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## Opportunities in the Extended Day: Approaches for Promoting Physical Activity and Healthy Eating During Out-of-School Time

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### Abstract

**BACKGROUND:** This systematic review aims to identify out-of-school time (OST) interventions (eg, programming, policies) that increased opportunities for physical activity (PA) and healthy eating and/or improved youth PA and dietary behaviors.

**METHODS:** We searched for articles within systematic reviews that met our criteria (2010–2018) and for individual articles (2010–2020). Reviewer pairs screened articles, double-extracted data, assessed risk of bias (RoB), and achieved consensus. We included 71 articles (55 studies, 60 intervention arms).

**RESULTS:** Health (n = 3) and nutrition education (n = 7) interventions showed promising results, but most used weak designs and had high RoB. PA-focused interventions (n = 23) were largely consistent in improving fitness and moderate to vigorous PA during programming. Programmatic interventions that improved both PA and nutrition outcomes engaged family or

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Human Subjects Approval Statement

Preparation of this paper did not involve primary research or data collection involving human subjects, and therefore, no institutional review board examination or approval was required.

Conflict of Interest

The authors have no conflicts to declare.

### SUPPORTING INFORMATION

The following Supporting Information is available for this article:

**Appendix S1:** Individual articles included in the OST evidence synthesis.

**Appendix S2:** Full citations for articles included in the OST evidence synthesis.

Additional supporting information may be found online in the Supporting Information section at the end of the article.

community members (n = 4/13). Most organizational policy interventions improved the nutrition environment and student PA during OST.

**CONCLUSIONS:** Organization-level policy and programmatic interventions can improve environmental supports and youth behaviors during OST programming, complementing school-day efforts to address student PA and dietary intake. To maximize their potential impact, OST programs need to be accessible to families. Administrators can consider actions to reduce participation barriers.

### Keywords

students; health behavior; health policy; diet; exercise; afterschool

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Each year, out-of-school time (OST) programs reach millions of children in the United States before and after school and during summer.<sup>1,2</sup> Such programs extend the Whole School, Whole Community, Whole Child (WSCC) approach beyond the school day by offering supervised activities that help youth continue to feel safe, supported, challenged, healthy, and engaged.<sup>1,3</sup> Children who are on school grounds for OST programming can benefit from supportive elements such as family and community engagement.

Community connections can involve creating joint-use agreements between schools and community programs that outline sharing of facilities and equipment, providing transportation from school to community-based programs, and engaging community members to lead programs or train staff. OST programs offer a regular opportunity to interact with families, who are increasingly looking for OST programs to provide children with healthy snacks/meals and opportunities to be active.<sup>4</sup> Before and after school activity is a component of the Comprehensive School Physical Activity Program (CSPAP), a framework to help schools support student physical activity (PA).<sup>5,6</sup> The National Strategy on Hunger, Nutrition, and Health highlights the importance of addressing physical activity during summer learning and after school to promote food and nutrition security and health.<sup>7</sup>

Students arrive at afterschool programs several hours after eating lunch; 36% of schools in the United States start their lunch periods before 11 AM.<sup>8</sup> Given that most youth fall short of recommended intakes of fruits, vegetables, and whole grains, and overconsume added sugar and sodium,<sup>9</sup> nutritious afterschool snacks and meals can help support healthy eating patterns.

We conducted a systematic review to help answer “What policies and programs increase opportunities for PA and healthy eating in OST programs and/or contribute to improvements in youth activity levels and dietary intake?” To reflect the WSCC approach, we aimed to identify effective OST interventions that are school-based or exemplify school and community partnerships.

## METHODS

### Article Selection

The introduction and methods article in this special issue gives more details about the 2-phase approach we used for identifying articles from existing systematic reviews (Phase 1) and searches for individual articles (Phase 2).<sup>10</sup> Given overlapping keywords between school-day and OST interventions to support PA and nutrition, research librarians recommended reviewing search results for PA and nutrition interventions rather than conducting a separate OST search for Phase 1. We identified 2 relevant systematic reviews, but we did not select either as an “anchor review article”, that is, a high-quality and sufficiently relevant review from which we would extract individual articles that met our criteria. One systematic review was the basis for the 2018 Community Preventive Services Taskforce (CPSTF) recommendation about active transportation and therefore we did not prioritize for inclusion,<sup>11,12</sup> and the other was an older review (2012) with an obesity prevention focus.<sup>13</sup> Rather than update that search strategy in Phase 2, we worked with research librarians to develop a new search for PA and nutrition interventions in OST. Table 1 presents the search terms used.

To be eligible for consideration, articles had to describe OST programs for school-aged youth and policy, program, systems, and environmental change interventions in OST settings; and meet all other criteria described in table 1 of the introduction and methods paper.<sup>10</sup> To focus on programming broadly available to youth, we excluded interventions with a skill-based criterion (eg, interscholastic sports tryouts). We also excluded articles about active transportation and school gardens because CPSTF already recommends these interventions.<sup>12,14</sup>

### Random Sampling for Articles Describing PA Interventions in OST

After completing full-text screening, subject matter expert (SME) pairs coded articles by their primary and secondary intervention topic to differentiate between “novel” and “confirmatory” topics that expanded on a recommendation or systematic review, such as “Before and After-school PA within CSPAP.”<sup>5</sup> (Figure 1) We coded “Before-and-After-school (OST)” as the primary intervention for OST articles. All OST articles were considered novel except those with PA as a secondary intervention. One PA-focused intervention was reclassified as novel because it described a smartphone app, a newer intervention strategy. SMEs concurrently coded whether OST interventions were school-based; affiliated with organizations that have sites both on school grounds and in community settings (eg, YMCA, Boys & Girls Clubs of America); illustrated a school and community partnership (eg, joint use agreements; school-sponsored transportation to community center); involved multiple settings (eg, school and community-based sites); solely community-based; or unspecified. To retain relevance to school settings, we excluded 5 solely community-based interventions but included unspecified settings. During the coding step, SMEs excluded 9 additional articles for the wrong study design, population, intervention, or outcomes. We then randomly selected 10 articles for inclusion from the “Before-and-after-school (OST)/PA” stratum (n = 10/27), as described in the intro/methods<sup>10</sup> Through this process, we identified 57 articles (10 confirmatory, 47 novel) for extraction in Phase 2.

## Data Extraction

Reviewers met in pairs to assess each included article for risk of bias (RoB) and to reconcile any differences in data extraction until they reached consensus. Additional details about systematic review methods, documentation, data extraction, and RoB assessment can be found in the introduction and methods article at the start of this special issue.<sup>10</sup> During data extraction, SMEs identified additional articles as having OST components (20 from Phase 1, 20 from Phase 2) and excluded 6 articles for being redundant with articles extracted during Phase 1 or having an ineligible study design.

## Data Synthesis

We then compiled articles that reviewers coded as having an OST component during ( $n = 91$ ) or after ( $n = 2$ ) data extraction. Interventions that included an OST component but did not evaluate its impact on program nutrition and PA environments and/or youth dietary intake and PA were moved to other papers in this special issue ( $n = 22$ ). We included a total of 71 unique articles. We grouped articles by study ( $n = 55$ ), identified the total intervention arms ( $n = 60$ ), and conducted a qualitative synthesis, comparing how many interventions reported statistically significant outcomes in the expected direction, null outcomes, or significant outcomes in the unexpected direction (Table 2).

## FINDINGS

We describe these studies and interventions in aggregate in Table 2 and individually within the Supplemental Table S1, which includes detailed information about study and population characteristics and RoB assessments. We categorized articles by intervention type and present the results below.

### Health Education

Two studies (3 interventions, 2 articles) evaluated health education interventions in OST settings. One tested 2 comic-based interventions to promote healthy lifestyle behaviors—a knowledge-based version and a theory-based version that incorporated role modeling, role playing, goal setting, and positive reinforcement (4 sessions, 30 minutes each).<sup>15</sup> Both comic interventions were associated with increased self-efficacy to eat more nutritious foods and to be more physically active. Both reported null findings around self-efficacy to reduce sugar-sweetened beverages (SSB) consumption and screentime. Both interventions were associated with increased moderate to vigorous physical activity (MVPA), fruit, and vegetable (FV) consumption, and water consumption, and no change in SSB consumption or screentime. The authors reported no significant differences in outcomes between the comic-based approaches. The second study tested the Help a Friend, Help Yourself youth diabetes awareness program (4 sessions, 1 time per week) in a participating Boys & Girls Club of America program.<sup>16</sup> Participants reported increased knowledge of diabetes and its symptoms. These studies reported improvements in knowledge and attitudes; however, neither included a control group that received no health education.

## Nutrition Education

Seven studies (7 interventions, 7 articles) evaluated the impact of afterschool nutrition education.<sup>17–23</sup> Two focused on knowledge transfer, 1 via a 30-page comic book<sup>17,20</sup> and the other through 6 structured 60-minute lecture-based sessions;<sup>17</sup> 5 involved curricula with applied learning activities (eg, taste tests and/or food preparation).<sup>15,17–19,21–23</sup> Interventions showed increases in nutrition knowledge and self-efficacy more often than for nutrition perceptions/beliefs. Findings were largely mixed for dietary intake. Of the 6 studies measuring dietary intake, 4 reported both expected and null findings,<sup>18,19,21,22</sup> and 2 reported no dietary improvements.<sup>17,23</sup> One study, evaluating a single-session comic intervention, measured snack selection rather than dietary intake, observing greater selection of fruit compared to the control.<sup>20</sup> The study with the strongest design and moderate quality rating had no findings in the expected direction and was the only study to report findings contrary to the hypothesis (ie, decreased intakes of vegetables, beans; increased sodium) and to lack theory of behavior change-informed programming.<sup>17</sup>

## Physical Activity-Focused Programming

Twenty-three interventions (20 studies, 21 articles) focused on engaging youth in PA.<sup>24–44</sup> Programs offered sessions at least 2 times a week (range of 2–5 times/week; total of 12 to approximately 100 sessions). Most occurred after school (n = 21); 1 implemented PA before school<sup>31</sup> and 1 during summer.<sup>33</sup> Most interventions explicitly applied behavior change theories, primarily through skill development and mastery activities; several also included goal setting (n = 5). The studies all evaluated PA behaviors; most interventions showed expected increases in PA minutes or bouts (n = 16/18) or in physical fitness (n = 7/9).

## Physical Activity and Nutrition Programming

Thirteen interventions (13 studies, 12 articles) adopted multiple programming components to address both PA and nutrition outcomes, including knowledge, attitudes, and perceptions (KAP).<sup>41–56</sup> Eleven interventions involved either a curricular component or existing program,<sup>45–51,54,55</sup> and 3 were culturally-tailored for participants.<sup>49,52,53</sup> Significant outcomes in the expected direction were more frequently reported for dietary intake (6/8) than PA (3/9). Four of the 13 studies reported findings in the expected direction for both nutrition and PA/fitness outcomes, including KAP, all of which included a family or community engagement component.<sup>47,48,51,52</sup> One culturally tailored program implemented arts and nutrition education with dance performances and high school (HS) participants mentoring middle-school-aged students.<sup>52</sup> Two applied a curriculum-based PA and nutrition education intervention with integrated PA; 1 shared healthy recipe handouts with parents or guardians,<sup>47</sup> and the other included parent meetings.<sup>51</sup> Marathon Kids featured goal setting and self-monitoring, social reinforcement, and partnership building between schools, community leaders, and the private sector.<sup>48</sup>

## Policies and Standards Addressing Physical Activity and Nutrition

Fourteen interventions (13 studies, 29 articles) aimed to increase the adoption of voluntary quality standards in afterschool settings;<sup>57–85</sup> several of these also addressed staff practices, such as role modeling and verbal encouragement, and included optional curricula or

programs. While the exact organizational policies varied by study, 2 common goals included offering at least 30 minutes of MVPA each day and adopting standards for foods and beverages served with the goals of increasing FV, whole grains, and water, and decreasing refined grains, trans fats, and added sugars. All recruited multiple programs/sites (range 4–37). Most interventions (n = 13) engaged multipurpose afterschool programs (eg, YMCAs, Boys & Girls Clubs of America, parks and recreation sites, public school extended care programs) in adopting multiple organizational policy changes,<sup>59–68,71–73,78–83,85</sup> and 1 engaged volunteer-led OST programs (eg, scouting, 4-H) to serve fruits and vegetables at snacktime.<sup>66</sup>

All but one of the interventions focused on multiple organizational policy objectives (13/14), supported staff through professional development, training, and/or technical assistance (TA),<sup>57–62,65,67,68,71,74–77,79,81–84</sup> or engaged programs in action planning and prioritizing which standards to adopt.<sup>57,58,60–67,69</sup> Seven studies statistically analyzed changes to the nutrition environment for 8 interventions; 7 interventions led to both favorable and null outcomes. Most interventions (6/8) led to significant increases in serving FV,<sup>57,62,65,70,78,81</sup> or meaningful improvements in quality of beverages served (increased water and/or decreased SSBs, 6/8).<sup>57,62,65,70,78,81</sup> Partnerships with community retailers to decrease costs of healthier snacks were associated with significant increases in FV servings and decreases in desserts or salty/sweet snacks in less than a full school year in both volunteer-run OST programs and YMCA sites.<sup>70,72</sup>

Of the 3 interventions that included snack consumption measures,<sup>61,66,78</sup> 2 found that when programs offered healthier snacks, most students consumed them<sup>61,78</sup>; however, findings were subject to selection bias<sup>61</sup> and design limitations.<sup>78</sup> The third intervention reported decreased SSB intake but no improvements in snack consumption; notably, this study had the shortest implementation duration (<12 weeks) and was the sole intervention where staff tasked with adopting multiple policies received no professional development or TA.<sup>62</sup>

Although improvements to the nutrition environment were reported more often than for the PA environment, policy interventions that assessed youth PA outcomes (N = 6/14) all identified at least 1 significant improvement. For example, in 1 intervention, program time for MVPA was unchanged; however, youth became more active within the allotted time, increasing their MVPA.<sup>60</sup> Researchers noted significantly greater vigorous PA (VPA) increases among boys than among girls,<sup>71</sup> and among younger children (grades K-2 vs 3–6).<sup>60</sup>

## Secondary Outcomes

Sedentary behavior was the most frequently reported secondary behavioral outcome, with generally favorable results (5/6).<sup>26,33,65,69,71</sup> Three interventions with PA components assessed psychosocial outcomes with favorable results for mood,<sup>27,28</sup> self-esteem and body image,<sup>45</sup> but not for weight stigma.<sup>49</sup> Eighteen studies measured Body Mass Index (BMI) or prevalence of overweight/obesity,<sup>15–18,23,25,26,28,30–36,38,40,42,44,46,48,53–55</sup> with mixed results (Supplemental Table S2).

## DISCUSSION

OST programs provide access to healthy foods and beverages and opportunities for PA, which can support student learning and physical and mental health. Numerous interventions showed some evidence of effectiveness as well as feasibility of implementation among diverse racial and ethnic minority groups. We also identified some clear gaps: few interventions were designed for HS students (3 engaged HS students; 1 evaluated impact on HS students) or tested in rural communities (n = 1). Most interventions focused on afterschool programming; only 2 interventions included summer components and 1 evaluated a before-school intervention. We present some themes and common features within our qualitative synthesis.

### Enhancing the Program Environment With Policy Interventions

Organization-level policy interventions in OST settings, such as the planned adoption of voluntary standards, appeared to be effective at increasing the availability of healthier food and beverages, especially FV and water; reducing availability of desserts and SSBs; increasing participants' PA and reducing sedentary behavior during programming; with promising implications for snack and beverage consumption. Whereas most programmatically focused interventions engaged youth from racial/ethnic minority groups, this was true for only 4/14 policy interventions, including 2 randomized controlled trials of strong and moderate quality.<sup>59–64</sup> The strong quality study reported taking place in a school district with a high-prevalence of poverty (>75% students eligible for free or reduced-priced lunch).<sup>68</sup> Both reported some improvements to the nutrition environment<sup>62–64</sup>; 1 reported increased PA.<sup>60</sup> Altogether, findings suggest that policy-based interventions can be successfully implemented in varied settings and have the potential to help narrow disparities in PA and nutrition behaviors if proactively implemented in OST programs serving youth from racial/ethnic minority groups or communities experiencing poverty.

To accelerate uptake of policy interventions, several national youth-serving organizations have committed to adopting voluntary standards that align with the National Afterschool Association's Healthy Eating and Physical Activity (HEPA) standards,<sup>86</sup> which can be adopted incrementally and cover 5 content areas: PA and nutrition content and quality; staff training; social support; program support; and environmental support.<sup>87</sup> Common commitments across these organizations included serving a fruit or vegetable at every meal or snack, adopting nutrition standards, and dedicating 20% of time or at least 30 minutes for PA with 50% in MVPA.<sup>82,86</sup>

### Providing Different Ways to Be Physically Active

Compared to schools, OST programs may have more flexibility to tailor programming to meet diverse interests. Interventions adopted a variety of approaches including culturally relevant dance,<sup>24,52</sup> gender-specific programming,<sup>24,37,39,40,49</sup> using existing curricula and programs (eg, CATCH Kids Club, BOKS, Marathon Kids, America SCORES),<sup>31,32,38,43,45,48,54,65</sup> and integrating PA with science.<sup>34</sup> Most PA interventions emphasized skills development and self-improvement over competition and increased youth

PA during programming, although effects were typically small and sometimes differed by weight status,<sup>38</sup> gender,<sup>71,76,84</sup> and age.<sup>60</sup>

### Considering the Role of Program Frequency and Outcome Selection

PA-focused programs reported findings in the expected direction more consistently than nutrition or health education programs or combined PA/nutrition interventions. Frequency, measurement, and intervention testing may have played a role. PA programs tended to meet frequently—2–4 times/week; in contrast, nutrition education interventions offered 4–10 sessions over an extended timeframe (eg, approximately 3 months/school semester). Many of the PA interventions either incorporated or iterated on previously evaluated programs or curricula; in contrast, the OST nutrition or health education interventions were more frequently tested within pilot studies and studies with small samples (eg, 7/9 studies had <100 participants), and/or rated as having a high RoB than PA studies, suggesting stronger evaluations are needed. Most PA interventions evaluated PA levels during programming, which the intervention directly aimed to influence. In contrast, nutrition-focused interventions primarily reported on overall dietary intake (eg, 24-hour dietary recalls, past week food frequency screeners), which OST programs only partially influence, with mixed results.

### Engaging Families and Communities

The combined PA and nutrition interventions that resulted in significant improvements in both outcome categories engaged family members and the community. Family engagement approaches included information sharing (eg, newsletters),<sup>45,51,58,65</sup> intentionally improving communications with families,<sup>64</sup> involving families in program design choices,<sup>22,24</sup> home assignments,<sup>32,56</sup> and even program activities.<sup>24</sup> Another manuscript in this special issue offers a robust description of parent/community engagement strategies.<sup>88</sup> CPSTF recommends park infrastructure improvements with additional activities, like structured programming for increasing PA.<sup>89</sup> CPSTF finds the economic benefits exceed the cost for park infrastructure interventions to increase physical activity and use.<sup>90</sup> Schools could partner with parks and recreation departments to provide transportation to afterschool PA programming in community-settings, which may increase MVPA more than school-based aftercare,<sup>35</sup> and confer cardiovascular benefits.<sup>91</sup> Programs like Safe Routes to School, although outside the scope of the review, facilitate active transportation to school and are another CPSTF-recommended intervention that can connect families, communities, and schools to support PA before or after school.<sup>12</sup> CPSTF also recommends school garden programs with nutrition education to promote vegetable consumption among elementary school-aged children.<sup>14</sup> These programs can be offered after school and/or in partnership with community organizations.<sup>92</sup>

Partnerships with local food retailers helped site providers secure product discounts that were associated with improved snack quality.<sup>70,71</sup> For programs where meals and snacks were provided through a school district sponsor, an ongoing relationship with the school food service department supported implementation of nutrition standards.<sup>61</sup> Programs with access to an on-site kitchen or food storage were better equipped to adopt nutrition standards.<sup>61,81</sup> Nation-wide, only 21.9% of secondary schools had an agreement to allow



for shared use of school or community kitchen facilities and equipment, including with OST programs.<sup>93</sup>

### **Building Staff Capacity and Peer Leadership**

Professional development on instructional practices and implementation strategies was a common component across interventions that showed some positive changes and included facilitated peer-learning communities<sup>57–64,67</sup>; train the trainer<sup>38,62</sup>; and intensive trainings and follow-up TA offered by university staff,<sup>25–28,42,51,69,74,83</sup> extension agents,<sup>32,50</sup> or non-profit organizations to support adoption of their programs or curricula.<sup>19,31,36,38,45,68</sup> These institutions can be valuable assets for communities and OST programs.

Staff may benefit from TA to help maintain changes to practices and programming and from a training structure that is responsive to staff transitions. Data from 2 multi-year studies suggest policies and instructional practices, once adopted, are not necessarily maintained.<sup>74,75,77</sup> High turnover among leadership and/or program staff can affect youth experiences and impede policy adoption and continuity.<sup>58,68,73,94</sup> Unfortunately, staff shortages and retention worsened during the COVID-19 pandemic.<sup>95,96</sup> Online training models show potential; however, participants adopted fewer policies than in-person counterparts.<sup>62</sup>

Having adolescents serve as a role model for younger students and assume some program leadership responsibilities may be another means of boosting capacity. Four studies used this approach,<sup>46,50,52,55</sup> with 75% reporting positive impacts on nutrition KAP and improvements in dietary intake and/or PA.<sup>50,52,55</sup> This is a potential model to further explore in evaluations with stronger designs that also measure changes in mentors' PA and dietary behaviors and leadership skills.

### **Limitations**

The findings of this article are subject to the same limitations noted for the overall methodology,<sup>10</sup> including the potential for social desirability bias and detection bias inherent in studies that do not use blinding, and our inability to present standardized outcomes or measures of effect size. Roughly half of the studies were rated as having low quality/high RoB (n = 27/55), and 19 lacked a comparison (n = 17) or usual care control group (n = 2). These attributes may limit generalizability of results.

Some relevant articles were likely omitted. By excluding articles describing community-only programming (n = 5), we may have missed interventions relevant to programs operated on school grounds or in partnership with schools. The random stratified sampling approach excluded 17 PA-focused articles. However, the consistent findings in the PA-only section suggest that sampling among confirmatory topics worked as intended; results affirmed the value of including before and after school programming in the CSPAP framework to increase student PA.

## IMPLICATIONS FOR SCHOOL HEALTH POLICY, PRACTICE, AND EQUITY

### Implementing a Layered Approach to Policy and Programmatic Interventions

Multiple policy and programmatic interventions to address PA and nutrition appear to be both feasible to implement and effective in OST programs. Several interventions combined approaches such as off-the-shelf programs and curricula, intensive trainings, and partnerships with nonprofits or community organizations to deliver OST programming or program support. Action-planning processes, such as those widely used in the organizational policy interventions, could help facilitate an incremental and layered approach. Changes like adopting an existing evidence-based program or curriculum or eliminating SSBs could be implemented in as little as a semester, whereas enhancing play structures or developing a shared use agreement could be longer-term goals. Skills-focused trainings played a prominent role in many of these interventions; however, staff turnover can threaten continuity of knowledge and practice. Mechanisms to support ongoing staff training, including paths for new staff, and dedicated time for staff training and TA that promote organizational capacity, may be important to integrate into programs to support sustainability. The HEPA 2.0 standards outline best practices for staff training to support PA and nutrition. The policy interventions we identified through this review focused on changes at the organization-level. Changes to state childcare licensing standards or to federal nutrition programs, like the Child and Adult Care Feeding Program (CACFP) or Summer Food Service Program (SFSP) have the potential to influence the PA and nutrition environments in OST programs and present potential natural experiments to evaluate.

### Increasing Access to and Participation in OST Programming

The potential impact of any of these actions is contingent on families' access to OST programming and schools' capacity to offer such programming or develop the necessary partnerships.

Participation rates in federal programs like CACFP are lower than for school lunch programs.<sup>97,98</sup> Schools can play a role by sponsoring meal programs such as SFSP and CACFP or National School Lunch Program Afterschool Snack Service. Barriers to before and after school program participation include the cost of registration, transportation to/from programming, and—especially in rural communities—the availability of programming.<sup>99,100</sup> Unmet demand for after-school programming is highest in communities with people with lower incomes, in rural areas, and among Black and Hispanic or Latino children.<sup>2,100</sup> Creating new programs involves investments in coordination, transportation, materials (eg, snacks that meet USDA standards), personnel, and staff training; however, such programs are projected to be cost-saving within a 10-year period, owing to a more efficient caregiving structure, and to be effective at increasing PA and addressing childhood obesity.<sup>101</sup> Retention matters too; several programs noted differential effects on PA or BMI by attendance.<sup>33,37,40</sup>

Documented declines in PA, food security, and academic knowledge during summer and accelerated summertime weight gain among school-aged children highlight an important opportunity for action.<sup>102–105</sup> Multipurpose summer programs may be well positioned to

support learning recovery and offer the benefits of structured days, while also allowing for youth development, discovery, and play. Only 1 included intervention was specifically designed for summer.<sup>33</sup> As districts invest in summer learning to address COVID-19-related learning loss,<sup>106</sup> researchers have an opportunity to evaluate the impact of summer programming on physical health outcomes (ie, PA and nutrition), emotional wellbeing, and academic readiness.<sup>102</sup>

Additional evaluations of before-school PA interventions that consider both PA outcomes and potential spillover benefits could help address an evidence gap. The sole study evaluating a before-school intervention was promising: it adopted an existing program (BOKS) that was available at no cost to families and schools and showed effectiveness at increasing before-school MVPA, VPA, and total PA on intervention days.<sup>31</sup> Research evaluating the impact of before-school programming on PA and school breakfast consumption is a potential future research direction that builds from research showing that, during the school-day, offering recess before lunch appears to improve dietary intake at lunch.<sup>107</sup>

## Conclusions

Multiple interventions were successful in enhancing the program environment, staff practices, and youth behaviors during programming, highlighting how OST programs can complement school-day efforts to address PA and nutrition and increase opportunities to be active and eat healthful foods. However, few interventions succeeded in shifting overall nutrition or PA patterns. To meaningfully impact health behaviors, actions across the school, community, and home settings are needed, as presented in the WSCC framework, while also addressing structural barriers to health equity.

The COVID-19 pandemic has heightened awareness of the interconnectedness of communities and schools. Schools alone cannot bear the responsibility of recovering students' learning loss, worsened mental health, and need for social connectedness. OST programs can extend learning opportunities and help address inequities in health and educational outcomes that the COVID-19 pandemic has exacerbated.<sup>108</sup> Partnerships between schools, OST programs, youth, families, and community organizations (eg, nonprofits, food retailers) may be especially valuable as schools work to support students academically, socially, emotionally, and physically post-pandemic. The American Rescue Plan included funding that can be awarded directly to summer and afterschool programs and indirectly through local education agencies and/or AmeriCorps to OST programs—a historic opportunity to support school-OST partnerships and enhancements to OST environments.<sup>109</sup>

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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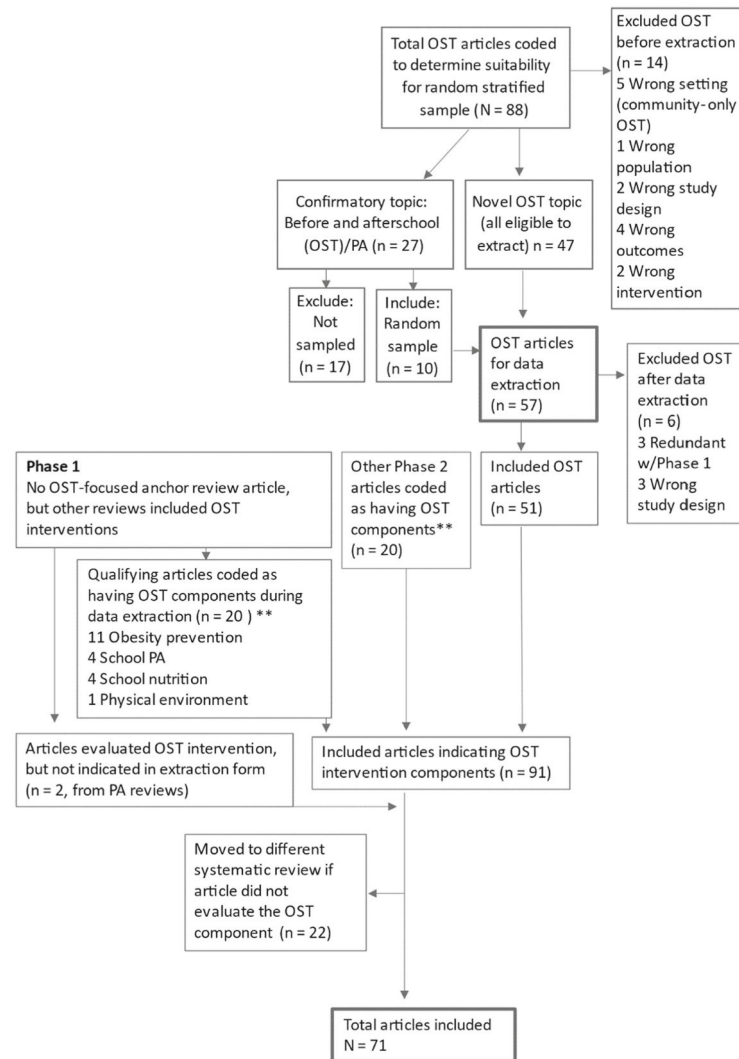
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**Phase 1:** Individual studies identified from systematic reviews\*

**Phase 2:** Individual articles about PA, nutrition, health education interventions ( eg, programs, policies, staff practices) in school and OST\*



**FIGURE 1. Selection of OST Articles across Phases 1 and 2.**

OST, out-of-school time; PA, physical activity. \*See Introduction/Methods paper in this special issue for full project flow chart. \*\*Articles coded as having a different primary intervention (eg, coordinated approach/local wellness policy; health education) but were identified as having an OST component during data extraction.

**Table 1.**

**Search Strategy Used to Identify Peer-Reviewed Publications About Interventions to Address Physical Activity and Nutrition in Out-of-School Time Settings**

| Topic  | Medline Strategy <sup>†</sup>  |
|--|--|
| Phase 1: Review of reviews   | (No specific OST strategy developed; authors looked to identify articles within reviews addressing physical activity and nutrition interventions for school-aged children)   |
| Phase 2: Individual articles out-of-school time physical activity and nutrition interventions run March 2020 | Fitness* OR physical activit* OR physically active OR exercise* OR physical education OR sport* OR recreation* OR playground* OR gym OR gymnasium* OR walk* OR bike OR biking OR recess OR movement OR Food* OR feeding OR beverage* OR nutrition OR nutritious OR diet* OR meal* OR lunch* OR breakfast* OR fruit* OR vegetable* OR snack* OR garden* OR cafeteria* OR cafeteria* OR (healthy ADJ2 eat*) OR (healthy ADJ2 choice*) OR drinking fountain* OR drinking water OR (access* ADJ3 water) OR water fountain* OR vending machine* OR free lunch* OR breakfast* AND ((exp Schools/OR primary school* OR secondary school* OR high school* OR middle school* OR elementary school* OR K-12 OR (school* ADJ3 student*) OR (school* ADJ3 children)) AND (((extracurricular OR intramural) AND school*) OR after hours OR before hours OR after class* OR before class* OR (outside ADJ3 hour*)) OR after school* OR before school* OR afterschool OR (summer ADJ5 school*) AND Intervention* OR program* OR polic* OR service* OR standard* OR prevention OR organiz* OR pilot project* AND journal article,pt OR review,pt 2010-current; English |

<sup>†</sup>We ran the Medline search strategy first. It yielded the largest number of independent citations; we then modified it for subsequent queries in PsycInfo (OVID), CINAHL (EBSCO), Scopus, ERIC (ProQuest), Education Database, and Sociological Abstracts.

**Table 2.** Aggregated Description of Out-of-School Time Study Characteristics and Outcomes by Intervention

| Intervention <sup>†</sup> N=60   | Study design <sup>‡</sup> N=55 | # Articles N=71 | Study Participant Characteristics |                    |  | Intervention Outcomes*   |  |  |
|--|--------------------------------|-----------------|-----------------------------------|--------------------|--|--|--|--|
|  |                                |                 | School Level                      | Location Type      | Race/Ethnicity <sup>§</sup>                      | Interventions Reporting PA and Nutrition Knowledge, Attitudes, Perceptions// | Interventions Reporting Program Environment for PA and Nutrition// | Interventions Reporting Student PA and Nutrition Behaviors// |
| <i>Health education</i> Programs use structured lessons to deliver information and promote learning about lifestyle behaviors and chronic disease prevention (N=3) | RCT/ CCT: 1 QED: 1             | N=2             | Elementary (n=1)                  | Not reported (n=2) | Majority White (n=1)                             | Nutrition self-efficacy (n=2)  | (n=0)  | Dietary intake (n=2)   |
|  |                                |                 | Middle (n=1)                      |                    | Majority Black (n=1)                             | + 2  | + 2  | = 0  |
|  |                                |                 | High school (n=0)                 |                    | Majority Hispanic or Latino (n=0)                | = 0  | = 0  | = 0  |
|  |                                |                 | Multiple grade levels (n=0)       |                    | Majority racial and ethnic minority groups (n=0) | PA self-efficacy (n=2)   |  | PA (n=2)   |
|  |                                |                 | Not reported (n=0)                |                    |  | + 2  |  | + 2  |
|  |                                |                 |                                   |                    |  | = 0  |  | = 0  |
|  |                                |                 |                                   |                    |  | = 0  |  | = 0  |
|  |                                |                 |                                   |                    |  | - 0  |  | - 0  |
|  |                                |                 |                                   |                    |  | Diabetes knowledge (n=1)   |  |  |
|  |                                |                 |                                   |                    |  | + 1  |  |  |
|  |                                |                 |                                   |                    |  | = 0  |  |  |
|  |                                |                 |                                   |                    |  | - 0  |  |  |
| <i>Nutrition Education</i> Programs used structured lessons to deliver information and promote learning about nutrition (N=7)                                      | RCT/ CCT: 2 QED: 5             | N=7             | Elementary (n=3)                  | Urban (n=4)        | Majority White (n=0)                             | Nutrition knowledge (n=3)  | (n=0)  | Dietary Intake (n=6)   |
|  |                                |                 | Middle (n=1)                      | Rural (n=0)        | Majority Black (n=1)                             | + 3  | + 4  | + 4  |
|  |                                |                 | High School (n=0)                 | Suburban (n=1)     | Majority Hispanic or Latino (n=5)                | = 2  | = 6  | = 6  |
|  |                                |                 | Multiple Grade Levels (n=3)       |                    | Majority racial and ethnic minority groups (n=1) | Nutrition self-efficacy (n=4)  |  | Food selection (n=1)   |
|  |                                |                 | Not reported (n=0)                |                    |  | + 3  |  | + 1  |
|  |                                |                 |                                   |                    |  | = 2  |  | = 0  |
|  |                                |                 |                                   |                    |  | = 0  |  | = 0  |
|  |                                |                 |                                   |                    |  | Nutrition perceptions/beliefs (n=4)  |  |  |
|  |                                |                 |                                   |                    |  | + 1  |  | + 1  |
|  |                                |                 |                                   |                    |  | = 5  |  | = 0  |
|  |                                |                 |                                   |                    |  | - 1  |  | - 0  |
| <i>Physical Activity-Focused Programming</i> Measured physical activity or fitness as the primary outcome (N=23)   | RCT/ CCT: 14 QED: 6            | N=21            | Elementary (n=11)                 | Urban (n=7)        | Majority White (n=5)                             | PA self-efficacy (n=4):  | PA environment (n=1)   | PA (n=18)  |
|  |                                |                 | Middle (n=1)                      | Rural (n=0)        | Majority Black (n=7)                             | + 4  | + 1  | + 16   |
|  |                                |                 | High school (n=0)                 | Suburban (n=0)     | Majority Hispanic or Latino (n=2)                | = 0  | = 1  | = 9  |
|  |                                |                 | Multiple grade levels (n=7)       |                    | Majority racial and ethnic minority groups (n=5) | PA attitudes and perceptions (n=1):  |  | Fitness (n=9)  |
|  |                                |                 | Not reported (n=1)                |                    |  | + 1  |  | + 7  |
|  |                                |                 |                                   |                    |  | = 1  |  | = 4  |
|  |                                |                 |                                   |                    |  | = 1  |  | = 4  |
|  |                                |                 |                                   |                    |  | - 0  |  | = 0  |
|  |                                |                 |                                   |                    |  | - 0  |  | = 0  |
|  |                                |                 |                                   |                    |  | Sedentary (n=3)  |  | Sedentary (n=3)  |
|  |                                |                 |                                   |                    |  | + 2  |  | + 2  |
|  |                                |                 |                                   |                    |  | = 1  |  | = 1  |
|  |                                |                 |                                   |                    |  | - 0  |  | - 0  |

|   |                                | Study Participant Characteristics |                 |   |  | Intervention Outcomes*  |   |  |   |
|---|--------------------------------|-----------------------------------|-----------------|---|--|---|---|--|---|
|   |                                |                                   |                 |   |  | + : Supports Hypothesis; =: No Effect; -: Does Not Support Hypothesis (“+,” and “-” Indicate Statistical Significance)  |   |  |   |
|   | Intervention <sup>†</sup> N=60 | Study design <sup>‡</sup> N=55    | # Articles N=71 | School Level  | Location Type  | Race/Ethnicity <sup>§</sup>   | Interventions Reporting PA and Nutrition Knowledge, Attitudes, Perceptions <sup>  </sup>  | Interventions Reporting Program Environment for PA and Nutrition <sup>  </sup>   | Interventions Reporting Student PA and Nutrition Behaviors <sup>  </sup>  |
| <i>PA and Nutrition Programming</i>   |                                |                                   |                 |   |  |   |   |  |   |
| Interventions include multiple afterschool programming components to address physical activity and nutrition (N=13)                               |                                | RCT/ CCT: 6<br>QED: 7             | N=12            | Elementary (n=7),<br>Middle (n=1)<br>High School (n=0)<br>Multiple Grade Levels (n=2)<br>Not reported (n=3) | Urban (n=3)<br>Rural (n=1)<br>Suburban (n=1)<br>Not reported (n=8)<br>Multiple (n=0) | Majority White (n=2)<br>Majority Black (n=1)<br>Majority Hispanic or Latino (n=6)<br>Majority Asian (n=1)<br>Majority racial and ethnic minority groups (n=2)<br>Not reported (n=1) | Nutrition self-efficacy (n=5)<br>+ : 1<br>= : 3<br>- : 1<br>Nutrition knowledge (n=6)<br>+ : 4<br>= : 2<br>- : 0<br>Nutrition attitudes and perceptions (n=6)<br>+ : 4<br>= : 3<br>- : 1<br>PA self-efficacy (n=3)<br>+ : 2<br>= : 1<br>- : 0<br>PA attitudes and perceptions (n=4)<br>+ : 1<br>= : 4<br>- : 0<br>PA knowledge (n=3)<br>+ : 1<br>= : 2<br>- : 0 | (n=0)  | Dietary Intake (n=8)<br>+ : 6<br>= : 7<br>- : 0<br>Eating behaviors (n=1)<br>+ : 0<br>= : 1<br>- : 0<br>PA (n=9)<br>+ : 3<br>= : 7<br>- : 0<br>Fitness (n=1)<br>+ : 1<br>= : 1<br>- : 0 |
| <i>Policies and Standards Addressing PA and Nutrition</i>   |                                |                                   |                 |   |  |   |   |  |   |
| Interventions involved programs adopting standards and policies to guide the types of food and PA opportunities available to youth on site (N=14) |                                | RCT/ CCT: 3<br>QED: 10            | N=29            | Elementary (n=0),<br>Middle (n=0)<br>High School (n=0)<br>Multiple Grade Levels (n=9)<br>Not reported (n=4) | Urban (n=1)<br>Rural (n=0)<br>Suburban Not reported (n=12)<br>Multiple (n=0)         | Majority White (n=8)<br>Majority Black (n=0)<br>Majority Hispanic or Latino (n=0)<br>Majority racial and ethnic minority groups (n=3)<br>Not reported (n=2)                         | (n=0)   | Nutrition environment (n=11)<br>+ : 8<br>= : 7<br>- : 0<br>N/A <sup>¶</sup> : 3<br>PA environment (n=8)<br>+ : 3<br>= : 7<br>- : 0<br>N/A <sup>¶</sup> : 1<br>Sedentary environment (n=3)<br>+ : 3<br>= : 0<br>- : 0 | Dietary intake (n=2)<br>+ : 2<br>= : 2<br>- : 1<br>PA (n=6)<br>+ : 6<br>= : 4<br>- : 0<br>Sedentary behavior (n=3)<br>+ : 3<br>= : 0<br>- : 0   |

Abbreviations: PA, physical activity; RCT/CCT, randomized control trial or controlled clinical trial; QED, quasi-experimental design; N/A, Not applicable.

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\* Examples of outcomes that support hypothesis and would be coded (+): increased nutrition knowledge, increased physical activity, decreased sugar-sweetened beverage intake, and decreased waist circumference.

<sup>7</sup> Interventions refers to the set of practices, policies, or approaches tested within a study. If a research study included multiple intervention arms, each arm counted as a separate intervention for a given outcome in this table.

<sup>7</sup> QED could be: 2-group cohort, including regression discontinuity; 1-group cohort; interrupted time series; repeat cross-sectional. Studies refer to interventions within the same population/sample, following the same protocol or trial registration. Multiple articles may reference the same study. Nabors (2015) is a single article that describes 2 different studies.

<sup>8</sup> Majority defined as >50% of participants/study population.

// Totals for measured outcomes may exceed the number of interventions evaluating a given outcome because a single intervention may be counted more than once if it reports mixed findings; for example, an intervention that reported increased consumption of fruits but not vegetables would count as both a (+) and (=) for dietary intake.

<sup>9</sup> Not applicable because the intervention measured the outcome, but the articles present descriptive results without testing for statistical significance.