N/A	High	Self-report by provider
Tilley et al, 2017 <sup>38</sup>	South Carolina	Food served	Cross-sectional (dissertation)	31	29 (eligible/non-enrolled=16; non-eligible=13)	N/A	N/A	High	Self-report and menu submission snack nutrient content averaged
Williams et al, 2021 <sup>36</sup>	Nebraska	Food served	Cross-sectional	Center-based=198; family child care home=970	Center-based=94; family child care home=83	N/A	N/A	High	Self-report by provider
Williams, 2016 <sup>41</sup>	Southeast	Food served	Pre-experimental study; dissertation	15	15	N/A	N/A	High	Calculated from menus

2 collected data solely via menu analysis,<sup>25,41</sup> 2 utilized direct observation of children's dietary intake to collect data,<sup>24,26</sup> and 3 studies collected data on child consumption or characteristics from parental reports.<sup>30,32,33</sup>

Fourteen studies were identified as having a high risk of bias,<sup>23,26–29,31,34–41</sup> while 5 were identified as having a moderate risk of bias<sup>24,25,30,32,33</sup>; no studies were assessed as having a low risk of bias. Most studies were considered as having a high risk of bias for several reasons, including a cross-sectional design, small sample size, lack of sample size justification, and/or not adjusting for confounding factors.

## Synthesis of results

*Fruits and vegetables.* Fruits and vegetables must be served in CACFP-provided meals, with both required at lunch and either fruits or vegetables at breakfast.<sup>8</sup> For foods served, 7 studies evaluated amounts or frequencies of serving fruits and vegetables separately,<sup>23,24,28,31,34,36,37</sup> and 3 studies evaluated amounts or frequencies of serving fruits and vegetables combined (Table 3; for full details on study findings, see Table S1 in the Supporting Information online).<sup>25,38,39</sup> Of the 7 studies evaluating the serving of fruit by itself, only 2 found that CACFP programs were significantly more likely to serve fruit.<sup>23,36</sup> Similarly, 2 out of the 7 studies found that CACFP programs were significantly more likely to serve vegetables.<sup>36,37</sup> Of the 3 studies evaluating fruits and vegetables combined, 2 found that CACFP programs were more likely to serve fruits and vegetables combined at certain meals,<sup>25,39</sup> while the remaining study found no significant difference.<sup>38</sup>

For foods consumed, 3 studies evaluated consumption of fruits,<sup>26,30,33</sup> the same 3 studies evaluated consumption of vegetables, and 1 study evaluated consumption of fruits and vegetables combined.<sup>24</sup> No studies found a significant difference between fruit consumption or fruit and vegetable consumption combined for CACFP meals versus non-CACFP meals. Two studies found higher vegetable consumption when children consumed CACFP meals.<sup>26,33</sup>

*Whole grains.* As of 2017, CACFP programs were required to serve at least 1 whole grain each day.<sup>8</sup> Ten studies evaluated the frequency of CACFP-participating programs serving whole grains,<sup>23–25,28,31,34,36–39</sup> 7 of which were published after 2017. One study evaluated consumption of whole grains.<sup>30</sup> Of the 10 studies evaluating whole grains served, 2 found CACFP programs were significantly more likely to serve whole grains at least once a day,<sup>25,34</sup> 1 found CACFP programs were significantly more likely to serve whole grains at snack than

non-CACFP programs, but no difference at lunch<sup>23</sup>; and 2 found that CACFP-participating centers were more likely to serve whole grains than non-CACFP centers, but no difference for family child care homes.<sup>36,39</sup> The remaining 5 studies found no significant differences in whole grains servings. The 1 study that evaluated whole grain consumption found that children consumed significantly more whole grains when attending a CACFP-participating child care than when at home (25.5 g on days when children received CACFP meals vs 19.8 g when children ate at home [ $P < .05$ ]).<sup>30</sup>

*Meat and meat alternates.* Meat/meat alternates—ie, foods likely to be high in protein—are required to be served at lunch for CACFP-participating programs.<sup>8</sup> While limiting processed or fried meats is encouraged by CACFP, it is not required.<sup>7</sup> Three studies evaluated the serving of meat/meat alternates overall,<sup>23,24,28</sup> and 3 evaluated consumption.<sup>24,26,30</sup> Additionally, 6 studies specifically evaluated serving of lean meats or vegetarian protein sources (including meat substitutes as well as eggs, nuts, and legumes),<sup>24,25,31,36,37,39</sup> and 5 evaluated the serving of red, processed, breaded, or fried meats.<sup>24,25,28,36,39</sup> None of the 3 studies that examined the frequency of serving meat/meat alternates overall found differences between CACFP and non-CACFP programs. Of the 3 that evaluated consumption, 2 found no difference,<sup>24,26</sup> while 1 found that children consumed less meat/meat alternates while attending child care that participated in CACFP compared with outside of child care settings.<sup>30</sup> Of the 6 studies evaluating the serving frequency of lean meats or vegetarian protein sources specifically, 2 found that CACFP-participating centers, but not family child care homes, were more likely to serve these foods than nonparticipating centers.<sup>36,37</sup> None of the 5 studies evaluating red, processed, and/or fried meats specifically found a difference between CACFP and non-CACFP programs.

*Beverages.* For milk, which CACFP requires to be served at breakfasts and lunches,<sup>8</sup> 5 studies evaluated whether any kind of milk was served more often in CACFP programs<sup>23,24,31,37,38</sup>; 7 studies specifically evaluated whether 1% or nonfat milk (a CACFP requirement for children 2 years–5 years of age) was served more often in CACFP programs<sup>24,25,27,28,34,36,39</sup>; and 2 studies evaluated consumption of milk.<sup>24,33</sup> Of the 5 that examined overall milk served, 3 found that CACFP programs were significantly more likely to serve milk than non-CACFP programs,<sup>24,31,37</sup> while 2 found no difference.<sup>23,38</sup> Of the 7 studies evaluating serving of low- or nonfat milk, 6 found that CACFP programs were more likely to serve this type of milk than non-CACFP programs,<sup>24,25,27,28,36,39</sup> while one found no difference.<sup>34</sup> Of

**Table 3 Summary of findings for associations between CACFP exposure and nutritional quality, weight status, food insecurity, and/or academic outcomes in systematic review of existing evidence (n=19 studies)**

Outcome	Number of studies	Association with CACFP participation: direction and statistical significance
<b>Fruits and vegetables</b>		
Served	10 <sup>23–25,28,31,34,36,37–39</sup>	2 studies found CACFP programs served significantly more fruit <sup>23,36</sup> ; 5 found no significant difference <sup>24,26,29,35,38</sup> 2 studies found CACFP programs served significantly more vegetables <sup>36,37</sup> ; 5 found no significant difference <sup>23,24,26,35,38</sup> 2 studies found CACFP programs were more likely to serve fruits and vegetables combined than non-CACFP programs <sup>25,39</sup> ; 1 found no difference <sup>38</sup>
Consumed	4 <sup>24,26,30,33</sup>	3 studies found no difference in fruit consumption <sup>26,30,33</sup> 1 study found no difference in fruit and vegetable consumption combined <sup>24</sup> 2 studies found CACFP was significantly associated with higher vegetable consumption <sup>26,33</sup>
<b>Whole grains</b>		
Served	10 <sup>23–25,28,31,34,36–39</sup>	2 studies found CACFP programs were significantly more likely to serve whole grains at least once a day <sup>25,34</sup> 1 study found CACFP programs were significantly more likely to serve whole grains at snack than non-CACFP programs, but no difference at lunch <sup>23</sup> 2 studies found that CACFP-participating centers were more likely to serve whole grains than non-CACFP centers, but no difference for family child care homes <sup>36,39</sup>
Consumed	1 <sup>30</sup>	5 studies found no difference in whole grains serving 1 study found children consume significantly more ounces of whole grains when consuming a CACFP meal than when not consuming a CACFP meal <sup>30</sup>
<b>Meat and meat alternates</b>		
Served	8 <sup>23–25,28,31,36,37,39</sup>	3 studies found no difference in serving of meat/meat alternates overall <sup>23,24,28</sup> 2 studies found CACFP centers, but not family child care homes, served more lean meats or vegetarian protein sources <sup>36,37</sup> ; 4 found no difference <sup>24,31,32,38</sup> 5 studies found no difference in serving of red, processed, fried, and/or breaded meats <sup>24,25,28,36,39</sup>
Consumed	3 <sup>24,26,30</sup>	2 found no difference in consumption <sup>24,26</sup> 1 found lower consumption of meat/meat alternates in CACFP <sup>30</sup>
<b>Milk</b>		
Served	11 <sup>23–25,27,28,31,34,36–39</sup>	3 studies found CACFP more likely to serve milk of any kind; 2 found no difference Six found CACFP more likely to specifically serve skim or low fat milk; 1 found no difference
Consumed	2 <sup>24,33</sup>	1 study found milk consumption higher for CACFP <sup>24</sup> ; 1 study found no difference <sup>33</sup>
<b>100% juice</b>		
Served	7 <sup>23,24,27,31,34,37,38</sup>	1 study found CACFP centers less likely to serve juice, but CACFP family child care homes <i>more</i> likely to serve juice <sup>37</sup> ; 6 studies found no difference <sup>(23,24,26,30,34,38)</sup>
Consumed	0	N/A
<b>Water</b>		
Served	8 <sup>23,24,27,28,31,37–39</sup>	4 studies found CACFP less likely to serve water with meals <sup>23,24,31,37</sup> ; 2 found no difference <sup>28,38</sup> 1 study found CACFP more likely to make water available during day <sup>39</sup> ; 1 found no difference <sup>27</sup>
Consumed	0	N/A
<b>Sugar-sweetened beverages</b>		
Served	10 <sup>23,24,27,28,31,34,36–39</sup>	5 studies found CACFP less likely to serve sugar-sweetened beverages <sup>27,28,31,37,39</sup> ; 1 study found CACFP family child care homes, but not centers, less likely to serve sugar-sweetened beverages; 4 studies found no difference <sup>23,24,26,30</sup>

(continued)



Table 3 Continued

Outcome	Number of studies	Association with CACFP participation: direction and statistical significance
Consumed	1 <sup>33</sup>	1 study found no association between CACFP and sugar-sweetened beverage consumption <sup>33</sup>
<b>Total energy (kcal)</b>		
Served	2 <sup>35,41</sup>	1 study found no significant difference in kcals served <sup>35</sup> ; 1 study found CACFP meals had significantly lower caloric content <sup>41</sup>
Consumed	3 <sup>24,26,30</sup>	2 studies found no difference in kcals consumed between CACFP and non-CACFP settings <sup>24,26</sup> ; 1 study found children specifically consumed fewer “empty calories” when consuming CACFP meals <sup>30</sup>
<b>Nutrition environment quality</b>	4 <sup>25,29,39,40</sup>	4 studies found overall nutrition environment scored better in CACFP compared with non-CACFP settings <sup>25,29,39,40</sup>
<b>Weight status</b>	1 <sup>33</sup>	1 study found CACFP was significantly associated with reduced risk of underweight, but not overweight or obesity <sup>33</sup>
<b>Food insecurity</b>	2 <sup>2,33</sup>	One study found CACFP was associated with a reduction in likelihood of household food insecurity <sup>32</sup> ; one study found no association <sup>33</sup>
<b>Academic or cognitive outcomes</b>	0	N/A

the 2 studies that evaluated milk consumption, 1 found that consumption was higher in CACFP settings compared with non-CACFP settings,<sup>24</sup> while another found that attending a CACFP center was not associated with significantly higher overall consumption of milk.<sup>33</sup>

For 100% juice, which is reimbursable as a fruit serving for CACFP but was recently limited to a small serving size once per day with the 2017 meal pattern update,<sup>8</sup> 7 studies evaluated some type of outcome related to the frequency of serving 100% juice or of having a policy limiting the serving of 100% juice,<sup>23,24,27,31,34,37,38</sup> and no studies evaluated consumption. Of these 7 studies, only 1 found differences between CACFP and non-CACFP programs; Ritchie et al (2012) reported that CACFP-participating centers were less likely to serve juice than their nonparticipating counterparts, while CACFP-participating family child care homes were significantly more likely to serve juice than non-CACFP family child care homes.<sup>37</sup>

For water, which has only recently been encouraged for CACFP-participating programs, 8 studies evaluated an outcome related to either the frequency of serving water or a policy about water.<sup>23,24,27,28,31,37–39</sup>; no studies evaluated water consumption. The outcomes were variously defined, however, with some referring to serving water as a beverage during meals or snacks and some referring to making drinking water available throughout the day. Of the 6 studies evaluating water served as a beverage at meals, 4 found significantly less frequency in serving water at CACFP-participating programs compared with nonparticipating,<sup>23,24,31,37</sup> while the remaining 2 did not find significant differences.<sup>28,38</sup> Of the 2 studies evaluating whether programs made water available throughout the day, 1 found CACFP-

participating programs were more likely to follow this practice,<sup>39</sup> while the other was null.<sup>27</sup>

For sugar-sweetened beverages (SSBs), which are not reimbursable through CACFP but are not strictly prohibited,<sup>8</sup> 10 studies evaluated either the frequency of serving SSBs or whether programs had policies not to serve SSBs,<sup>23,24,27,28,31,34,36–39</sup> and 1 study evaluated differences in SSB consumption between children at CACFP-participating centers versus those unexposed to CACFP.<sup>33</sup> Of the 10 studies evaluating serving SSBs, 5 found that CACFP-participating programs were significantly less likely to serve SSBs,<sup>27,28,31,37,39</sup> and 1 additional study found that CACFP-participating family child care homes, but not centers, were significantly less likely to serve SSBs.<sup>36</sup> The remaining 4 studies found no difference between CACFP and non-CACFP programs. The study evaluating consumption of SSBs also found no difference in likelihood of consumption.<sup>33</sup>

**Total energy.** Three studies assessed some measure of calories consumed,<sup>24,26,30</sup> and 2 studies assessed calorie content of meals served as written in a menu.<sup>35,41</sup> Of the 3 studies assessing energy consumption, 2 examined total kilocalories consumed at child care and found no significant difference in consumption of energy from meals and snacks consumed at child care between CACFP versus non-CACFP centers.<sup>24,26</sup> The third study specifically evaluated “empty calories” and found consumption of empty calories was significantly lower while a child was in CACFP-participating care compared with outside of care.<sup>30</sup> Of the 2 studies assessing caloric content of meals served from menus, 1 found no significant difference,<sup>35</sup> while another found CACFP meals to have significantly lower caloric content than non-CACFP meals.<sup>41</sup>

*Summary measures of nutrition environment.* Four studies evaluated some type of overall summary score of best nutrition practices, environmental attributes or policies and compared CACFP with non-CACFP programs.<sup>25,29,39,40</sup> All 4 of these studies found CACFP-participating programs had significantly higher nutrition practice, environment, and/or policy scores than non-CACFP programs.

*Weight status.* One cross-sectional study examined the relationship between CACFP and weight status in a nationally representative sample of young children.<sup>33</sup> This study found that among low-income children, CACFP participation was significantly associated with reduced odds of underweight (adjusted odds ratio [aOR]=.51, 95% confidence interval [CI]: .26, .97), but not significantly associated with overweight or obesity.

*Food insecurity.* Two cross-sectional studies examined the odds of household food insecurity based on CACFP participation using the same nationally representative sample of U.S. children.<sup>32,33</sup> One study found that participating in CACFP was not significantly associated with the odds of household- or child-level food insecurity,<sup>33</sup> while the other study found that attending a child care program participating in CACFP was associated with a statistically significantly (4.19 percentage points) lower likelihood of household-level food insecurity.<sup>32</sup> These divergent findings from the same study sample appear to be due to differences in the analytic approach: 1 study used propensity-score weighting to account for confounders that might influence the relationship between CACFP and food insecurity,<sup>33</sup> while the other study used an instrumental variable approach.<sup>32</sup> The 2 studies also used slightly different definitions of food insecurity, with Heflin et al using a validated cut-off to code food insecurity.

## DISCUSSION

Given CACFP's focus on child nutrition and its large reach—impacting over 4 million young children in the United States on any given day—this federal nutrition assistance program has immense potential to positively impact young children's health. However, this systematic review of existing literature estimating the associations between CACFP, child care center meal quality, and child health outcomes suggests that the evidence for such a positive impact is mixed, and of relatively weak quality. While some studies in this review indicate some positive dietary outcomes in CACFP-participating programs when compared with non-CACFP programs for serving and consumption of fruits, vegetables, whole

grains, meat/meat alternates, lean meats, milk, and sugary drinks, not all studies found significant differences in these outcomes. This review also found that CACFP-participating programs tended to have significantly higher-scored nutrition environments and policies, and that attending a CACFP program may be associated with a reduction in the likelihood of food insecurity. However, this review found no clear evidence for an impact on childhood obesity.

Importantly, this study also found an overall dearth of research on the impacts of CACFP for child health; only 19 studies were identified, and all were at medium or high risk of bias. CACFP's impacts on child-level outcomes may be particularly difficult to study, given that child-level data collection often happens via parental report, and families may be unlikely to know if they receive CACFP-subsidized meals.<sup>32,42</sup> Thus, surveys or cohort studies of families asking about CACFP receipt will not be able to accurately measure exposure and outcome; to accurately measure CACFP participation, it would be necessary to also measure outcomes at the child care program level. However, studies including nutrition-related outcomes and exposures measured at both the child care program level and the child level are rare. More studies, with more robust designs for making causal inferences and better geographic representation, are needed to better understand CACFP's potential influence on child health.

These results also indicate a need for more consistent, and validated, measurement approaches. Few studies presented data on the validity or reliability of their measurement tools, which was particularly concerning given that most of the studies relied on child care center directors or parents to report on outcomes; such self-report measures could be particularly prone to bias. Additionally, no studies utilized the Healthy Eating Index, which would have enabled easier comparison of the studies; nearly all of the studies examined specific food groups only, and often defined these food groups differently across studies. While examining the serving and consumption of key food and beverage categories can be useful for developing easy-to-translate recommendations on meal patterns, even these outcomes were also measured inconsistently across studies. Some studies measured precise intake in standard serving sizes or ounces and others simply counted whether child care providers self-reported serving a given category in the last day. This inconsistent measurement made it impossible in this study to succinctly summarize or quantify the size of nutritional benefits for CACFP using a meta-analytic approach. Future studies should consider using standardized methods of measuring nutritional quality to enable comparisons and pooling of data across studies.

Few studies out of the many reviewed from the initial search met the inclusion criteria of at least having a comparison group of unexposed children; most of the CACFP-related studies identified initially were descriptive in nature. While having a comparison group enables researchers to at least estimate possible associations between CACFP and child health outcomes, this alone does not result in the ability to make causal inferences about the impact of CACFP. Cross-sectional designs cannot rule out reverse causality (ie, perhaps programs that already provide healthier foods are more inclined to participate in CACFP); observational studies in general cannot rule out the introduction of confounding due to nonrandom selection into CACFP participation. While several studies adjusted for potential confounders in the relationship between CACFP and child outcomes, uncontrolled confounding cannot be ruled out. Stronger study designs, such as quasi-experimental evaluations, are needed.

This systematic review on CACFP participation was based on a comprehensive search of the literature using 8 major electronic databases. The search and data extraction were completed by 2 reviewers independently and included a systematic assessment of study quality. Limitations of the study included the inability to meta-analyze data due to a low number of available studies and heterogeneity across measures. As almost all studies were limited to specific states, generalizability of the results could be affected. Additionally, most of the studies were at high risk of bias due to using a cross-sectional study design, failing to account for confounders, and/or relying on unvalidated, self-report measures. Future reviews based on data from more studies and real-world settings will be needed to strengthen these conclusions.

## CONCLUSION

CACFP, with its broad coverage and ability to reach those most impacted by nutrition inequities, has strong potential as a policy tool to support healthier nutrition in young children. This systematic review found some emerging evidence for a beneficial association between CACFP participation and reduced risk of child underweight and food insecurity, and some evidence of healthier food environments and food service in CACFP-participating programs. However, the evidence to date is limited and has had to rely on weak study designs and measurement approaches. More robust research on CACFP and its impacts on child health is needed.

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*Author contributions.* E.L.K. conceptualized and designed the study, supervised the research team, oversaw data analysis and interpretation, and drafted and edited the manuscript. K.T. collected review data, analyzed and managed data, and drafted and edited the manuscript. R.P. collected data and analyzed data and edited the manuscript. C.M. designed the search strategy, contributed to the analytic design, and edited the manuscript. T. A. conceptualized the study, interpreted data, and edited the manuscript.

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*Declaration of interest.* The authors have no relevant interests to declare.

## Supporting Information

The following Supporting Information is available through the online version of this article at the publisher's website.

[Figure S1 Search strategy results](#)

[Table S1 Detailed outcomes across studies in systematic review of Child and Adult Care Food Program and child health](#)

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