



## Change in the implementation of healthy nutrition and physical activity best practices in Minnesota early care settings: A longitudinal cohort study (2010–2016)

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### ABSTRACT

The goal of the ‘Healthy Start, Healthy State’ study was to describe changes in the implementation of healthy nutrition and physical activity (PA) best practices in early child care and education (ECE) settings from 2010 to 2016. A cohort of 215 Minnesota licensed center- and family/home-based providers completed a survey describing 15 nutrition and 8 PA best practices that they “already do” in 2010 and again in 2016 were analyzed in 2016. There was a significant net implementation rate increase for 15 best practices (10 nutrition, 5 PA) in centers and 12 best practices (8 nutrition, 4 PA) in family/home-based programs. The 2010 nutrition and PA scores were negatively associated with mean change in 2016 indicating the decreased potential for improvement among sites with more best practices already implemented in 2010. Adjusted for 2010 nutrition score and other factors, centers implemented, on average, 1.45 more nutrition best practices from 2010 to 2016 than family/home based programs, and CACFP participating programs implemented, on average, 1.7 more nutrition best practices from 2010 to 2016 than non-CACFP participants. Urbanicity, provider education, and provider years of experience were not significantly associated with 2010–2016 change in nutrition score. The mean PA score change had a small but significant increase for each additional year of provider ECE experience after adjusting for the 2010 score. State-level surveillance of implemented best practices in ECE settings is useful. Findings identify opportunities for stakeholders to respond with targeted technical support and training and to consider potential future policy levers.

### 1. Introduction

A responsible reaction to the obesity epidemic in early childhood is directing resources towards early care and education (ECE) settings to better support healthy weight promoting environments (Institute of Medicine, 2011; Ward et al., 2013). However, reviewing interventions within ECE settings that aimed to limit unhealthy weight gain and promote healthy weight management reveals mixed results (Hesketh and Campbell, 2010; Campbell and Hesketh, 2007; Sisson et al., 2016). Recent literature suggests improved regulatory policy within ECE settings may offer a promising alternative to individual interventions by yielding more favorable child diet, activity and weight outcomes as well

as broader societal level economic impacts (Ritchie et al., 2015; Wright et al., 2015).

To achieve improved child health outcomes, national association experts recommend better alignment between best practices grounded in scientific evidence and state regulatory policy (Buscemi et al., 2015; Benjamin Neelon and Briley, 2011). Most states lack strong regulations for nutrition and physical activity (PA) practices within ECE settings. Furthermore, implementation variability of nutrition and PA between states that do have regulations is considerable (Larson et al., 2011). ‘Achieving a State of Healthy Weight’, a report of state regulations across a variety of healthy weight practices in ECE settings, provides an annual snapshot of obesity prevention language in child care

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regulations by state. The report confirmed only a 5% increase in full implementation and a 1% increase in partial implementation of 47 recommended policies from 2010 to 2015 (page 7) ([National Resource Center for Health and Safety in Child Care and Early Education, 2016](#)). Evidence is emerging that training, support and resources for ECE providers are necessary if state policies are to be strengthened and aligned with best practices ([Nanney et al., 2016a; Tovar et al., 2015](#)). The role of state agencies and sponsors in providing training and technical assistance in ECE settings is particularly important with the need to implement federal standards required by the Child and Adult Care Food Program (CACFP) ([Child and adult care food program: meal pattern revisions related to the healthy, hunger-free kids act of 2010](#)).

Despite the potentially broad reach of state policy enactment, the possibility for unintended consequences following increased regulations must also be considered. There is some evidence that stricter regulations among ECE settings could exacerbate disparities. In their economic analysis [Hotz and Xiao \(2011\)](#) identify pros and cons of increasing regulations on ECE programs with gains primarily seen among those living in higher income areas ([Hotz and Xiao, 2011](#)). Another study describes concerns expressed by a stakeholder group indicating that stricter regulations and the costs associated may result in increased tuition and child care costs for low income families ([Sisson et al., 2016](#)). The potential for additional ECE policies to lead to greater health inequity is concerning as childhood obesity is seen disproportionately in racial and ethnic minority and low income children ([Ogden et al., 2016](#)).

The prevalence of obesity is 5.2% among non-Hispanic white preschoolers, twice as high among non-Hispanic black preschoolers at 10.4%, and three times as high among Hispanic preschoolers at 15.6% ([Ogden et al., 2016](#)). The prevalence of obesity is 5.7% among 2–5 year old children living in households headed by an individual with greater than a high school degree and twice as high (13.6%) among children living in households headed by an individual that did not complete high school ([Ogden et al., 2016](#)). Therefore, careful regulatory construction and consistent monitoring of a broad range of potential outcomes, including disparities is important.

A gap exists in our understanding of how current federal, state, and/or local best practice policy initiatives are being translated into implementation at the program level ([Dietz, 2015](#)). State surveillance to monitor policy implementation, identify support needed, and assess progress over time across ECE programs is needed to inform decision makers. Established state specific surveillance systems exist (School Health Profiles, Minnesota Student Survey) to monitor weight-related student behaviors, health outcomes, nutrition and PA policies and practices in school settings. These tools have effectively been used to describe trends in school policies and practices ([Larson et al., 2014; Kubik et al., 2013](#)), identify disparities ([Larson et al., 2016; Caspi et al., 2015](#)), and evaluate the impact of school environments upon the diet and PA behaviors and weights of students. ([Nanney et al., 2016b; Nanney et al., 2014; Hearst et al., 2018; Kubik et al., 2015](#)) Evaluating the weight-related behaviors and outcomes of children in ECE settings is a priority gap to be addressed ([Ward et al., 2013](#)). Similar to school settings, there is a growing body of evidence addressing disparities in the social and physical child-care environments provided for young children ([Dietz, 2015](#)).

In 2010, the University of Minnesota and University of Wisconsin Clinical and Translational Science Institutes funded a cross-university collaboration that resulted in a bi-state survey of nearly 900 licensed ECE providers. This research established baseline prevalence data on the implementation of healthy nutrition and PA best practices, perceived difficulty and barriers to implementation, and provider training needs ([Nanney et al., 2016a; Caspi et al., 2015; Arcan et al., 2015](#)). In 2016, the Minnesota team launched another survey among licensed Minnesota providers that included the 2010 provider participants. The present study, ‘Healthy Start, Healthy State’, describes best practice trends related to healthy nutrition and PA among a cohort of licensed

center- and family/home-based programs from 2010 to 2016. The longitudinal cohort design generates data necessary for stakeholders to defend, maintain, or strengthen existing supports and regulations and anticipate additional needs of ECE providers.

## 2. Methods

### 2.1. Study design and program recruitment

In 2010, a stratified random sampling procedure was utilized to select representative cross-sections of licensed ECE programs throughout Minnesota; 500 center-based, and 500 family home-based licensed programs were randomly selected and invited to participate in the survey utilizing a publically available list. Recruitment of ECE providers was designed to balance participants by program type in order to assess potentially meaningful differences. A comparison of the 2010 and 2016 state license databases revealed that 43% of providers that were eligible to be randomly selected to participate in the 2010 survey were no longer licensed to provide care in 2016. This represents 20% of center-based and 46% of family/home-based ECE sites in Minnesota. The loss rate of unlicensed providers was significantly higher among rural sites than urban sites ( $p$  for Chi-square test < 0.0001). Childcare centers were significantly more likely to still be in practice in 2015–2016 than family/home-based childcare (80.6% vs 60.3%,  $p < 0.0001$ ).

From February through May 2016, providers were invited to participate in the ‘Healthy Start, Healthy State’ follow-up study if their site had completed the 2010 survey and had an active license to provide care in Minnesota in 2016. Recruitment strategies were consistent across both time points. Providers were mailed a packet that included the study description, a link to the online survey, a paper copy of the survey, and a postage paid return envelope to return a completed paper survey. Consenting ECE providers confirmed their contact information for future communication and to receive study results. Finally, providers were given a gift card for participation in the study (\$20 in 2010 and \$30 in 2016). Reminder cards, emails and phone calls were used to encourage participation. Among the 2010 survey participants, 318 (182 center, 115 family/home-based) were still licensed and subsequently invited to participate in the 2016 follow-up survey; of those invited 215 (72%) completed the survey instrument (128 center and 87 family/home). To assess non-response bias 2010 site characteristics were used. Comparisons between the 215 sites who responded and the 103 that did not respond to the 2016 survey identified no significant differences in site or provider characteristics evaluated. The University of Minnesota Institutional Review Board approved the study protocol.

### 2.2. Survey development

The ‘Healthy Start, Healthy State’ study team reengaged the original (2010) study stakeholders, along with new members. Together, the study team and the stakeholder group built upon the 2010 survey instrument by reviewing the relevance of previous items, identifying updates in best practices to include, and anticipating areas of future importance. Most of the 2010 items were retained to facilitate a longitudinal cohort comparison while addressing new stakeholder needs and minimizing respondent burden. A review of the current best practices for nutrition (e.g., NAP SACC (<https://gonapsacc.org/resources/nap-sacc-materials>), American Heart Association (Policy recommendations for obesity prevention in early care and education settings, 2015)) and physical activity (e.g., YMCA (The YMCA’s Healthy Eating and Physical Activity Standards for Early Childhood and Afterschool Programs), Let’s Move Child Care! (Let’s Move! Child Care: Tools for Child and Day Care Centers and Family-Care Homes)) in ECE settings for infants and children ages birth to five was completed. Each survey item was then assessed for alignment with federal policy (e.g., CACFP proposed rule ([Child and adult care food program: meal pattern](#)

**Table 1**  
 Characteristics of a cohort of licensed early care and education providers (n = 215) in Minnesota, 2016<sup>a</sup>.

	Overall N=215	Centers N= 128	Family Home N= 87
<b>Provider Characteristics</b>			
Age, Mean (SD)	45.5 (10.9)	44.8 (11.7)	46.5 (9.6)
Median (range)	45 (23, 79)	45 (23, 79)	46 (28, 68)
Missing	21	11	10
Non Hispanic White, N (%)	194 (95%)	119 (95.2%)	75 (94.9%)
Missing	11	3	6
Education, N (%)			
Some high school or high school graduate	24 (11.5%)	1 (0.8%)	23 (27.7%)
Trade school or some college	76 (36.5%)	31 (24.8%)	45 (54.2%)
Bachelors or graduate	108 (51.9%)	93 (74.4%)	15 (18.1%)
Missing	7	3	4
Years of ECE experience, Mean (SD)	18.1 (9.8)	18.2 (10.6)	18.1 (8.4)
Median (range)	18 (< 1 year, 42)	18 (< 1 year, 40)	17 (7, 42)
Missing	7	2	5
<b>Program/Site Characteristics</b>			
Head Start	11 (5.1%)	11 (8.6%)	0 (0%)
Total number of children on a typical day, Mean (SD)	43.3 (64.4)	66.9 (74.4)	8.0 (2.4)
Median (range)	24 (2, 576)	44.5 (10, 576)	8 (2, 12)
Missing	5	2	3
Food is prepared on-site, N (%)	176 (84.2%)	93 (73.8%)	83 (100%)
missing	6	2	4
Serve at least one meal (breakfast, noon, evening), N(%)	176 (82.6%)	91 (71.1%)	85 (100%)
Missing	2		2
Serve meal or snack, N (%)	213 (100%)	128 (100%)	85 (100%)
Missing	2		2
Nonprofit, N (%)	95 (45%)	85 (67.5%)	10 (11.8%)
Missing	4		
Currently participate in the Child and Adult Food Care Program (CACFP), N (%)	131 (62.7%)	56 (44.8%)	75 (89.3%)
Have reliable and consistent internet access, N (%)	203 (97.1%)	122 (97.6%)	81 (96.4%)
Licensed to serve infants, N (%)	153 (72.2%)	71 (55.9%)	82 (96.5%)
2016 Urban/ Rural location, N(%)			
Urban	146 (67.9%)	94 (73.4%)	52 (59.8%)
Large rural town	31 (14.4%)	17 (13.3%)	14 (16.1%)
Small rural town	24 (11.2%)	14 (10.9%)	10 (11.5%)
Rural Area	14 (6.5%)	3 (2.3%)	11 (12.6%)
			35 (40.2%)
<b>Characteristics of Families Served</b>			
Average annual family income, N (%)			
<\$25,000	18 (8.4%)	16 (12.5%)	2 (2.3%)
\$25,000 - \$59,999	85 (39.5%)	46 (35.9%)	39 (44.8%)
>=\$60,000	63 (29.3%)	42 (32.8%)	21 (24.2%)
I do not know/missing	49 (22.8%)	24 (18.8%)	25 (28.7%)
Currently have children with assistance/scholarships, N (%)			
Yes	110 (54.5%)	81 (67.5%)	29 (35.4%)
No	30 (14.9%)	13 (10.8%)	17 (20.7%)
We are willing to accept subsidies, but we currently do not have families who participate in the program.	62 (30.7%)	26 (21.7%)	36 (43.9%)
Missing	13	8	5
Selected another language spoken at home other than English, N (%)	78 (36.3%)	63 (49.2%)	15 (17.2%)

<sup>a</sup> Table 1 includes early child care and education (ECE) provider responders from Minnesota licensed center-based, including Head Start, and family home-based in both 2010–2011 and 2016. Tribal-based ECE programs are excluded.

revisions related to the healthy, hunger-free kids act of 2010)), national association updates (e.g., Caring for Our Children (American Academy of Pediatrics et al., 2012)), and Minnesota law (Minnesota Department of Human Services 2015 Legislative Session Summary).

**2.3. ‘Healthy Start, Healthy State’ 2016 survey instrument**

A 115-item survey was developed and pilot-tested with 8 providers (96-items in 2010). A complete copy of the survey is available on the project website (Healthy Start, Healthy State Study Website). For this longitudinal cohort comparison, 15 nutrition-related and 8 PA-related items were present in both the 2010 and 2016 surveys.

Nutrition and Physical Activity Practices: 15 Nutrition practices included questions within five categories assessing whether providers:

1) serve healthy meals and snacks, including beverages (n = 9), 2) attend nutrition training at least once in the past year (n = 1), 3) provide nutrition education lessons to children at least three times a year (n = 1), 4) encourage healthy eating habits and provider/staff role modeling (n = 3), and 5) write and implement a healthy nutrition policy (n = 1). Eight PA practices were constructed under five categories assessing whether providers: 1) meet frequency and time standards for PA, including for children with special needs (n = 3), 2) limit inactive time (n = 2), 3) attend PA training at least once a year (n = 1) 4) provide PA lessons to children at least 3 times a year (n = 1) and 5) write and implement a PA policy (n = 1). Providers were asked to indicate whether ‘I do this already’ (yes/no). 2010 and 2016 implementation rates for each best practice were calculated as the proportion of sites that had already implemented (‘I do this already’) the

practice in each year. Net change from 2010 to 2016 in implementation rates was calculated as the 2016 implementation rate minus the 2010 implementation rate (i.e. absolute percent change); positive net change for a best practice reflects an increase in implementation rate for that practice from 2010 to 2016. Nutrition and PA summary scores for 2010 and 2016 were constructed by summing the number of nutrition and PA best practices already implemented in each year. The 2016 nutrition summary score had a mean (SD) of 8.4 (3.4) and ranged from 0 to 15; Cronbach's alpha = 0.78. The 2016 PA summary score had a mean (SD) of 4.6 (2.3) and ranged from 0 to 8; Cronbach's alpha = 0.75. Change in nutrition and PA best practice summary scores was calculated as the 2016 nutrition/PA summary score minus the 2010 nutrition/PA summary score for each site; positive nutrition and PA change scores reflect an increase from 2010 to 2016 in number of nutrition and PA best practices implemented, respectively.

#### 2.4. Geographic location

The Census tract-based Rural Urban Commuting Area (RUCA) version 3 data, based on 2010 census commuting data with a ZIP code approximation available on the [Center for Rural Health](#) website, was merged with survey data by ZIP code to identify geographic location for each program site. RUCA codes identify four main locations which were combined into Urban (RUCA “Metropolitan” codes 1–3) or Rural (includes RUCA Large rural city/town (“Micropolitan”) codes 4–6, Small rural town codes 7–9, and Rural areas code 10).

#### 2.5. Statistical analysis

Descriptive statistics include mean (SD) for continuous measures and n (%) for categorical measures. Cronbach's alpha was used to evaluate internal reliability of the summated nutrition and PA scores. Analysis methods appropriate for paired data were used to evaluate mean change over time in summary scores and change over time in individual best practice implementation rates in this cohort of ECE sites with providers who completed both 2010 and 2016 surveys. Comparisons were stratified by program type (center- and family/home-based). Paired t-tests were used to test mean change from 2010 to 2016 in the nutrition and PA summary scores within each program type. McNemar's chi-square test was used to test for change in implementation rates of individual best practices from 2010 to 2016. Generalized linear models were used to estimate associations between program and provider characteristics and change from 2010 to 2016 in Nutrition and PA best practice summary scores, both unadjusted and adjusted for other factors. A type I error rate (alpha) of 0.05 was used to identify significance of statistical tests. No adjustment for multiple comparisons was done. SAS version 9.4 was used for all statistical analysis.

### 3. Results

In 2016, study participants had a mean age of 46 (SD = 10.9), were primarily non-Hispanic White (95%), and about half had a bachelor's degree or higher (74% centers, 18% family/home-based). The average number of years of experience was 18 (SD = 9.8) with the majority of providers reporting preparing food on-site (84%) and participating in the CACFP (63%). See [Table 1](#) for additional details.

[Table 2](#) shows that 2016 implementation rates for individual nutrition and PA best practices ranged from 18% to 88%. There was a significant net implementation rate increase for 15 best practices (10 nutrition and 5 PA) in centers. Best practices with a net implementation rate increase near 25% in centers were: provide PA education lessons for children at least three times a year (+27.4%), serve only white (unflavored), low fat milk to children two years or older (+27.3%), and provide a minimum of 60 min of PA per day (+23.4%). McNemar's chi-square tests for these changes in PA best practice implementation rates

were significant ( $p < 0.001$  for all). In family/home-based programs, there were significant net implementation rate increases in 12 best practices (8 nutrition and 4 PA). Best practices with a net implementation rate increase near 25% in family/home-based programs were: attend PA training at least once per year (+26.4%), serve high sugar foods less than once per week or not at all (+25.3%), allow children to decide when they are full (+25.3%), serve only white (unflavored), low fat milk to children two years or older (+25.3%), and never serve sugary drinks (+24.2%). McNemar's chi-square tests for these changes in nutrition best practice implementation rates were significant ( $p < 0.001$  for all). There were no significant net implementation rate changes in either direction for family/home-based or center programs for the following practices: serve low sodium meals or snacks every day (marginally significant increases), serve only 100% fruit juice and limit to 4–6 oz per day or less, attend healthy eating and nutrition training at least once per year (not counting CACFP training), and write and implement a PA policy (marginally significant increases). The lack of significant net implementation rate changes for serving only 100% fruit juice and limiting to 4–6 oz per day or less are attributable, in part, to high 2010 implementation rates of this best practice: 62% in centers and 71% in family/home-based programs. Center-based programs had significant increases from 2010 to 2016 in nutrition and PA best practices implementation scores with a mean (SE) increase of 1.9 (0.4) nutrition and 1.2 (0.2) PA practices ( $p < 0.01$  for both). Family/home-based programs had similar increases in nutrition and PA best practices implementation summary scores with a mean (SE) increase of 1.8 (0.3) nutrition and 1.0 (0.3) PA practices ( $p < 0.01$  for both).

[Table 3](#) includes generalized linear model estimates of associations between program and provider characteristics and nutrition and PA implementation summary score change from 2010 to 2016. Only baseline (2010) nutrition and PA scores were significantly associated with change from 2010 to 2016 in nutrition and PA summary scores in unadjusted analyses (data not shown). In a model adjusted for other program and provider characteristics (childcare type, urbanicity, CACFP participation, provider education and provider years of experience), the 2010 nutrition summary score was negatively and significantly associated with mean change in nutrition summary score with a 0.8 point decrease in mean nutrition score change ( $p < 0.0001$ ) for each additional nutrition practice already implemented in 2010, indicating the decreased potential for improvement among sites that had more nutrition best practices already implemented in 2010. Adjusted for this strong effect of 2010 nutrition score and other factors, centers implemented, on average, 1.45 more nutrition best practices from 2010 to 2016 than family/home based programs, and CACFP participating programs implemented, on average, 1.7 more nutrition best practices from 2010 to 2016 than non-CACFP participants. Urbanicity, provider education, and provider years of experience were not significantly associated with 2010–2016 change in nutrition score. Adjusted for the same factors, the 2010 PA summary score was negatively and significantly associated with mean change in 2016 PA summary score with a 0.3 point decrease in mean PA score change ( $p < 0.0001$ ) for each additional PA practice already implemented in 2010, again reflecting the decreased potential for improvement in programs that had already implemented more PA best practices in 2010. The mean PA score change had a small but significant ( $p = 0.018$ ) increase for each additional year of provider ECE experience after adjusting for the 2010 score and other factors in the model. Unlike the model for change in nutrition summary score, program type and CACFP participation were not associated with mean change in PA summary score after adjusting for 2010 PA score and other factors.

### 4. Discussion

Study findings revealed significant net implementation rate increases from 2010 to 2016 for 12 best practices (8 nutrition, 4 PA) in family/home-based programs, 5 best practices had a net increase of



about 25%. Centers had significant net implementation rate increases for 15 best practices (10 nutrition, 5 PA), 3 had a net increase of about 25%. These improvements took place within a state policy environment that did not enact a single additional nutrition or PA policy targeting ECE settings during the study observation period (from 2010 to 2016). Since these improvements cannot be attributed to changes in state policy they may be a result of focused efforts made by other state and local initiatives. For example, in Minnesota, the Statewide Health Improvement Program (SHIP) (Minnesota State Health Improvement Program, n.d), a state funded investment focusing on increasing

physical activity, improving nutrition and reducing the number of people who use or are exposed to tobacco, targets ECE, school, and workplace settings. Nearly 18% of providers in the current sample indicated receiving direct support from SHIP, and more may have benefited from some form of SHIP funded programming without being aware of it. Other national and state initiatives offering support for ECE providers include Let's Move! Child Care (Let's Move! Child Care: Tools for Child and Day Care Centers and Family-Care Homes), Farm to Childcare (National Farm to School Network), the Healthy, Hunger-Free Kids Act (Child and adult care food program: meal pattern

**Table 2**  
2010 and 2016 implementation rates and change over time in nutrition and physical activity best practices implemented among licensed early care and education providers, by program type<sup>a</sup>.

Nutrition & physical activity practices	"I do this already" <sup>b</sup>					
	Center-based N = 128			Family home-based N = 87		
	2010	2016	Absolute % change and p-value <sup>c</sup>	2010	2016	Absolute % change and p-value <sup>c</sup>
	% (n)	% (n)		% (n)	% (n)	
<b>Meals and snacks</b>						
Serve high fat foods less than once per week or not at all	39.1 (50)	46.9 (60)	+7.8 p = 0.211	25.3 (22)	47.1 (41)	+21.8 p = 0.0009
Serve high sugar foods less than once per week or not at all	39.8 (51)	46.9 (60)	+7.1 p = 0.241	21.8 (19)	47.1 (41)	+25.3 p = 0.0002
Serve low-sodium meals or snacks every day	24.2 (31)	32.0 (41)	+7.8 p = 0.086	12.6 (11)	23.0 (20)	+10.4 p = 0.061
Serve only whole grain foods	18.0 (23)	34.4 (44)	+16.4 p = 0.0002	14.9 (13)	32.2 (28)	+17.3 p = 0.004
Serve at least one fruit and/or non-fried vegetable at every meal and snack	39.8 (51)	57.8 (74)	+18 p = 0.001	57.5 (50)	65.5 (57)	+8.0 p = 0.223
Serve only white (unflavored), low-fat milk to children two years of age and older	43.0 (55)	70.3 (90)	+27.3 p < 0.0001	55.2 (48)	80.5 (70)	+25.3 p = 0.0007
Serve only 100% fruit juice and limit to 4–6 oz per day or less	62.8 (71)	64.6 (73)	+1.8 p = 0.763	71.3 (57)	63.8 (51)	-7.5 p = 0.289
Never serve sugar sweetened beverages	58.6 (75)	77.3 (99)	+18.7 p = 0.0003	51.7 (45)	75.9 (66)	+24.2 p = 0.0003
Children can access drinking water freely throughout operation hours	72.7 (93)	87.5 (112)	+14.8 p = 0.003	71.3 (62)	88.5 (77)	+17.2 p = 0.005
<b>Gross motor activities</b>						
Provide children with a minimum of 60 min of gross motor activity per day consisting of both teacher-led and free play	56.3 (72)	79.7 (102)	+23.4 p < 0.0001	69.0 (60)	69.0 (60)	± 0 p = 1.000
Provide opportunities for gross motor physical activity for children with special needs <sup>d</sup>	47.7 (61)	58.6 (75)	+10.9 p = 0.052	16.1 (14)	33.3 (29)	+17.2 p = 0.007
Provide outdoor, gross motor physical activity at least two times per day	55.5 (71)	65.6 (84)	+10.1 p = 0.047	48.3 (42)	50.6 (44)	+2.3 p = 0.715
<b>Sedentary activities</b>						
Limit television, video, and computer time to no > 60 min per day	75.0 (96)	87.5 (112)	+12.5 p = 0.011	58.6 (51)	71.3 (62)	+12.7 p = 0.048
Limit children's inactive time to no longer than 30 min except when sleeping or eating	60.9 (78)	74.2 (95)	+13.3 p = 0.035	46.0 (40)	55.2 (48)	+9.2 p = 0.238
<b>Provider training</b>						
Attend healthy eating and nutrition training at least once per year, not counting food safety (CACFP)	21.1 (27)	18.8 (24)	-2.3 p = 0.612	48.3 (42)	40.2 (35)	-8.1 p = 0.274
Attend gross motor physical activity training at least once per year	20.3 (26)	28.9 (37)	+8.6 p = 0.078	11.5 (10)	37.9 (33)	+26.4 p < 0.0001
<b>Child education</b>						
Provide healthy eating and nutrition education to children at least 3 times per year	33.6 (43)	52.3 (67)	+18.7 p = 0.0005	34.5 (30)	37.9 (33)	+3.4 p = 0.578
Provide education lessons for children with a focus on gross motor physical activity at least 3 times per year	39.8 (51)	67.2 (86)	+27.4 p < 0.0001	21.8 (19)	42.5 (37)	+20.7 p = 0.001
<b>Child development and role modeling</b>						
Refrain from using food for reward or punishment	71.1 (91)	84.4 (108)	+13.3 p = 0.007	63.2 (55)	73.6 (64)	+10.4 p = 0.117
Allow children to decide when they are full during meal and snack times	69.5 (89)	85.2 (109)	+15.7 p = 0.002	49.4 (43)	74.7 (65)	+25.3 p = 0.0001
Have at least one adult sit at the table and eat the same meals and snacks as the children	61.7 (79)	74.2 (95)	+12.5 p = 0.008	21.8 (19)	25.3 (22)	+3.5 p = 0.532

(continued on next page)

**Table 2** (continued)

Nutrition & physical activity practices	“I do this already” <sup>nb</sup>					
	Center-based N = 128			Family home-based N = 87		
	2010	2016	Absolute % change and p-value <sup>c</sup>	2010	2016	Absolute % change and p-value <sup>c</sup>
Meals and snacks	% (n)	% (n)		% (n)	% (n)	
Policy						
Written and implemented a healthy nutrition policy <sup>c</sup>	33.6 (43)	47.7 (61)	+14.1 p = 0.016	9.2 (8)	18.4 (16)	+9.2 p = 0.046
Written and implemented a physical activity policy <sup>c</sup>	36.7 (47)	47.7 (61)	+11.0 p = 0.075	10.3 (9)	18.4 (16)	+8.1 p = 0.071
Summary	Mean (SD)	Mean (SD)	Mean change <sup>f</sup> (SE)	Mean (SD)	Mean (SD)	Mean change <sup>f</sup> (SE)
Total nutrition-related practices (maximum of 15)	6.9 (4.0)	8.8 (3.4)	<b>1.9 (0.39)</b> p < 0.0001	6.1 (3.7)	7.9 (3.3)	<b>1.8 (0.25)</b> p = 0.0004
Total physical activity-related practices (maximum of 8)	3.9 (2.4)	5.1 (2.1)	<b>1.2 (0.24)</b> p < 0.0001	2.8 (2.0)	3.8 (2.3)	<b>1.0 (0.27)</b> p = 0.0006

<sup>a</sup> Table 2 includes early child care and education (ECE) provider responders from Minnesota licensed center-based, including Head Start, and family home-based in both 2010–2011 and 2016. Tribal-based ECE programs are excluded. Absolute change (2016 rate minus 2010 rate) is reported.

<sup>b</sup> Denominator includes provider responses of NA (Not Applicable) or missing response.

<sup>c</sup> Bolded indicates significant McNemar’s Chi-square test of paired implementation prevalence rates between 2010 and 2016 (p < 0.05); null hypothesis of McNemar’s chi-square test is that there is no net change in prevalence over time.

<sup>d</sup> 26%, 1.7% (n = 33, 2) of center-based and 63%, 0% (n = 55, 0) of family home-based providers reported NA (Not Applicable) for this question in 2010 and 2016 respectively; NA are included in denominator.

<sup>e</sup> One question in 2010 and two questions in 2016. 2016 questions for writing and implementing policy were combined (“and”) to compare with 2010 question.

<sup>f</sup> Bolded indicates paired t-test of mean change between 2010 and 2016 was significantly different from 0 (p < 0.05). Mean change was calculated as 2016 score minus 2010 score.

revisions related to the healthy, Hunger-free Kids Act of 2010), Minnesota Food Charter (Minnesota Food Charter), and Minnesota’s Born to Thrive initiative (Born To Thrive). Licensed small family/home-based programs in Minnesota have a high participation rate in the CACFP, which provides unique training opportunities. For example, the largest sponsoring agency, Providers Choice, provides training for small family/home-based providers relating to nutrition and active play, beyond the CACFP meal pattern requirements. This supports the current study findings that CACFP participation was a positive predictor of change in the nutrition best practice score; however, not for change in PA score. Several research studies have identified positive associations with CACFP participation and healthier meals and snacks in ECE settings and preschooler diet and weight status (Lumeng et al., 2015; Ritchie et al., 2012). In general, there has been a widespread focus on healthy eating and physical activity within local and national media outlets. Specific impact of this social shift is challenging to quantify, it is

possible that this has influenced provider actions to some degree. A recent systematic review of interventions in ECE centers identified that providing technical support and training for environmental changes appeared to demonstrate favorable effect on nutrition outcomes (Sisson et al., 2016). Relatedly, an ecologic evaluation of ECE settings conducted in New York City reported that an improvement in the weight status of low income children within these settings was observed from 2004 to 2006 to 2008–2010; researchers concluded that observed improvements could be attributed to efforts by multiple stakeholders working in concert to achieve the same goal (Sekhobo et al., 2014). These studies and our findings indicate that providers are best equipped to adhere to best practice when they receive support and training from multiple sources.

Our findings identified no significant change in either direction by either ECE program type for serving low sodium meals or snacks, limiting 100% juice consumption to 4–6 oz a day (attributable in part to

**Table 3**

Predictors of mean change in nutrition and physical activity policies and practices from 2010 to 2016 among Minnesota early care and education settings.

2010 Program or Provider characteristic	Mean change in nutrition summated score (2010–2016)		Mean change in PA summated score (2010–2016)	
	Estimate (SE)	p-value <sup>a</sup>	Estimate (SE)	p-value <sup>a</sup>
2010 Baseline score: 1 point increase	−0.81 (0.06)	< 0.0001	−0.30 (0.05)	< 0.0001
Program type: center compared to family/home	1.45 (0.64)	0.024	0.50 (0.47)	0.292
Urbanicity: Urban compared to Rural <sup>b</sup>	0.14 (0.50)	0.788	0.44 (0.38)	0.244
CACFP participation: Yes compared to No	1.70 (0.63)	0.007	0.75 (0.47)	0.109
Provider education: post HS education vs HS or less	0.55 (0.75)	0.458	0.60 (0.56)	0.283
Provider years of experience: 1 year increase	0.0001 (0.03)	0.997	0.05 (0.02)	0.018

<sup>a</sup> Generalized linear models were used to estimate associations between program and provider characteristics and change from 2010 to 2016 in summated Nutrition and Physical activity best practice summary scores, adjusted for the other factors listed in the table.

<sup>b</sup> Program sites were defined urban or rural using census tract-based Rural Urban Commuting Area (RUCA) codes with ZIP code approximations available on the Center for Rural Health website.

already high implementation rates in 2010), attending nutrition training at least once per year, and writing and implementing a PA policy. At the state level, according to the ‘Achieving a State of Healthy Weight’ report, limiting sodium in meals and snacks and having a written PA policy were less likely to be addressed in state regulations across the country and have seen little improvement since 2010 (pages 14–15) (National Resource Center for Health and Safety in Child Care and Early Education, 2016). On the federal level, the recently released (4/25/2016) CACFP meal pattern final rule revisions related to the Healthy, Hunger-Free Kids Act of 2010 prohibits juice for infants under 8 months of age, and limits juice to one serving of 100% juice per day for age 8 months to six years (Child and adult care food program: meal pattern revisions related to the healthy, Hunger-free Kids Act of 2010). The federal rule does not directly address sodium in foods. In 2010, top barriers to achieving best nutrition and PA practices were ‘cost of healthy foods’ and “weather”, respectively (Nanney et al., 2016a). They also remain the top barriers in 2016 (data not shown). Exploring strategies that address these barriers should also consider how to intersect with supporting providers in meeting best practices where progress has stalled (e.g., serve low sodium foods), as well as those best practices that have demonstrated momentum but still have room to improve (e.g., provide PA lessons). For example, one way to address the barrier of food cost with the goal of increasing the number of low sodium food served would be through design of programs that develop providers' food preparation skills and literacy; by improving food preparation skills they will be better equipped to prepare less processed foods while still adhering to a tight food budget.

## 5. Study strengths and limitations

To our knowledge the longitudinal cohort study design, generated from an initial random sample of licensed ECE programs in 2010 and follow-up in 2016, is the first reported in the ECE literature and serves as a model for other states. Prior work demonstrates that a sampling design that allows for comparisons in implementation of policies and practices across program types is necessary (Nanney et al., 2016a). Significant stakeholder input on survey development potentially adds to the utility of the data. However, the results of the ‘Healthy Start, Healthy State’ study are limited to Minnesota and may not be generalizable to other states. In addition, the findings are limited to practices of licensed ECE providers and may not apply to unlicensed family, friend and neighbor caregivers. Also, nearly half (49%) of center ECE providers reported that children in their care spoke a language other than English at home. The stakeholder group discussed the need to gather data from providers primarily caring for immigrant children. Finally, potential bias among the respondents themselves should be considered when interpreting study findings. First, provider practices are self-reported and may be overstated. Second, it is not known that the provider survey respondent in 2010 was the same as the provider respondent in 2016. For example, there is a smaller than 6 year difference in mean years of ECE experience providers reported in 2010 (16.9 years) and 2016 (18.1 years) for the 215 sites responding in both 2010 and 2016. Third, maturation bias among provider respondents is also a consideration. There was a significant association between 2010 years of ECE provider experience and mean increase from 2010 to 2016 in the PA best practices summary score but not with the nutrition best practices score. However, as suggested above, provider respondents may not be the same across 2010 and 2016 surveys.

## 6. Conclusions

In Minnesota, obesity rates among 2- to 4-year-olds enrolled in WIC from 2010 to 2014 dropped slightly from 12.7% to 12.3%. State-level surveillance of implemented best practices and policies in ECE settings can be informative, especially when repeated over time. The ‘Healthy Start, Healthy State’ study uniquely describes areas of progress and

stalls and predictors of implementation practices over a 6-year period. The context is especially insightful as no additional nutrition or PA-related regulatory requirements targeting ECE settings were enacted within the state of Minnesota during the study time frame (Minnesota Department of Human Services 2015 Legislative Session Summary). Instead, healthy food and active play initiatives at the federal, state and local level were employed and credited for the significant improvements in implementation of best practices. These findings identify opportunities for targeted technical support and training along with potential future policy levers for stakeholders to consider.

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