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Evaluation of a multi-year policy-focused intervention to increase physical activity and related behaviors in lower-resourced early care and education settings: *Active Early* 2.0

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ABSTRACT

Physical activity is a critical component of obesity prevention, but few interventions targeting early childhood have been described. The *Active Early* guide was designed to increase physical activity in early care and education (ECE) settings. The purpose of *Active Early* 2.0 was to evaluate the effectiveness of *Active Early* along with provider training, microgrant support, and technical assistance over 2 years (2012–2014) to increase physical activity and related behaviors (e.g., nutrition) in settings serving a high proportion of children from underserved groups in recognition of significant disparities in obesity and challenges meeting physical activity recommendations in low-resource settings. The physical activity and nutrition environment were assessed before and after the intervention in 15 ECE settings in Wisconsin using the Environment and Policy Observation Assessment tool, and interviews were conducted with providers and technical consultants. There was no significant change in Total Physical Activity Score or any EPAO subscale over the intervention period; however, significant improvements in the Total Nutrition Score and the several Nutrition subscales were observed. Additionally, the percentage of sites with written activity policies significantly increased. Overall minutes of teacher-led physical activity increased to 61.5 ± 29.0 min ($p < 0.05$). Interviews identified key benefits to children (i.e., more energy, better rest, improved behavior) and significant barriers, most notably care provider and child turnover and low parent engagement. Moderate policy and environmental improvements in physical activity and nutrition were achieved with this intervention, but more work is needed to understand and address barriers and to support sustained changes in lower-resource ECE settings.

1. Introduction

Significant disparities in childhood obesity prevalence and risk factors have been identified for some racial/ethnic minority groups and children from low-income backgrounds, among other risk factors. (Dixon et al., 2012; Datar and Chung, 2015; Ogden et al., 2016) Evidence suggests these disparities are present by the preschool years, (Woo Baidal et al., 2016; Taveras et al., 2013) highlighting the importance of the early life experiences for child health. In the US, approximately one quarter of children younger than age 5 are in some form of organized child care, including nearly three quarters of young children with working mothers.(Laughlin, 2013) Organized child care includes regulated home-based and center-based care, collectively referred to as early care and education [ECE] settings. With children spending an average of 36 h per week in care outside the home, these ECE settings represent important venues for the development of healthy behaviors. Diet and physical activity are known to be significant contributors to obesity, and early childhood years are a critical period for the development of food preferences, motor skills, and physical activity habits.(Skinner et al., 2002; Loprinzi et al., 2015) In recognition of this opportunity, the Institute of Medicine in 2012 identified increasing physical activity in child care settings as a key strategy for accelerating progress in obesity prevention.(Institute of Medicine, 2012) However, limited available data suggest few sites are meeting recommended

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Table 1
Active Early 2.0 site demographics overall and by site type at baseline.

	Home-based (n = 7 sites, 35 children)	Center-based (n = 8 sites, 465 children)	All (n = 15 sites, 500 children)	p-Value
Staff, mean ± SD (range)	1.3 ± 0.5 (1–2)	14.5 ± 6.4	8.3 (1 − 23)	< 0.0001
% female	100.0 ± 0.0	96.2 ± 4.3	98.0 ± 3.6	< 0.05
Teacher education, %				
High school	28.6%	15.8%	21.7%	0.50
Trade school	14.3%	15.2%	14.8%	0.96
Some college	57.1%	39.5%	47.7%	0.41
Bachelor's degree	0.0%	27.5%	14.7%	< 0.01
Graduate school	0.0%	2.1%	1.1%	0.21
Teacher age, %				
18–25 years	0.0%	14.5%	7.7%	< 0.05
26–40 years	35.7%	46.9%	41.7%	0.56
41–55 years	42.9%	32.0%	37.1%	0.59
> 55 years	21.4%	6.7%	13.5%	0.31
Teacher race/ethnicity, %				
Asian	28.6%	4.1%	15.5%	0.18
Black	0.0%	20.2%	10.8%	0.10
White	42.9%	55.7%	49.7%	0.58
Hispanic	28.6%	5.0%	16.0%	0.20
American Indian	0.0%	14.2%	7.6%	0.20
Multi/Other	0.0%	1.6%	0.8%	0.19
Enrolled children, mean ± SD (range)	5.0 ± 2.5 (2–8)	58.1 ± 52.6 (5–166)	33.3 ± 46.3 (2–166)	< 0.05
Asian	28.6%	3.1%	15.0%	0.16
Black	11.2%	32.6%	22.6%	0.14
White	21.2%	26.0%	23.7%	0.76
Hispanic	24.8%	6.8%	15.2%	0.21
American Indian	14.3%	25.7%	20.4%	0.61
Multi/Other	0.0%	5.8%	3.1%	0.14
Participation in CACFP (yes)	100%	87.5%	93.3%	0.33

CACFP, Child and Adult Care Food Program; SD, standard deviation. All sites were located in Wisconsin, and measurements were made from 2012 to 2014.

levels of physical activity for children.(Tandon et al., 2015; Tandon et al., 2012; Cardon et al., 2008; Dowda et al., 2004; Pate et al., 2004)

Interventions have been successfully developed to increase physical activity in ECE settings, (,(Goldfield et al., 2016) reviewed in(Ward et al., 2010)) although some have yielded mixed results.(Bonvin et al., 2013; Campbell and Hesketh, 2007; Mehtala et al., 2014; Alhassan and Whitt-Glover, 2014) Moreover, few interventions have addressed these types of settings serving children who may be at greater risk for obesity and other adverse health outcomes.(Skouteris et al., 2011; Wolfenden et al., 2016) To address the significant problem of childhood obesity in Wisconsin, a statewide partnership developed the *Active Early* guide to target increasing physical activity opportunities in ECE settings. We previously demonstrated the benefits of the *Active Early* guide for improving structured physical activity in ECE settings in Wisconsin. (LaRowe et al., 2016) However, these settings tended to be higher-resource, and it was unknown if this curriculum could be successful in sites serving a high proportion of children from diverse backgrounds and of low socioeconomic status. The aim of *Active Early* 2.0 was to evaluate the *Active Early* guide in combination with technical support and microgrant assistance in ECE settings serving a high proportion of children from families of lower socioeconomic status and who are Latino, African American, American Indian, and Hmong in recognition of the significant disparities in overweight and obesity experienced by these groups and the challenges of meeting physical activity recommendations in low-resource settings.

2. Methods

2.1. Pilot site recruitment and selection

Six community-based Child Care Resource and Referral agencies recruited and selected pilot sites locally using standardized recruitment materials available in English and Spanish, including flyers, emails, applications, and a scoring rubric. Scoring was weighted to prioritize centers serving children who were Hmong, Latino, African American, and American Indian and of low socioeconomic status. Other factors included regulatory compliance, program longevity, staff retention, motivation for quality improvement, benefit, program buy-in, and family engagement. The 15 highest-scoring sites were selected for *Active Early* 2.0 intervention evaluation. The *Active Early* 2.0 intervention was reviewed by the University of Wisconsin-Madison's Institutional Review Board and was granted exemption from full review. For providers, all evaluation data were de-identified; if a provider or staff verbally declined to participate, their data were not included. All evaluation data of participating children were de-identified, and parents/caregivers were provided the option to submit an opt-out form for the child.

2.2. Intervention delivery

Active Early 2.0 consisted of provider training, development of quality improvement plans, microgrants, and ongoing technical assistance throughout a 2-year intervention period.

2.2.1. Curriculum and training

Development of the *Active Early* guide has been described previously (LaRowe et al., 2016). In brief, an 80-page guide, *Active Early: A Wisconsin guide for improving childhood physical activity* (Cullen et al., n.d.) was developed by a statewide partnership based on available scientific evidence, public health practices, and national recommendations around 6 key areas related to physical activity: Development, Child Assessment, Routines, Environment, Resources, and Business Practices. Each key area included sample daily routines, activity ideas, suggested equipment and materials, culturally competent approaches, and strategies to engage families and communities around increasing physical activity. After baseline evaluation, pilot sites received a 4-h training on foundational topics relating to physical activity in early care and education, including childhood obesity, definitions of physical activity and age-based recommendations, child development, and development of quality improvement plans. Providers also were trained on daily routines (e.g., schedules, lesson plans, transitions), indoor and outdoor environments, child-provider interactions, policies, provider wellness, and family involvement. *The Guide* and all trainings were available in

Table 2
Nutrition and physical activity scores (EPAO) overall and by site type.

	Baseline	Midpoint	Endpoint	p-Value
Total physical activity score	**12.7 ± 3.2**	**12.6 ± 3.1**	**12.5 ± 2.4**	**0.981**
Center-based	15.1 ± 1.7	13.5 ± 2.4	12.7 ± 2.0	
Home-based	10.3 ± 2.4	11.7 ± 3.7	12.4 ± 2.9	
Active opportunities	**11.2 ± 6.0**	**12.9 ± 5.0**	**13.8 ± 7.1**	**0.260**
Center	15.7 ± 3.2	13.8 ± 5.1	15.7 ± 3.7	
Home	6.7 ± 4.7	11.9 ± 5.0	11.9 ± 9.4*	
Sedentary opportunities	**16.9 ± 4.9**	**15.7 ± 4.2**	**16.2 ± 3.4**	**0.793**
Center	19.0 ± 2.5	16.2 ± 3.6	14.3 ± 2.5*	
Home	14.8 ± 6.0	15.2 ± 5.0	18.1 ± 3.5	
Sedentary environment	**13.8 ± 4.9**	**10.0 ± 5.1**	**13.3 ± 4.5**	**0.036**
Center	15.2 ± 5.0	12.4 ± 6.0	16.2 ± 3.6	
Home	12.4 ± 4.6	7.6 ± 2.5	10.4 ± 3.6	
Portable play environment	**16.5 ± 4.2**	**16.7 ± 4.7**	**14.1 ± 4.8**	**0.129**
Center	19.2 ± 2.2	19.2 ± 1.4	15.5 ± 3.2	
Home	13.9 ± 4.2	14.3 ± 5.7	12.7 ± 5.9	
Fixed play environment	**16.3 ± 3.9**	**17.8 ± 2.3**	**15.4 ± 2.9**	**0.276**
Center	18.0 ± 2.7	18.8 ± 2.1	16.1 ± 2.0	
Home	14.7 ± 4.3	16.7 ± 2.1	14.7 ± 3.5	
Activity training and education	**2.9 ± 3.8**	**4.6 ± 4.1**	**4.3 ± 3.9**	**0.363**
Center	5.0 ± 4.1	6.4 ± 3.8	5.7 ± 4.5	
Home	0.7 ± 1.9	2.9 ± 3.9	2.9 ± 2.7	
Physical activity policy	**7.1 ± 7.2**	**11.4 ± 8.6**	**10.7 ± 7.3**	**0.165**
Center	10.0 ± 8.2	12.9 ± 7.6	10.0 ± 5.8	
Home	4.3 ± 5.3	10.0 ± 10.0	11.4 ± 9.0*	
Total nutrition score	**10.7 ± 1.7**	**12.4 ± 1.4**	**13.0 ± 2.0**	**< 0.001**
Center	11.3 ± 1.9	13.0 ± 0.9	13.3 ± 1.2*	
Home	10.1 ± 1.4	11.9 ± 1.7	12.7 ± 2.7*	
Fruits & vegetables	**14.4 ± 3.5**	**15.6 ± 2.8**	**13.9 ± 3.1**	**0.264**
Center	12.9 ± 3.0	15.4 ± 2.5	14.5 ± 1.4	
Home	15.9 ± 3.6	15.8 ± 3.3	13.2 ± 4.3	
Whole grains & low-fat meats	**7.1 ± 3.9**	**13.5 ± 2.8**	**12.3 ± 3.9**	**< 0.001**
Center	8.4 ± 5.2	13.5 ± 1.8	13.3 ± 1.9*	
Home	6.0 ± 1.3	13.6 ± 3.7	11.2 ± 5.1*	
High sugar/high fat foods	**11.7 ± 3.3**	**14.6 ± 2.5**	**15.2 ± 5.1**	**< 0.05**
Center	11.4 ± 2.7	13.8 ± 2.5	12.1 ± 5.6	
Home	12.1 ± 3.9	15.3 ± 2.5	18.3 ± 1.7*	
Beverages	**11.9 ± 2.4**	**13.5 ± 3.0**	**13.9 ± 3.8**	**< 0.05**
Center	12.8 ± 1.9	15.4 ± 1.4	14.4 ± 2.1*	
Home	10.9 ± 2.5	11.7 ± 3.1	13.2 ± 5.2*	
Nutrition environment	**11.9 ± 5.3**	**15.8 ± 3.3**	**17.5 ± 2.8**	**< 0.01**
Center	11.4 ± 7.4	16.4 ± 4.2	16.9 ± 3.4*	
Home	12.4 ± 2.5	15.2 ± 2.2	18.0 ± 2.2*	
Nutrition training & education	**2.6 ± 3.0**	**4.5 ± 3.8**	**5.1 ± 4.8**	**0.063**
Center	4.0 ± 3.3	5.7 ± 2.1	5.7 ± 5.1	
Home	1.1 ± 1.2	3.4 ± 4.9	4.5 ± 4.9*	
Nutrition policy	**9.5 ± 3.4**	**12.1 ± 5.0**	**12.9 ± 4.3**	**< 0.05**
Center	12.4 ± 2.5	14.3 ± 3.2	13.8 ± 4.0	
Home	6.7 ± 0.0	10.0 ± 5.8	11.9 ± 4.7*	

Values for all sites combined are indicated in bold. EPAO, Environmental Policy Assessment and Observation tool. All sites were located in Wisconsin, and measurements were made from 2012 to 2014.

* Indicates the change for the specific site type also was significant at the $p < 0.05$ level or was significant even though the overall cohort did not show significant change over the intervention period.

both English and Spanish.

2.2.2. Technical assistance

On- and off-site technical assistance was provided by the Child Care Resource and Referral agencies to sites throughout the evaluation period (2012–2014). Prior to intervention delivery, all pilot sites completed a modified version of the Nutrition and Physical Activity Self-Assessment for Child Care instrument (Ammerman et al., 2007). Providers worked with a trained technical consultant to develop a quality improvement plan based on this assessment that defined specific, measurable goals toward achieving 120 min of daily physical activity and improving their physical activity environment. Consultants also worked with providers on strategies to implement nutrition improvements in conjunction with physical activity improvements. Home- and center-based providers were allotted 30 and 60 h of on-site technical assistance per year, respectively, in addition to 12 h of off-site technical assistance per year via phone. Technical assistance sessions covered objectives, action steps, resources, cultural competency information, and assistance on engaging families.

2.2.3. Micro-grant support

Each pilot site received a one-time micro-grant of $5000 for center-based providers and $2500 for home-based providers. Micro-grant expenditure was required to be linked to the self-assessments and quality improvement plans, and funds were intended to support physical activity and implementation of the intervention.

2.3. Outcome evaluations

Collection of outcome variables described below occurred at three time points over the 2-year intervention: Spring 2012 (baseline), Spring 2013 (midpoint), and Spring 2014 (endpoint).

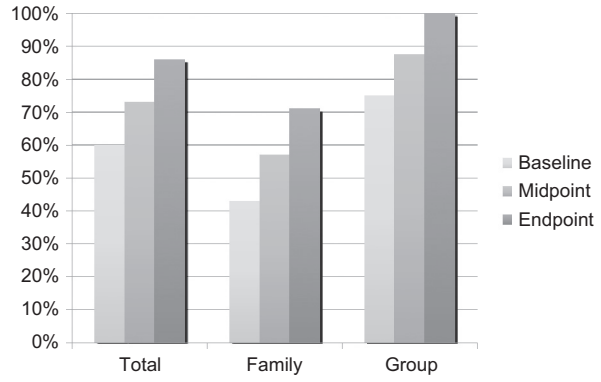

Fig. 1. Percentage of both family and group centers with written activity policies across the 2-year *Active Early* intervention period. The percentage of sites with written activity policies for at least 60 min per day significantly increased ($p > 0.05$) over the intervention period.

2.3.1. Demographics

At each time point, demographic variables were collected via survey, including site-level (number of children enrolled, number of staff, participation in the Child and Adult Care Food Program), staff-level (educational level, age, race/ethnicity) and child-level (age, race/ethnicity) factors.

2.3.2. Environment, policies, and minutes of physical activity

For each evaluation period, the three-year-old classroom for center-based sites and the entire enrollment for home-based sites were used to collect data. Child care physical activity environment and policies were assessed using the validated Environment and Policy Assessment and Observation (EPAO) instrument, which has been previously described and was utilized in *Active Early* 1.0. (LaRowe et al., 2016). Although nutrition was not a focus of this intervention, the EPAO instrument measures both the nutrition and physical activity environment, and we chose to use the full instrument in this evaluation without adaptations. In brief, a trained researcher evaluated the nutrition and physical activity environment of each site and conducted a document review of relevant policies, activities, and menus over a day-long observation period. Each site was evaluated for 1 day at each time point, and the same researcher conducted all of the evaluations. A *Total Physical Activity Score* and *Total Nutrition Score* were determined from 8 physical activity and nutrition related subscales, respectively (Ammerman et al., 2007; Ward et al., 2008). A higher score indicates a better outcome for all indicators. Additionally, minutes of teacher-led physical activity (indoor and outdoor) and free playtime (indoor and outdoor) were determined from the observations.

2.3.3. Physical activity

Physical activity intensity was measured using Actical triaxial accelerometers. Children were outfitted with an accelerometer monitor attached to an adjustable belt worn on the hip. Each child wore the belt for the entirety of their personal attendance on the day of the observation. The accelerometers provided activity counts for each 15 s interval. Data were reduced to quantify activity counts in one-minute intervals and further to quantify the number of intervals for sedentary, light, and combined moderate to vigorous activity per hour. Age-specific count cutoffs were used to correspond to physical activity levels (Puyau et al., 2004). Data were converted to percentages to correct for variations in time worn. For center-based sites, we prioritized accelerometry measurement among children in the observation classroom (3-year-old), followed by 4–5 year olds, and then 2-year-olds.

2.3.4. Interviews

Exit interviews were conducted with site directors (at both center- and home-based sites) and technical consultants to obtain information regarding the effectiveness of the program and implementation strategies. Examples of questions used include, "*What benefits to the children did you observe based on your participation in Active Early?*" (for site directors) and "*Did you observe a shift in thinking about physical activity in organizational culture, attitudes, and practice of any of the programs you advised?*" (for technical consultants). Interviews were transcribed and analyzed by two independent research staff to code for major themes using an inductive approach.

2.4. Statistical analysis

Descriptive statistics were determined for demographic variables. Differences between center- and home-based sites were analyzed using one-way analysis of variance. EPAO variables were analyzed using repeated measures analysis of variance for each subscale and for the *Total Nutrition* and *Total Physical Activity Scores*. For these analyses, 14 sites provided data for all three time points and were therefore included in the analysis. Sites were analyzed together and by site type (home- or center-based) using repeated measures analysis of variance. Accelerometer data were analyzed using repeated measures analysis of variance on group means from each; additional repeated measures analyses were run on the subset of children who were present for all three measurement periods (n = 66). All data were analyzed in SPSS v.22 with a significance level of 0.05.

3. Results

3.1. Demographics

Staff and child demographics are listed in Table 1. Briefly, *Active Early* 2.0 sites consisted of both center- (n = 8) and home-based providers (n = 7) serving 500 children (ages 2–5 years) at baseline (mean age 3.3 ± 0.9 years). Children were 23.7% white/Caucasian, 22.6% African American, 20.4% American Indian, 15.2% Hispanic, 15.0%

Table 3
Observed teacher-led physical activity overall and by site type.

	Home-based sites (n = 7 sites)			Center-based sites (n = 8 sites)			Overall (n = 15 sites)			Time main effect for all sites (Overall)
	Baseline	Midpoint	Endpoint	Baseline	Midpoint	Endpoint	Baseline	Midpoint	Endpoint	
Teacher-led PA, minutes										
Indoor	12.0 ± 7.9	52.4 ± 25.0	44.6 ± 36.3	37.7 ± 27.7	123 ± 62.3	52.3 ± 19.3	26.0 ± 24.6	90.8 ± 59.5	48.8 ± 27.0	< 0.05
Outdoor	3.8 ± 6.2	14.8 ± 18.6	17.0 ± 25.7	4.8 ± 5.1	7.1 ± 11.3	5.5 ± 11.6	4.4 ± 5.2	10.2 ± 14.2	10.1 ± 18.2	0.54
Total	14.8 ± 13.1	68.0 ± 38.3	67.0 ± 45.2	42.5 ± 27.6	130 ± 67.3	57.8 ± 15.8*	31.4 ± 26.2	105 ± 63.4	61.5 ± 29.0	< 0.05
Outdoor play, minutes	31.3 ± 27.0	59.3 ± 24.0	70.8 ± 55.2	53.3 ± 35.1	20.2 ± 37.8	59.8 ± 39.6	44.5 ± 32.5	35.8 ± 37.3	64.2 ± 43.8	0.13

Midpoint indicates measurements after Year 1, and Endpoint indicates measurements after year 2. PA, physical activity. All sites were located in Wisconsin, and measurements were made from 2012 to 2014.

Table 4
Major themes and selected comments from providers (P) and technical consultants (TC).

Benefits and co-benefits	• In the beginning I noticed the kids would get really really tired, it struck me as kind of sad, that I had 3-, 4- and 5-year-olds that would get winded after physical activity. Now they have more energy and are not huffing and puffing at the end – an overall health improvement (P3: Center) • They're not sitting down any more; they're outside longer. They don't want to leave me because they know they're going to go home to watch TV or do something boring (P10: Home). • A lot of the programs now don't have the behavioral issues they were having before; I have heard the teachers say that. Not as much acting out or "aggressional" behaviors. (TC4) • I think it does help with behaviors. Even the physical activity that doesn't necessarily get their heart rates up, like yoga, helps their mental health, not just physical (TC7). • They're eating things I never thought they would eat - fresh spinach, broccoli, cauliflower. They weren't sure about artichoke, but they'll deal - it's changed a lot of things (P3: Home). • When it's time for rest, they are ready. Some of them, it increases their appetites and then they eat better. If they are hungry they will try things even if it isn't their first choice (P5: Center).
Successful strategies (e.g., transition time and equipment)	• The challenge is to get them to look at opportunities in their regular day that they already do physical movement, and count it toward 120 minutes - rather than think "I have to be outside for 120, what? I won't get anything else done" - knowing it can be in transitions (TC1). • I also used transition cards with group centers: the teachers carry it with them - pick one to go outside or they could do something while waiting for kids to put on jackets (TC2). • Both the centers that are going to sustain it have large muscle centers out in the environment, a lot in the outdoor environment that encourage activity - the environments are going to be what keep the kids going (TC6). • The important thing is that the play is intermittent to be successful. To get those other minutes in, it has to be very natural. I think you can get many more than 120 minutes in if you think about all the time that children wait that they could be moving (TC8).
Age range challenges in home-based sites	• Older kids, school-age kids, if they didn't want to participate, the other kids didn't want to (P4: Home). • Finding 120 minutes, considering age-span, is very very difficult. The span that they work with on an individual basis makes it a challenge for scheduling and getting outside and providing that opportunity for those children to move (TC1).
Turnover challenges in center-based sites	• Staff turnover was a big issue. It seemed every time I went there was new staff I had to reintroduce myself and *Active Early* as a whole (TC4). • The biggest challenge is staff and director turnover, once we trained them and got everyone on board, they would quit and we'd have to start over (TC7). • The first challenge was constant turnover - the site itself was going through a lot of restructuring so there was a lot of distrust. I had to build a lot of trust - once we did, they had a great deal of buy-in (TC8).
Parent engagement challenges in all sites	• I can hand out a newsletter, I try talking to them, but most are so busy or want to get home to rush to this practice or that practice (P2: Home). • Especially in the area that our center is in, because a lot of our kiddos don't get outside with their families, they go home, the sit in front of the TV, their parents don't have time to get outside with them (P5: Center). • My pilot sites, some are in areas where parents are single, lower end of economic scale, and so when they're at the child care facility, that's when the kids get that physical activity. It has benefitted them in the sense that they get to go outside and play because once they leave that environment, my guess is that they don't get to do those things (TC1). • Language is a barrier - getting the communication across to parents is challenging. A lot of demonstrations help, but the connection with parents is the hard part (TC5)
Importance of staff buy-in	• Teacher-led time may be more difficult to achieve, because getting buy-in of teachers is more difficult. A large percentage of my teachers would be considered overweight or obese, harder there because they are fairly stagnant themselves - motivation and stamina isn't there, I've got a much older group too (P6: Center). • Some teachers, especially in the beginning, let the kids do whatever they wanted for gym time. Now the teacher-led time is much more meaningful for the teachers and kids (P11: Center). • I suggest building a relationship with the provider before stepping right in with a whole bunch of paperwork. It has helped me a lot. Mine were both tribal providers, and they were both very much into building relationships first (TC4). • Once you get purpose to buy in on WHY, everyone was pretty positive. Really positive (TC7).
Value of *Active Early* and need for technical assistance	• It was a very worthwhile program - anyone who is considering doing it should do it. Reverting back wouldn't be an option - the kids wouldn't even allow it! (P3: Family) • Definitely financially, there would be no way I'd be able to afford the things *Active Early* has provided me with (P4: Family). [Could the curriculum be successful w/o technical assistance?] • No-it's so different when you get mailed a tool, and you get it and can thumb through it but have no idea how to make it a hands-on program (TC4). • The pace is too fast in child care, and without direct leadership, they wouldn't have seen the things they could do. They needed me saying this is the goal, this is the outcome, this is how we're going to get there. (TC8).

Home, home-based early care and education setting; center, center-based early care and education setting. All sites were located in Wisconsin, and measurements were made from 2012 to 2014.

Asian, and 3.1% mixed race/ethnicities or other. Center-based sites had significantly more staff with bachelor's degrees and in the 18–25-year-old age range compared to home-based sites, who tended to have staff who were older and had attained less education.

3.2. Intervention delivery

All sites fully completed the intervention and associated evaluation reaching approximately 500 children (number of children at baseline was 500, 497 at midpoint, and 493 at endpoint). Total hours of technical assistance delivered were 439.25, with an average of 29 h per home-based site (out of 30 allowed) and 38 for center-based sites (out of 60 allowed). The majority of technical assistance was on-site, with < 10% occurring as off-site phone calls. Consultants utilized on-site sessions to work directly with children to visually model for providers different physical activity opportunities, including modeling staff behavior to plan, encourage, and lead the children in physical activity. This was significant for providers who felt unsure or inexperienced regarding their ability to provide physical activity opportunities. Consultants worked with providers to incorporate intentional time for physical activity into daily lesson plans and to identify other times when physical activity could be supported (e.g., transition times); these strategies allowed providers to prepare in advance. Consultants covered family engagement strategies: approaches implemented by sites during

the project included newsletters, health-focused family events, bulletin boards on *Active Early* 2.0, and a health fair. Consultants frequently worked with sites to create or update policies to be more explicit regarding physical activity. Other topics included physical activity recommendations, child development and inclusion, child assessment, storage of equipment, and cultural competency.

For the microgrant support, home-based sites used on average $2539/$2500 and center-based sites utilized $4808/$5000. Many sites purchased climbing structures and fixed playground equipment along with smaller items, such as balls, jump ropes, hula hoops, bean bags, cones, parachutes, and tunnels. The small equipment purchases allowed sites to provide variety in physical activity planning, were easily stored, accessible for children to initiate play, and most could be used indoors and outdoors, which is significant in a cold weather climate. Purchase of equipment represented ~85% of expenditures, with small amounts spent on family engagement activities and professional development.

3.3. Physical activity and nutrition environment

EPAO data are shown in Table 2. There was no significant change in *Total Physical Activity Score* or any of the Physical Activity subscales over the intervention period for all sites combined. However, the percentage sites with written activity policies for at least 60 min per day significantly increased ($p > 0.05$) over the intervention period (Fig. 1). When analyzed by site type, home-based programs significantly improved over time for *Active Opportunities* subscale, and there was a trend for an improvement in *Total Physical Activity Score* ($p = 0.07$). For *Sedentary Opportunities*, the scores for the center-based sites significantly decreased over time, indicating more sedentary opportunities were observed at the end of the intervention (as scores are constructed so that higher scores on all subscales indicate better outcomes). There were significant improvements in the Total Nutrition Score and the majority of the Nutrition sub-scores for all sites combined, with the exception of *Fruits and Vegetables* and *Nutrition Training and Education*. When analyzed by site type, both home- and center-based programs showed significant improvements over time in *Total Nutrition Score*, *Whole Grains*, *Beverages*, *Nutrition Environment*. For *Nutrition Training and Education*, home-based programs improved significantly, and there was a trend for improvement for all sites combined ($p = 0.06$).

3.4. Minutes of observed physical activity

Overall minutes of teacher-led physical activity (indoor and outdoor) increased significantly over the intervention period to 61.5 ± 29.0 min ($p < 0.05$, Table 3). When analyzed separately, the increase in teacher-led physical activity was significant indoors but not outdoors. Minutes of outdoor playtime did not significantly change over the intervention period ($p = 0.13$). However, mean outdoor playtime post-intervention was 64.2 ± 43.8 min, indicating sites were providing approximately 120 min on average post-intervention (mean indoor and outdoor time combined).

3.5. Minutes of measured physical activity

There were no significant changes in group mean activity levels for home- or center-based sites during the intervention period. At baseline, sedentary activity was 63% of time recorded, 34% was light activity, and 3% was moderate to vigorous activity. Per hour, these values correspond to 37.8 sedentary minutes, 20.4 min of light activity, and 1.8 min of moderate to vigorous activity. Because of high turnover of children and irregular attendance, data on only 66 children were available from all measurement periods; for these children, there were no significant changes in activity levels from baseline to endpoint.

3.6. Provider and technical consultant exit interviews

Major themes and sample comments from both providers and technical consultants relating to each theme are listed in Table 4. Participants identified benefits to children, including more energy, better rest periods, improved behavior and attention, and increased appetite for healthy foods. Providers also indicated improvements in their own health and behaviors. Important challenges identified included the large age-span in home-based sites, significant turnover in center-bases sites, and low parent engagement at all sites. Participants also highlighted successful strategies, including obtaining teacher buy-in regarding the importance of physical activity and focusing on active transition times for children to help teachers view achieving 120 min of physical activity as something they could accomplish.

4. Discussion

We observed significant improvements in some components of the physical activity and nutrition environment and in minutes of teacher-led physical activity after the 2-year *Active Early* 2.0 intervention. The significant changes in the nutrition environment were unexpected, as nutrition was addressed in the curriculum and training but was not the primary target of the intervention. After completing the intervention, centers were achieving > 120 min of physical activity on average in alignment with intervention goals and national recommendations. We did not observe improvements in child physical activity as measured by accelerometry, which may be related to the high turnover at multiple levels (e.g., both children and providers). This turnover way that they already do physical movement, and cos identified by care providers and technical consultants as a barrier to both implementing and evaluating the *Active Early* 2.0 intervention.

We observed significant improvements in minutes of outdoor, teacher-led physical activity and in the percentage of centers with written physical activity policies. Bell et al. determined these two factors, along with teachers participating in active play, were positively associated with pedometer-measured physical activity of children in ECE settings in Australia,(Bell et al., 2015) suggesting the changes we observed may be critical to increasing child activity levels. Supporting centers in creating wellness policies that address nutrition and physical activity may represent an important step to improving child health in ECE settings and better positions the centers to sustain improvements even if staff turnover occurs. As for outdoor play time, this aspect may be particularly beneficial for promoting moderate to vigorous physical activity. Brown et al. showed that although levels of moderate to vigorous physical activity were low overall in an observational study of 476 preschool children, significantly greater time was spent in moderate to vigorous activity while children were outdoors compared to indoors (Brown et al., 2009).

At baseline, children in our study ($n = 186$) spent only 1.8 min per hour in moderate to vigorous physical activity (3% of observed time), which would translate to approximately 15 min during an 8-h day. These levels align with those reported by Brown et al. of 3% (Brown et al., 2009) and also Tandon et al., who reported 20 min of total daily moderate to vigorous physical activity in 98 children in ECE settings using accelerometers (Tandon et al., 2015). Henderson et al. found higher levels of moderate to vigorous activity in preschool age children (9 min per hour or approximately 72 min in an 8-h day), although noted these were likely higher than other reports due to data collection occurring in the late spring and early summer when activity levels may be particularly high (Henderson et al., 2015). Moreover, evidence suggests physical activity levels decline across the lifespan, (Dumith et al., 2011; Alberga et al., 2012) with a pedometer-based study suggesting this decline may happen as early as age 6 (Tudor-Locke et al., 2010). These data support the need for early intervention at a young age to prevent this decline by addressing both the quantity and quality of physical activity to promote development of lifelong healthy lifestyle

habits.

Some barriers to physical activity reported by participating home- and center-based sites were similar to those reported by higher resourced sites in the original *Active Early* cohort, (LaRowe et al., 2016) including lack of space and equipment, need for more developmentally appropriate activities, inclement weather, and parent engagement. However, an additional barrier of staff and child turnover was identified among the *Active Early* 2.0 sites. Staff turnover at both the administrative and direct care level was particularly problematic for center-based sites, who reported staff turnover rates of 9–73%. Nationally, rates of 30–50% have been reported (Porter and W. S. University, 2012; Whitebook et al., 2016) for reasons including low wages, lack of benefits, and lack of administrative support, and these factors may be more of an issue in under-resourced areas. Turnover was more of an issue for center-based care, as home-based care tended to be single providers; however, it is unknown if this factor may be related to the greater improvements in physical activity seen in home-based care. To address the issue of turnover, technical consultants provided individual training to newly hired staff centered around specific project deliverables and the strategies used to implement physical activity. Technical consultants also worked with the administrators at the sites to add *Active Early* 2.0 materials into the general orientation and training process for new teachers to increase the sustainability of the project by minimizing the individual training required for each new teacher participating in the intervention. Therefore, all staff who were at a project site were trained on the intervention over the course of the intervention. In addition, the high turnover of children among measurement periods made it difficult to measure physical activity longitudinally using accelerometers. Another limitation was the potential for interclass correlation among children at each site, which was not accounted for during evaluation.

We noted significant improvements in multiple domains of nutrition and the nutrition environment in this study, particularly among home-based providers. This finding was surprising as nutrition was not a focus of the *Active Early* curriculum, although some training and technical assistance were provided around nutrition as part of this intervention. A companion curriculum to *Active Early* that focused on nutrition and the nutrition environment, *Healthy Bites*, was being developed concurrently in the state and may have reached some of these centers. In addition, the baseline scores for the nutrition and physical activity environment were higher than those reported for the previous higher-resourced *Active Early* cohort, (LaRowe et al., 2016) suggesting some exposure to these physical activity and nutrition resources may already have been occurring. However, the sites would not have been receiving technical assistance or microgrant support around *Healthy Bites* or other nutrition/physical activity focused information, and no other interventions were occurring at the study sites during the intervention period. We must note the inability to assess the relationship of these factors represents a significant limitation of this evaluation.

This study is notable for examining an intervention in lower resourced ECE centers and in centers serving a high percentage of children from minority populations. The significant improvements in the nutrition environment may suggest that changes in this area are easier to implement in low-resource settings and represents an important area for further investigation. Other future efforts should address increasing staff retention, focusing on sustainability of changes, and addressing challenges specific to center- and home-based settings to promote healthy environments for young children in these settings.

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Conflict of interest statement

The authors declare they have no conflict of interest.

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