(SDAS) State Policy and Childhood Obesity
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I. Introduction

A. Nature of the research problem

Childhood obesity is a significant public health problem affecting nearly 17% of American youth (1). Obese children are more likely to have physical, emotional and psychological health problems, such as type 2 diabetes, cardiovascular disease, and depression (2). The health risks associated with childhood obesity persist into adulthood and include arthritis, stroke, liver disease, cancer and lower life expectancy (3). Obesity-related diseases carry considerable economic and social costs, and these costs are escalating (4). Obesity-related medical costs in the United States increased about $68 billion from 1998 to 2008; reaching an estimated $147 billion in 2008 (5).

Increasing national recognition of the lifelong and societal threats of childhood obesity has led to a surge in obesity research, prevention programs and policies. However, the effectiveness of state policies is mixed (6–11), and childhood obesity rates have remained stable despite increases in obesity prevention efforts (1).

B. Purpose, scope, and methods of the investigation

The objective was to examine the relations between state-level school policies and childhood obesity for youth ages 10-17 years. The three specific aims were to examine:

1) Changes in state school policies for nutrition and physical education from 2003 to 2006
2) Whether state nutrition and physical education (PE) policies in schools in 2006 are related to the state prevalence of childhood obesity
3) Whether state policies related to nutrition and PE in schools in 2006 have an independent effect on related childhood obesity after adjusting for individual child, family and neighborhood characteristics.

We conducted secondary analysis of the 2003-2006 School Nutrition Environment State Policy Classification System (SNESPCS), 2003-2007 Physical Education Related State Policy Classification System (PERSPCS), and the 2003 and 2007 National Surveys of Children's Health (NSCH) to assess eleven nutrition and 5 PE policy domains for elementary (ES), middle (MS), and high school (HS) children. The primary analyses were logistic regression models for the association of state–level school policies on obesity prevalence in 2007 as well as change scores for the policy assessments.

C. Nature of the findings

The study results show an increased use of many state policies regulating the school health environment. Findings also indicate that stricter state-level school nutrition and PE policies are associated with a higher odds of childhood obesity even after adjusting for related child, family and neighborhood factors. Stricter nutrition policies are positively associated with the odds of 2007 obesity in 3 ES and 2 MS domains and negatively associated with 1 HS domain. One MS and 2 ES PE policy domains are positively associated with 2007 obesity. Furthermore, improvements in the health policy environment from 2003 to 2006/2007 are associated with greater odds of obesity in 2007 for 7 of the state school health policies examined. These findings suggest that states with the higher obesity levels have responded with greater institution of policies.

II. Review of the Literature

A. Consequences of and Increasing Prevalence of Childhood Overweight and Obesity

Obesity is an increasing public health problem affecting about 12 million US children. For children ages 2-19 years, obesity is defined as having a body mass index (BMI, kg/m^2) at or above the 95th percentile for children of the same age and sex. Being overweight, or at risk for obesity, is defined as being at the 85th to 95th percentile for BMI. Data from the National Health and Nutrition Examination

Surveys (NHANES) reveal that the percentage of obese children, ages 2-19 years, increased from 13.9% in 1988-1994 to 17.1% in 2003-2004 with increases seen among 2-5 year olds (7.2%-13.9%), 6-11 year olds (11.3%-18.8%) and teens 12-19 (10.5% - 17.4%) (12, 13).

Consequences of childhood overweight include increasing risk of being obese as adults and poor physical, emotional and social health. Overweight children have more cardiovascular risk factors (high blood pressure, high cholesterol and triglyceride levels, Type 2 diabetes) even in childhood. Poor emotional health is expressed as low self-esteem, negative body image, and depression; poor social health is characterized by stigma, negative stereotyping, discrimination, teasing, bullying, and social marginalization (2). Overweight adolescents have 70% chance of becoming overweight or obese adults. Adult obesity increases the risk of cardiovascular disease and diabetes as well as cholelithiasis, arthritis, and stroke and is related to other chronic diseases such as colorectal cancer, end stage renal and liver disease, low back pain, obstructive sleep apnea and urinary incontinence (14). Overweight children use more health care resources and have higher medical care costs (15); these costs have dramatically risen in the last few decades (4).

B. Factors Associated with Overweight

A complex set of interrelated factors contribute to overweight including genetic, behavioral (energy intake, physical activity), and environmental factors (home, child care, schools, communities) (16). Childhood overweight reflects and imbalance between energy intake and calorie expenditure. In effect, children consumer too many calories relative to the number of calories used (2). Recent findings from the Monitoring the Futures Study of Youth in 8th and 10th grades suggest that lifestyle behaviors (related to eating, exercise, sleep, TV viewing) are more important than family/parenting characteristics (such as after school parental supervision, living with both parents), but environmental factors that influence children's behavior were not considered (17).

To address obesity, state legislators have adopted legislation to promote healthier diets and greater exercise starting in childhood. State legislation for wellness polices also has been considered in response to the federal 2004 Child Nutrition and WIC Reauthorization Act that required school districts in the National School Lunch/Breakfast Programs to establish a local wellness policy by the start of the 2006-2007 school year. State strategies include nutrition standards for schools, nutrition and physical education in schools, BMI screening, support of farmers markets, and mandatory insurance coverage for obesity prevention and treatment. Also, many states have established related commissions, task forces and advisory groups. There are no systematic studies, however, examining the effect of state laws on childhood obesity. The Arkansas Center of Health Improvement attributes the decrease in overweight students from 20.9% in 2004 to 20.4% in 2006 to BMI screening, but the change is small and theses results do not adjust for other factors that contribute to obesity (18, 19). In an analysis of state policies from 2003 to 2005 Boehmer found no association between adult obesity prevalence and legislation (20). However, this study did not assess the comprehensiveness of state polices, did not focus on children, and included both introduced and adopted legislation.

C. Role of State Policies in Addressing Childhood Health

Policy evaluation studies support the use of state polices to improve child health. For example, increased use of policies regulating motor vehicle safety and newborn screening is associated with reductions in child morbidity and mortality (21, 22). State policies are one effective tool for improving the school health environment (23, 24), however, the extent to which state school policies impact youth health and obesity prevalence needs further evaluation (6–11).

Inconsistent findings from policy effectiveness studies that use obesity prevalence as the outcome may be due to differences in study designs, the complex nature of weight change and an insufficient lag time between adoption of the policy and evaluation of the outcome. Nanney et al. (25) examined state-level school obesity prevention policies and found positive relations between policies and state obesity rates, suggesting a responsiveness of states with high childhood obesity prevalence to adopt obesity prevention policies. However, these findings were limited because only bivariate cross-sectional analyses were conducted with data from the 2006 School Health Policies and Programs Study. These data were not designed to assess state-level obesity prevention policies and policy domain scores were constructed from a selected set of survey responses.

III. Study Design and Methods

A. Study design

Secondary analysis of data from the 2003-2006 SNESPCS, 2003-2007 PERSPCS, and the 2007 and 2003 NSCH was performed. The SNESPCS and PERSPCS classify state laws about school nutrition and PE policies using the Westlaw legal database (26, 27). Data from the NSCH are collected via a telephone interview with parents/guardians of children 0-17 years old in the US (28).

B. Population studied

The 2007 NSCH contains information about 91,642 children 0-17 years old. NSCH data are representative at the national and state level. The 2007 NSCH had an interview completion rate of 66% (29).

C. Sample selection

Children 10-17 years old with complete height and weight data in the NSCH and who attended public or private schools were included in the analysis. This subsample represents 96% of the 2007 NSCH sample ages 10 and 17 years and 48% of the total 2007 NSCH sample.

D. Instruments used

Child, Family and Neighborhood Data

The NSCH collects data on children 0-17 years old using random digit dialing of households with children under 18 years of age conducting telephone interviews parents/guardians about one child per household (28). The 2007 NSCH provides information about child, family and neighborhood characteristics that was used in the analyses. See Table 1 for a list of variables from the NSCH.

Table 1. Information from the NSCH

Variable	Type
Child Overweight [1,2]	Dependent Variables
Child Obese[1]	
Child Age	Independent Covariates: Individual Characteristics
Child Sex	
Child Race	
Child Ethnicity	
Child School Type	
Child Health Status	
Family Structure	Independent Covariates: Family Characteristics
Maternal Age	
Primary Lang. in Home[2]	
Respondent Education	
Family Income Level	
Involvement in Sports Teams	Independent Covariates: Physical / Sedentary Activity
Extent of Physical Activity	
Computer Usage	
TV Usage	
TV in Child's Bedroom	
Neighborhood Parks	Independent Covariates: Community Characteristics
Neighborhood Sidewalks[2]	
Neighborhood Rec. Centers[2]	
Community Safety[2]	

[1] From respondent report of child height, weight, age and sex.
[2] Variable not included in primary analyses.

Policy Data

The SNESPCS and the PERSPCS systematically classify state statutory and administrative laws about school nutrition and PE policies for all 50 states and the District of Columbia (26, 27). Each policy is rated using an ordinal scale ranging from 0 to 3 or higher depending on the policy (26, 27). The score ranges for nutrition policy areas are based on Institute of Medicine's (IOM) guidelines for each school health standard (26, 27, 30). Scores of zero indicate no state policy and scores of one indicate that guidelines were recommended, but not required (26, 27). Scores of two and higher indicate the strictest requirements. Policy data were collected separately by school-type (ES, MS, HS) for each state and the District of Columbia (26, 27).

Analyses used the newest version of the SNESPCS 2003 and 2006 data which match IOM school recommendations (30). The SNESPCS assessed seventeen policy areas; eleven of these were evaluated separately for ES, MS and HS, and six across all three school-types. "Preferential Pricing" policies in 2003 and 2006 assessments were excluded because no state had adopted such policies. PERSPCS data from 2003 and 2007 evaluated five policy domains, four of which are assessed for ES, MS, and HS separately, and one ("Time requirements for recess") for ES only. See Table 2 for information about policy variables

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Statistical techniques employed

Preliminarily analyses

Data cleaning, editing and merging was performed to create a single dataset for the analyses. See Table 1 for a list of variables from the NSCH. Overweight and obesity were defined as having a BMI ≥85th and ≥95th percentile (respectively) for age and sex using the 2000 Centers for Disease Control and Prevention Charts for the United States (31). Child age was a continuous variable by year. All other individual, family and neighborhood variables were categorized: sex (male, female), race (white, Black, multi-racial, other), ethnicity (Hispanic, non-Hispanic), health status (excellent/very good/good, fair/poor), type of school attended (private, public), involvement in sports teams (yes, no), extent of physical activity (<3days/week, ≥3 days/week), computer and television usage (≤2 hours/day, >2 hours/day), child has a television in his/her bedroom (yes, no), family structure (two biological/adoptive parents, two parents with a step-parent, single mother, other family structure), maternal age (< 34, 35-39, 40-44, 45-49, ≥50 years), primary language spoken at home (English, not English), respondent's level of education (>high school (HS), HS, < HS) family income level (≤100% of the federal poverty level (FPL), 101-150% FPL, 151%-200% FPL, 201-300% FPL, >300% FPL), access and availability of parks and playgrounds, sidewalks, community recreation centers (yes, no), community safety (yes, no).

Table 2. Policy Variables

State Policy Area	Scale for Policy Area[1]
Nutrition Policies (2006)	
Competitive Foods a la Carte in Cafeterias	
A la carte non-entrée snacks in cafeterias	0-6
A la carte non-entrée beverages in cafeterias	0-6
A la carte entrées in cafeterias	0-5
Competitive Foods a la Carte in Cafeterias Domain	0-17
Competitive Foods in Vending Machines	
Vending machine foods available during the school day	0-6
Vending machine beverages available during the school day	0-6
Competitive Foods in Vending Machines Domain	0-12
Competitive Foods in Other Venues	
Foods available from school stores/canteens	0-6
Beverages available from school stores/canteens	0-6
Competitive Foods in Other Venues Domain	0-12
Fundraiser Foods and Beverages	
Foods available from fundraisers	0-6
Beverages available from fundraisers	0-6
Fundraiser Foods and Beverages Domain	0-12
Reimbursable School Meals	0-5
Nutrition Education	0-4
School Meal Environment	0-3
Food Service Director Qualifications	0-4
Coordinating Advisory Councils	0-3
Marketing and Advertising	0-3
BMI Screening	0-2
Physical Education Policies (2007)	
PE Time Requirements	0-5
PE Staff Qualification Requirements	0-4
PE Curriculum Standards	0-4
Assessments of Health-related Fitness	0-4
Time Requirements for Recess in ES	0-4

[1]A score of 0 means there is no state policy in place, and a score of 1 means there are recommendations but no requirements. A score of 2 reflects the least stringent requirement. Scores of 3 and higher (depending on the domain), denote the strictest requirements. Policies evaluated for each of the 50 states and the District of Columbia.

Policy variables were assessed individually (17 SNESPCS and 5 PERSPCS), combined into state composite scores for ES, MS, and HS, and grouped into 11 nutrition policy domain areas and 5 PE policy areas. When composite policy scores were created we used raw and z-score transformed scores to allow for the comparison of variables with different scales and the appropriate weighting of variables in composite scores. Furthermore, a change score for each policy variable was created for each state and the District of Columbia by subtracting the 2003 state-specific policy score from the most recent (2006 for nutrition and 2007 for PE data) state-specific policy score. See Table 2 for a list of policy variables and the 16 policy areas.

Missingness was examined for each variable. Variables with 1-5% missing data were assigned a response of "missing." For variables with less missing data, missing responses were included in the reference group, and a variable was created to code children with at least one variable with missing data.

Missing values for Family Income Level exceeded 7%, so multiple imputation techniques were used with 5 imputed values provided by the 2007 NSCH.

Cross-tabs with chi-squared statistics and bivariate logistic regression explored the relations between overweight and/or obesity and each NSCH and policy variable. Multivariable logistic regression examined the associations between the 20 NSCH factors and the odds of being overweight and/or obese when groups of related variables were used as predictors. The strength of these associations and the conceptual importance of each of the 20 NSCH variables were considered in the selection of covariates for the primary analysis. See Table 1 for a list of these 20 variables and their groupings.

Primary analyses

Wilcoxon signed rank sum tests examined the extent of change in state policies from 2003 to the most recent assessment (2006 for nutrition and 2007 for PE policies) and compared the comprehensiveness of the most recent policy domain scores across school-type (ES, MS and HS).

Logistic regression was used to examine adjusted associations between state policies and obesity. Adjusted analyses accounted for the influence of child age, sex, race, ethnicity, health status, type of school attended, involvement in sports teams, extent of physical activity, computer and television usage, whether or not the child had a television in his/her bedroom, family structure, maternal age, respondent's level of education, family income level, and neighborhood access and availability of parks and playgrounds. First, cross-sectional models regressing the odds of obesity in 2007 on each of the 2006/2007 policy area scores and controlling for covariates were performed. Second, change score models were constructed using policy difference scores for each policy area to assess the adjusted association between changes in policy with 2007 obesity while controlling for 2003 state obesity levels and 2007 covariates. All models incorporated cluster-robust standard errors to account for the correlation of observations within states. All regression analyses were performed separately for ES (10 year old children), MS (11-14 years) and HS (15-17 years) for each of the eleven nutrition and five PE policy domains.

Because the sample for analysis only included children 10-17 years with complete BMI data, probability sampling weights from the 2007 and 2003 NSCH were adjusted using predicted values from logistic regressions of an indicator for missing BMI data on child's age, race and ethnicity. Adjusted probability weights were used in logistic regressions and to estimate age and state-specific 2003 obesity prevalence. The use of sampling weights is not agreed upon by all researchers when regression results are not expected to reflect the baseline population; therefore, we performed all primary analyses with both weighted and unweighted NSCH data (32).

We also employed a multi-level regression model approach with State as a random effect to assess the independent effect of state-level school policies on the odds of obesity after adjusting for individual, family, and neighborhood factors and accounting for intra-state correlations. These models used unweighted NSCH data. For all analyses sensitivity tests examined the impact of alternate age groupings for ES, MS and HS to 10-11 year olds for ES, 11-13 and 12-14 for MS and 14-17 for HS. All analyses were conducted in Stata Release 11 (33).

IV. Detailed Findings

A) Description of state school nutrition and PE policies from 2003 to 2006/2007

From 2003-2006/2007 there was increased use of 5 of 11 nutrition and 4 of 5 PE policy areas ($p<0.05$). The greatest changes in policy adoption were found in ES (Figures 1 and 2). In 2007 states had implemented more comprehensive nutrition policies in ES than in MS and HS. Of the 6 nutrition policy domains, 4 were more stringent in ES than in MS and HS, and 2 were stronger in MS than HS. A different pattern was observed for PE policies; MS and HS policies regarding staff qualifications were more comprehensive than those in ES. Many policies have low mean scores in 2006/2007, suggesting that they were not commonly enacted at the state-level. BMI screening policies, for example, were passed by only 3 of 51 legislatures.

B) Association between state school nutrition and PE policies in 2006/2007 and childhood obesity in 2007

Stricter policies regulating competitive foods and beverages sold a la carte in cafeterias (HS), in other venues (ES) and at fundraisers (ES), as well as food services director qualifications (MS, HS) and BMI screening (ES) were associated with higher odds of obesity in 2007. PE policies in 2007 regulating time requirements for recess in ES were also related to higher state childhood obesity prevalence. However, more comprehensive policies for PE class time requirements in 2007 were associated with a decreased odds of obesity in 2007 for MS only. After adjusting for individual, family and neighborhood factors, policies regulating competitive foods in other venues (ES) and at fundraisers (ES), food service director qualifications (MS), BMI screening (ES) and time requirements for recess (ES) remained significantly and positively related to the odds of obesity. BMI screening policies were also positively associated with obesity in MS youth. Stricter policies addressing assessments of health-related fitness (ES) and PE curriculum standards (MS) were related to higher odds of obesity after controlling for covariates, while policies regulating the school meal environment in HS were associated with a reduced odds of obesity. See Table 3 for information from the adjusted logistic regression models.

C) Association between changes in state school nutrition and PE policies from 2003 to 2006/2007 and childhood obesity in 2007

Increases in policies addressing BMI screening (ES), PE staff qualifications (ES) and PE curriculum standards (ES, HS) from 2003 to 2006/2007 were significantly and positively related to the odds of obesity in 2007, even after controlling for age- and state-specific obesity levels in 2003 and individual, family and neighborhood factors in 2007. Increased use and comprehensiveness of policies regulating the school meal environment in HS was significantly negatively associated with obesity odds in 2007, as was the relation between changes in food service director qualifications among ES students. Increases in the latter policy, however, were positively associated with obesity in 2007 for MS students. PE staff qualifications and curriculum standards in MS are also significantly and positively associated with the odds of obesity in 2007. See Table 4 for information from the change score adjusted logistic regression models.

Results from sensitivity analyses conducted using variable age groupings for ES, MS and HS and multi-level regression models were similar to those reported here.

V. Discussion and Interpretation of Findings

A. Conclusions to be drawn from findings

Stricter state-level school nutrition and PE policies are associated with higher odds of childhood obesity even after adjusting for related child, family and neighborhood factors. These findings suggest that states with high prevalence of childhood obesity have responded with greater adoption of policies.

Positive association between state school nutrition and PE policies and increased odds of childhood obesity could be interpreted as stricter policies causing obesity, although this conclusion seems unlikely. Seven of the nine significant associations between increases in policy adoption or comprehensiveness and 2007 obesity were positive. This indicates that, after controlling for 2003 obesity levels, improving the health policy environment from 2003 to 2006/2007 was associated with greater odds of obesity in 2007. These findings may reflect the responsiveness of states with increasing levels of childhood obesity to institute school health policies, while states which had existing policies experienced a plateauing in their levels of childhood obesity. Policy and obesity may be trending together over time, with states with rising obesity levels responding with increased policy.

Many of the relations found between obesity prevalence and policy comprehensiveness and change scores were observed for policies which, overall, did not increase from 2003-2006/2007. This may reflect the responsiveness of a subset of states with particularly high obesity prevalence, and may not be indicative of a wider pattern of state legislative responsiveness, and may also hold for policies which are rare, such as BMI screening.

The consistent negative association between policies regulating the school meal environment in HS and obesity odds suggests that this policy may be effective at reducing obesity in older students within a relatively short timeframe. This policy area assesses the appropriateness of the scheduling of school meal periods (e.g., lunch from 11:00 AM-1:00 PM and at least 20 minutes long). The 2007 IOM report

(30) suggests that longer meal periods may allow for healthier decision-making in cafeterias. Such policies may differentially benefit HS students who might otherwise face conflicts between lunch periods and academic/extracurricular activities.

B. Explanation of study limitations

Several study limitations warrant discussion. First, the state-level policy data used do not account for the extent to which policies were implemented or enforced, nor do they allow for the consideration of local/district-level policies, programs or initiatives. The cross-sectional analyses are limited to correlational findings which do not imply causality. Although the findings were largely supported by the results of the policy change score analyses, additional studies using longitudinal data are needed to fully understand the relation between state-level policy change and childhood obesity. Also, policy change score analyses did not adjust for 2003 individual, family, neighborhood, or state characteristics. Finally, there were several limitations related to the use of the NSCH data, including the use of self-report by parents/guardians for child height, weight and individual, family and neighborhood-level covariates, response bias, and a lack of information about other relevant individual characteristics, such as diet and family history of obesity (29).

C. Comparison with findings of other studies

Nanney et al. (25) used data from the School Health Policies and Practices Study (SHPPS) 2006, the NSCH 2003 and the US Census 2000 to examine relations between state-level school nutrition and PE policies and obesity and found positive associations between competitive food and food service standards with state obesity rates. These findings, however, were limited because only bivariate cross-sectional analyses were conducted using the SHPPS 2006 data. Our findings are consistent with and strengthen the findings of Nanney et al. (25) by demonstrating an independent relation between policies and obesity and by using more comprehensive data about state-level nutrition and PE school policies.

It is not surprising that the majority of the observed effects are positive and/or null, given the typically long lag time between state policy adoption and implementation at the local level. This is particularly true when community-level agencies have high administrative independence, as is the case with local school districts. Furthermore, the time from school-level implementation to individual changes in obesity among children may also be long. More proximal measures of changes in behavior, rather than BMI, may be more appropriate for evaluating the effectiveness of obesity prevention efforts in the short-term. For example, Taber and colleagues (24) examined the relation between the state policies regulating the availability of junk food on school campuses and soda consumption and BMI in adolescents. They found that increased use of regulations from 2000 to 2006 was associated with reduced soda consumption (24). No associations, however, were found between state school junk food policies and adolescent BMI, suggesting that a greater lag time may be needed to observe changes in BMI related to the policy environment (24). .

D. Possible application of findings to actual MCH health care delivery situations

The variability in state policies implemented with regard to PE and nutrition in schools suggests opportunities for shared learning among states as to strategies and perceived benefits of implementing related school policies. These findings also suggest the need to follow obesity prevalence over time in relation to implemented policies to account for lag time in implementation from the state to district to local levels and in order to assess causal effects.

E. Policy implications

The finding that state legislatures are responding to the threat of childhood obesity by enacting policies in accordance with IOM recommendations is encouraging. As noted above, further tracking of obesity prevalence at the state level is needed to assess the effects of implemented policies

F. Suggestions for further research

Our findings suggest that while some states are responding to high levels of childhood obesity by enacting policies to promote a healthy school environment, a considerable amount of time may be

required before the effects of these policies are reflected in changes in obesity prevalence. Therefore, further research is needed to evaluate the effectiveness of these policies using more proximal measures of change, such as caloric intake or frequency of physical activity. Also, longitudinal studies using data with a longer lag time from policy enactment to change in obesity prevalence may yield important findings regarding the effectiveness of obesity prevention policies. Finally, future research focusing on the extent of policy implementation at the local-level is also needed to understand the impact of state-level policies on obesity prevalence.

VI. List of products

One peer reviewed manuscript was published (34):

Riis J, Grason H, Strobino D, Ahmed S, Minkovitz C. State school policies and youth obesity. Matern Child Health J. 2012 Apr;16 Suppl 1:S111-8. doi: 10.1007/s10995-012-1000-4. PubMed PMID: 22527761.

Findings were also presented at the 7th Annual Research Day symposium of the Department of Population, Family and Reproductive Health at the Johns Hopkins School of Public Health and at the Association of Maternal and Child Health Programs 2012 Annual Conference (Poster).

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Figure 1. Mean Change in State School Nutrition Policies Scores from 2003 to 2007

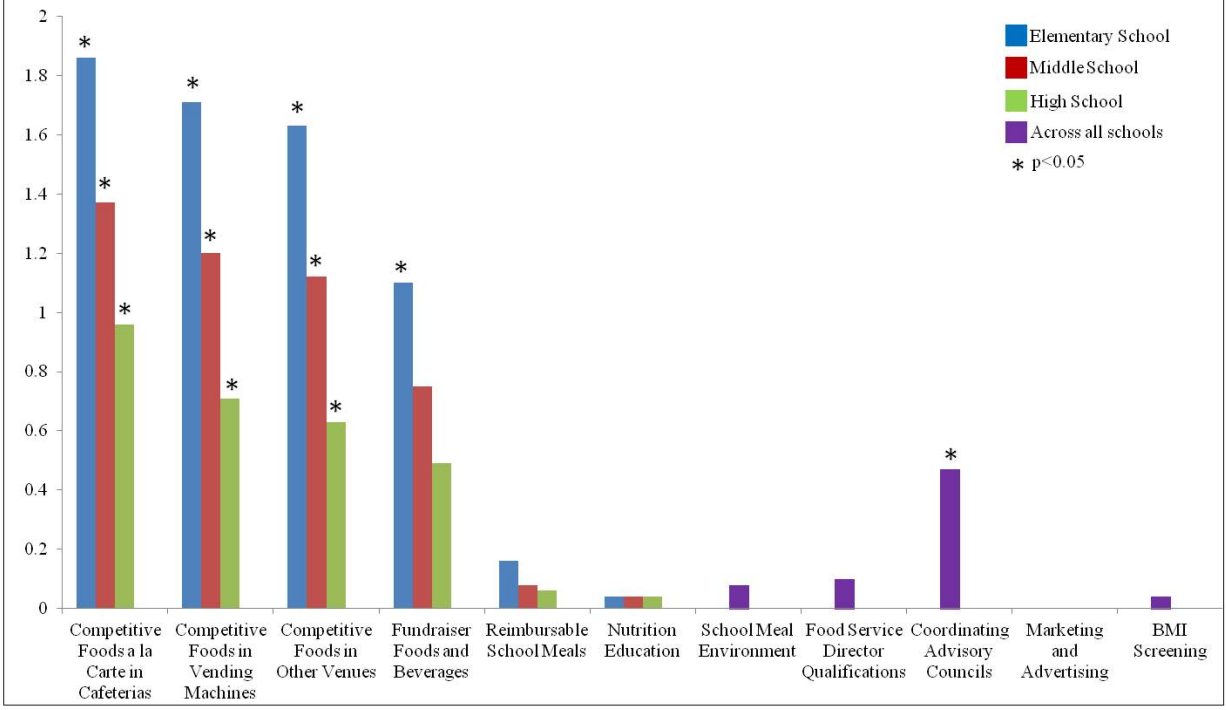

Figure 2. Mean Change in State School Physical Education Policies Scores from 2003 to 2007

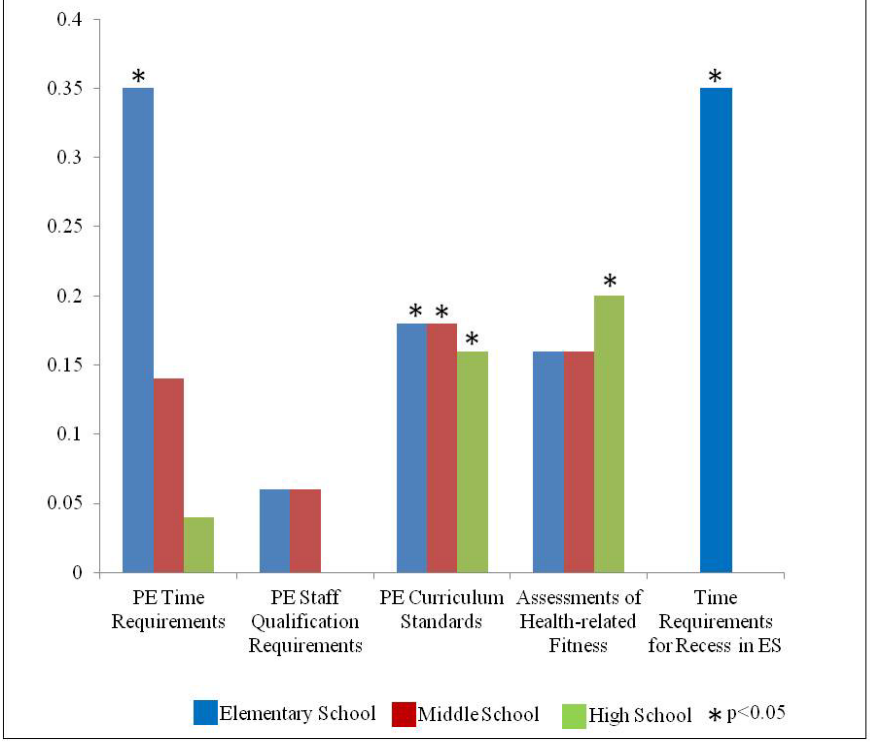

Table 3. Adjusted Association between 2006/2007 state policy scores and the odds of obesity for elementary, middle and high school-age youth in 2007.[a]

State Policy Area	Adjusted Association		
	Elementary School Students (n= 4,451)	Middle School Students (n= 19,753)	High School Students (n= 18,667)
Nutrition Policies (2006)			
Competitive Foods a la Carte in Cafeterias	–	–	–
Competitive Foods in Vending Machines	–	–	–
Competitive Foods in Other Venues	↑	–	–
Fundraiser Foods and Beverages	↑	–	–
Reimbursable School Meals	–	–	–
Nutrition Education	–	–	–
School Meal Environment	–	–	↓
Food Service Director Qualifications	–	↑	–
Coordinating Advisory Councils	–	–	–
Marketing and Advertising	–	–	–
BMI Screening	↑	↑	–
Physical Education Policies (2007)			
PE Time Requirements	–	–	–
PE Staff Qualification Requirements	–	–	–
PE Curriculum Standards	–	↑	–
Assessments of Health-related Fitness	↑	–	–
Time Requirements for Recess in ES	↑	n/a	n/a

[a] Elementary school children =10 years old); middle school children =11 -14 years old; high school children =15-17 years old. Adjusted for child age, sex, race, ethnicity and health status, child participation in sports and physical activity, TV in child bedroom, family income level, child school type, parent/guardian's level of education, family structure, child TV and computer use, maternal age, access to neighborhood parks.

↑ = Odds ratio is >1 ($p<0.05$); ↓ = Odds ratio is <1 ($p<0.05$); – = No statistically significant association ($p>0.05$).

Table 4. Adjusted association between nutrition and physical education (PE) policy change scores and the odds of childhood obesity for elementary, middle and high school-age youth in 2007.[a]

State Policy Area	Adjusted Association		
	Elementary School Students (n= 4,451)	Middle School Students (n= 19,753)	High School Students (n= 18,667)
Nutrition Policies (2006-2003)			
Competitive Foods a la Carte in Cafeterias	–	–	–
Competitive Foods in Vending Machines	–	–	–
Competitive Foods in Other Venues	–	–	–
Fundraiser Foods and Beverages	–	–	–
Reimbursable School Meals	–	–	–
Nutrition Education	–	–	–
School Meal Environment	–	–	↓
Food Service Director Qualifications	↓	↑	–
Coordinating Advisory Councils	–	–	–
Marketing and Advertising	n/a	n/a	n/a
BMI Screening	↑	–	–
Physical Education Policies (2007-2003)			
PE Time Requirements	–	–	–
PE Staff Qualification Requirements	↑	↑	n/a
PE Curriculum Standards	↑	↑	↑
Assessments of Health-related Fitness	–	–	–
Time Requirements for Recess in ES	–	n/a	n/a

[a] Elementary school children = 10 years old; middle school children = 11 -14 years old; high school children = 15-17 years old. Policy change scores = domain score in 2006 – policy domain score in 2003 for nutrition policies; policy domain score in 2007 – policy domain scores in 2003 for PE policies. Adjusted for child age, sex, race, ethnicity and health status, child participation in sports and physical activity, TV in child bedroom, family income level, child school type, parent/guardian's level of education, family structure, child TV and computer use, maternal age, access to neighborhood parks, and 2003 age- and state-specific obesity levels.

↑ = Odds ratio is >1 ($p<0.05$); ↓ = Odds ratio is <1 ($p<0.05$); – = No statistically significant association ($p>0.05$).