Public Health in Practice 2 (2021) 100091

Contents lists available at ScienceDirect

Public Health in Practice

journal homepage: www.journals.elsevier.com/public-health-in-practice

Original Research

From policy to practice: Examining the role of recess in elementary school

Janelle Thalken *, William V. Massey, Alexandra Szarabajko, Isabella Ozenbaugh, Laura Neilson

College of Public Health and Human Sciences, School of Biological and Population Health Sciences, Kinesiology Program, Oregon State University, United States

ARTICLE INFO

Keywords:
Play
Physical health
School policy

ABSTRACT

Objectives: To examine the relationship between school recess policies, the quality of the recess environment and body mass index (BMI) among elementary school children.
Study design: Observational.
Methods: Data were collected at 23 schools across four geographically distinct regions of the United States. Measures included recess observations using the Great Recess Framework-Observational Tool (GRF-OT), recess policies were collected with the School Physical Activity and Policy Assessment, and BMI was obtained through height and weight measurements among 429 students in third and fifth grade.
Results: Results showed that school policies related to recess access significantly predicted children's BMI, and school policies related to investment in recess significantly predicted recess quality as measured by the GRF-OT.
Conclusions: Results from this study can be used to help inform future research regarding how school recess policies can impact child-level outcomes and the recess environment.

1. Introduction

In the United States of America (USA), childhood obesity continues to be a major public health issue. Estimates suggest that 18.4% of children between the ages of six and 11 years old are obese [1]. This is concerning, especially among children, as it puts them at higher risk for high blood pressure, high cholesterol, and metabolic conditions [2]. Evidence has shown that an increase in sedentary behavior and a decrease in physical activity among this age group influences excess weight gain [2]. While the USA has current physical activity guidelines of 60 minutes of daily moderate to vigorous physical activity (MVPA), among children ages six to 11 years old only 42% meet current recommendations [3,4]. Given that over 50% of children in the USA are not meeting the physical activity guidelines, schools can play a vital role at increasing physical activity as a key strategy for obesity prevention [5]. Children in the USA spend an average of 6.8 hours in school per weekday, and recess is one of the few times during the school day where children can be physically active. In fact, up to 44% of all physical activity during the school day happens at recess [6]. Recess is the only unstructured part of the school day in which children can play and be physically active with their peers, and it also offers children physical, social and emotional benefits [7].

While recess is one of few opportunities for children to engage in physical activity during the school day, up to 40% of the 16,000 school districts in the USA have cut or eliminated recess from the daily elementary school schedule since the mid-2000's [8]. Furthermore, while the push for additional academic and standardized testing time has played a role in the disinvestment of recess, there are additional factors at play as to why time for recess is not prioritized. According to a Gallup survey, despite the benefits of recess, 77% of school principals in the USA reported withholding recess from students as punishment for student behavior. Moreover, schools struggle with student behavior at recess, as approximately 90% of discipline related problems are reported during lunch and recess [8]. Recess can be an environment in which there are higher rates of bullying, victimization, conflict, and negative social interactions that are detrimental to children's health [8–14]. There are also large disparities in how much time children get for recess, as urban and economically disadvantaged schools see less recess time as compared to their suburban, rural and higher income school counterparts [15,16], possibly compounding the greater risk for obesity and other chronic health conditions with these populations [17,18].

When considering the impacts of recess on children's health and development, various ecological level influences play a role [19,20]. For example, intrapersonal factors such as gender and motor competence differentiate levels of children's physical activity [21]. On an interpersonal level, evidence shows that improving adult-student relationships [22], and decreasing bullying and exclusionary behavior between

* Corresponding author. Oregon State University, College of Public Health and Human Sciences, 160 SW 26th Street, Corvallis, OR, 97331, Women's Building, Room 022, United States.
E-mail address: thalkenj@oregonstate.edu (J. Thalken).

https://doi.org/10.1016/j.puhip.2021.100091
Received 3 July 2020; Received in revised form 21 January 2021; Accepted 25 January 2021
Available online 5 February 2021

children [23], are important for recess quality [24]. On an organizational level, several important factors play a role in recess outcomes. Previous research has found that recess length significantly predicted children's MVPA and steps per minute, which suggests that children will be more physically active if given additional access to recess [24]. Moreover, when schools provide additional investment through school-level recess interventions, physical activity at recess increases [25,26], especially for girls [27], and minority students [28]. Additionally, adult leadership on the playground, staff development for recess, and investment in recess equipment have shown improvements in regard to child-level outcomes such as physical activity and prosocial behaviors [6,22–24,29,30]. Finally, evidence shows that there are reciprocal benefits in how recess can help improve school climate and classroom behavior [15,23,31,32].

Despite this evidence, few studies to date have examined the impact of policies on recess outcomes. Two previous studies examined school district policies on physical education; however, there are inconsistent findings in how district policies are carried out at the school-level, or how they impact child-level outcomes [33,34]. Given this, it is pertinent to study more proximal influences, such as school-level policy, to examine the impact of recess policy on both processes and outcomes. Therefore, the purpose of the current study was to examine the relationship between school recess policies, the quality of the recess environment and body mass index (BMI) among elementary school children.

2. Methods

2.1. Study participants

Research requests were sent to 15 school districts across five different states that represented diverse geographical regions in the USA (i.e., East Coast, West Coast, Mountain West, Midwest, South) and encompassed urban, rural, and metropolitan demographics. Of the school districts that agreed to participate, large districts (>30 schools) were stratified by socio-economic status and enrollment (above or below the district median for both) so that equal numbers of schools would be invited to participate from each quadrant; whereas all schools were invited to participate in smaller districts. The final sample included 23 schools in four of the five regions (see Table 1). Schools ranged from 31.6% to 98.2% economically disadvantaged (M = 78.50; SD = 18.48). A total of 429 children were randomly selected for height and weight measurements from third and fifth grade classes.

2.2. Measures

2.2.1. Recess policy

Recess policies at the school-level were assessed using selected items from the School Physical Activity Policy Assessment (S-PAPA) [33]. This assessment examines policy related to physical activity opportunities at elementary schools and includes three modules: (a) Physical Education; (b) Recess, and (c) Other Before, During, and After School Programs. The recess module items were collected in the current study. Items on the S-PAPA used in the current study were scored as a yes/no (1,0) dichotomized variable, with the exception of daily recess minutes, which was scored as 1 – less than 20 minutes per day, 2 – 21 to 30 minutes per day, and 3 – more than 30 minutes per day. Two composite variables, recess access and recess investment, were created by summing relevant S-PAPA items. Recess access included four S-PAPA items; (a) school policy for daily access to recess, (b) minutes of recess provided daily, (c) provisions for students to be physically active during inclement weather, and (d) teachers not withholding recess from children for academic or behavioral reasons. Recess investment included six S-PAPA items; (a) provision of organized activities at recess, (b) encouragement of physical activity by recess supervisors, (c) posted recess rules, (d) students being taught recess rules, (e) formal recess supervisor training, and (f) annual budget for recess equipment and supplies.

2.2.2. Recess quality

Recess quality was measured using the Great Recess Framework – Observational Tool (GRF-OT) [35]. The GRF-OT contains 17 items that each describe in short detail critical aspects of a quality recess environment and response formats for all items are according to a 1 (low quality) to 4 (high quality) rating. Previous research has revealed a four-factor measurement model and established measurement validity and reliability for the subscales including (1) structure and safety (SS); (2) adult engagement and supervision (AES); (3) student behaviors (SB); and (4) transitions (T) [35].

2.2.3. Body mass index (BMI)

In order to measure BMI, height and weight measurements were obtained from randomly selected children in the participating third and fifth grade classes. Height was measured using a portable stadiometer (Hopkins Medical Products) and weight was measured using a digital scale (RENPHO). Recordings of height and weight were transformed into BMI scores, translated to z-scores, percentiles, and age-adjusted BMI category using the age- and sex-specific parameters from the Centers for Disease Control and Prevention's BMI-for-age growth charts [36]. Upon calculating and adjusting BMI scores, each participant was classified based upon their BMI percentile value as underweight (BMI $<$ 5th percentile), normal weight (5th $\leq$ BMI $<$ 85th percentile), overweight (85th $\leq$ BMI $<$ 95th percentile), or obese (BMI $\geq$ 95th percentile).

2.3. Study procedure

All study procedures were approved by the Human Research Protection Program at the first author's institution. Data collection took place over several days at each of the 23 schools and data were collected by trained undergraduate and graduate students. When third and fifth grade classrooms participated in separate recess sessions, those sessions were scored independently. Across each recess session, a minimum of two lunch time recess observations were conducted. Approximately 15 minutes before the scheduled recess session, trained assessors completed a walkthrough of the playground and took notes about the built environment. They then observed the entire recess session, taking notes on each GRF-OT item throughout the process. In all cases, the recess environment was completely visible to the trained assessor, and they were trained to move throughout the playground in a discreet manner in order to observe patterns of interaction and behavior. In some cases, two trained assessors were present at recess, and one was focused on taking comprehensive notes of what happened at recess, while the other focused on scoring specific GRF-OT questions. Notes and scores were compared following recess to ensure consistency across multiple observers. In addition, final scoring was completed immediately after the recess session.

The S-PAPA was administered through an online survey platform and completed by the principal or assistant principal at each of the 23 schools. To measure BMI, height and weight measurements were obtained from randomly selected children, by trained assessors during the school day. Classroom teachers dismissed one child at a time to go with trained assessors to a quiet room with the measurement equipment. The trained assessors verbally reviewed the assent process with each child, and a clear yes or no response was required of the children prior to proceeding. Children who did not wish to participate were taken back to class. Children who agreed to continue had their weight measured using a digital scale and their height with a portable stadiometer. Children were asked to take their shoes off for both measurements. One of the trained assessors took the child through the protocol, while the other recorded the measurements.

2.4. Data analysis

To examine how policies governing recess are related to student health outcomes, a two-level regression model was run in Mplus (v. 8.4)

Table 1
School-level participant demographics.

	School Reported Race/ Ethnicity	School % Economically Disadvantaged	School Size	*n* in current study	Sex (%F)	Age (Mean, SD)	Recess Access Score	Recess Investment Score	GRF-OT Score (Mean, SD)	BMI (Mean, SD)
School 1	African American 24.9%; Hispanic/Latino 4.9%; Multiracial 5.6%; White 61.8%; Asian 2.1%	31.6	607	*n*= 29	58.24	8.98 (1.03)	5	5	50.00 (5.20)	18.20 (3.60)
School 2	African American 9.5%; Hispanic/Latino 19.6%; Multiracial 1.7%; White 30.2%; Asian 38.5%	80.1	587	*n*= *18*	57.32	9.24 (1.08)	4	2	42.67 (3.79)	18.99 (3.40)
School 3	African American 90.7%; Hispanic/Latino 2.7%; Multiracial 1.8%; White 1.3%; Asian 3.1%	97.3	225	*n*= *15*	47.36	9.68 (1.14)	3	4	48.00 (3.61)	19.24 (3.82)
School 4	African American 13.9%; Hispanic/Latino 32.7%; Multiracial 3.1%; White 27.7%; Asian 21.3%	91.5	553	*n=25*	51.52	9.43 (1.17)	2	2	45.17 (3.43)	19.13 (5.33)
School 5	African American 55.5%; Hispanic/Latino 11.2%; Multiracial 7.8%; White 17.1%; Asian 7.6%	63.1	409	*n*= *21*	55.81	9.32 (1.01)	4	4	51.00 (3.41)	20.73 (5.87)
School 6	African American 10.1%; Hispanic/Latino 81.4%; Multiracial 2.1%; White 4.2%; Asian 1.1%	96.4	663	*n*= *7*	52.38	10.16 (.45)	1	3	44.00 (1.00)	22.99 (6.73)
School 7	African American 17.6%; Hispanic/Latino 51.7%; Multiracial 7.9%; White 12.5%; Asian 9.4%	86.1	545	*n*= *19*	53.33	9.68 (1.28)	5	5	41.67 (4.23)	20.13 (5.18)
School 8	African American 96.6%; Hispanic/Latino 0.6%; Multiracial 0.6%; White 1.2%; Asian 0%	98.2	328	*n*= *10*	40.0	9.47 (1.30)	3	3	48.75 (3.20)	20.93 (3.60)
School 9	African American 67.1%; Hispanic/Latino 7.8%; Multiracial 4.8%; White 6.6%; Asian 13.2%	86.2	334	*n*= *1315*	60.0	10.0 (1.07)	3	5	47.00 (1.73)	18.55 (2.34)
School 10	African American 0.4%; Hispanic /Latino 97.7%; Multiracial 0%; White 1.4%; Asian 0.4%	84.4	917	*n*= *12*	67.67	9.38 (1.09)	2	3	50.75 (4.79)	20.07 (5.59)
School 11	African American 0%; Hispanic/Latino 96.4%; Multiracial 0.1%; White 2.6%; Asian 0.9%	95.4	695	*n*= *25*	57.45	9.28 (0.90)	4	6	52.75 (1.71)	22.01 (4.19)
School 12	African American 0.1%; Hispanic/Latino 96.5%; Multiracial 0.2%; White 2.7%; Asian 0.6%	94.2	903	*n*= *33*	53.33	9.75 (1.18)	5	5	51.00 (8.83)	20.36 (4.05)
School 13	African American 0%; Hispanic/Latino 99.5%; Multiracial 0%; White 0.5%; Asian 0%	92.6	876	*n*= *27*	50.05	9.73 (1.23)	3	3	49.75 (3.77)	20.17 (4.91)
School 14	African American 0.2%; Hispanic/Latino 98.7%; Multiracial 0%; White 1.1%; Asian 0%	92.3	853	*n*= *33*	63.83	9.25 (1.19)	3	2	40.50 (1.73)	19.00 (3.91)
School 15	African American 0.1%; Hispanic/Latino 97.4%; Multiracial 0%; White 1.9%; Asian 0.6%	86.2	698	*n*= *20*	43.24	9.03 (1.06)	3	5	51.50 (5.07)	19.31 (3.47)
School 16	African American 0.2%; Hispanic/Latino 96.5%; Multiracial 0%; White 3.0%; Asian 0.2%	91.8	838	*n*= *8*	60.0	10.10 (0.88)	4	2	35.00 (7.96)	19.47 (3.76)
School 17	African American 1%; Hispanic/Latino 48%; Multiracial 5%; White 42%; Asian 2%	60.0	440	*n*= *11*	77.77	10.53 (0.51)	4	3	50.33 (3.51)	18.35 (2.37)
School 18	African American 2%; Hispanic/Latino 34%; Multiracial 5%; White 58%; Asian <1.0%	53.0	379	*n*= *21*	57.44	9.40 (1.11)	6	5	41.63 (3.50)	18.54 (3.01)

(*continued on next page*)

Table 1 (*continued*)

	School Reported Race/ Ethnicity	School % Economically Disadvantaged	School Size	*n* in current study	Sex (%F)	Age (Mean, SD)	Recess Access Score	Recess Investment Score	GRF-OT Score (Mean, SD)	BMI (Mean, SD)
School 19	African American <1%; Hispanic/Latino 15%; Multiracial 1%; White 83%; Asian 0%	48.0	301	*n= 11*	58.33	10.12 (1.11)	5	3	45.33 (3.06)	19.91 (7.90)
School 20	African American <1%; Hispanic/Latino 53%; Multiracial 1%; White 44%; Asian <1%	70.0	202	*n= 10*	50.0	10.36 (1.01)	5	4	47.00 (2.45)	19.63 (3.96)
School 21	African American <1%; Hispanic/Latino 13%; Multiracial 6%; White 80%; Asian 1%	57.0	386	*n= 19*	64.71	9.62 (1.16)	5	4	48.69 (4.13)	19.89 (4.38)
School 22	African American 0.5%; Hispanic/Latino 74.9%; Multiracial 0.9%; White 21.8%; Asian 0.7%	80.0	427	*n= 15*	41.18	9.33 (1.03)	3	4	48.00 (5.44)	19.96 (5.37)
School 23	African American 0.1%; Hispanic/Latino 52.4%; Multiracial 2.1%; White 40.4%; Asian 3%	70.0	513	*n= 27*	60.0	9.79 (1.12)	4	2	48.67 (2.73)	20.74 (4.97)

[37]. The two-level model structure was used to examine the relationship between the two composite variables, recess access and recess investment, and BMI. This model structure accommodated child-level observations to be nested within schools, and schools within districts, while controlling for age and gender.

To examine how school recess policies are related to recess quality as measured by the GRF-OT, a second two-level regression model was run. This model accommodated GRF-OT scores to be nested within schools and controlled for recess grouping and the grade of children within that recess grouping.

3. Results

School-level demographic and descriptive data can be found in Table 1. School-level recess policies can be found in Table 2. In relation to recess access, 95.7% of schools had a school-level policy for access to daily recess, 26.1% of schools had less than 20 minutes of recess per day, 39.1% of schools had 20–30 minutes per day, and 34.8% of schools had over 30 minutes per day. Approximately 56.5% of schools provided opportunities for children to be physically active on days with inclement weather, and 13% of schools had policies that teachers could not withhold recess from students for academic or behavioral reasons. In relation to recess investment, 39.1% of schools had policies that recess supervisors should provide students with organized activities, and 91.3% had policies that recess supervisors should encourage physical activity. Only 39.1% of schools had their recess rules posted, but 95.7% of schools had policies for teaching their students the recess rules. Of recess supervisors, 47.8% have received formal training, and 52.2% of schools have an annual recess equipment and supplies budget.

3.1. Recess access, recess investment and BMI

Of the 429 children with BMI measurements, 1.4% were classified as underweight, 55.7% were classified as normal weight, 15.9% were classified as overweight, and 27.0% were classified as obese (n = 429; $M_{BMI} = 19.78$; $SD_{BMI} = 4.50$; Range = 13.2–40.8). As shown in Table 3, recess access significantly predicted BMI ($b = -0.335$, $p = 0.030$). However, no relationship was found between recess investment and BMI ($b = 0.260$, $p = 0.301$).

3.2. Recess access, recess investment and GRF-OT

Across the 23 schools, quality of recess as measured by the GRF-OT was considered low-to-moderate ($M_{GRF} = 46.88$; $SD_{GRF} = 4.79$; Range = 24–68). At the school-level, four schools averaged a minimum of three-out-of-four for each GRF scale item (i.e., total score of 51 or higher). As shown in Table 4, no relationship was found between recess access and GRF-OT ($b = -1.076$, $p = 0.185$). However, recess investment significantly predicted GRF-OT score ($b = 1.981$, $p = 0.014$).

4. Discussion

The current study examined the association between school recess policies, the quality of the recess environment, and children's BMI among elementary school children. Results show that policies related to recess access were significantly associated with children's BMI, while school policies related to recess investment were significantly associated with the quality of the recess environment.

Regarding policies of recess access, results revealed that only 34.8% of schools provided 30 or more minutes of recess per day, and just over half of schools provided physical activity opportunities on days with inclement weather. This is concerning due to the large proportion of children not meeting the current physical activity guidelines [3,4]. Moreover, only 13% of schools had policies that teachers could not withhold recess for behavioral or academic reasons, suggesting that recess may be further limited for already vulnerable students [38]. Regarding recess investment, 39.1% of schools reported policies that recess supervisors should provide students with organized activities, while 91.3% of schools reported policies that recess supervisors should encourage physical activity. This is encouraging considering previous evidence that adult engagement predicts children's physical activity and recess engagement [24,39]. Almost all schools had policies for teaching students the recess rules, whereas only 39.1% had the recess rules posted. Lastly, just over half of the schools had annual budgets for recess equipment and supplies, and just under 50% of recess supervisors received formal training. Staff development for recess supervisors and improvements to recess equipment have been found to increase physical activity, recess engagement, and prosocial behaviors among elementary school children [23,30].

The current study found that the presence of school policies relating to recess access significantly predicted lower child BMI. This highlights the importance of recess access for children's physical health, especially considering that a large portion of physical activity that takes place during the school day occurs at recess [6]. As schools in the USA have shifted to a greater focus on academic time, recess has been overlooked in terms of its potential benefits. However, increased physical activity and

Table 2
School-level recess policies from the S-PAPA.

	Daily Recess	Daily Recess Minutes	Active During Inclement Weather	Teachers Cannot Withhold Recess	Organized Activities	Encourage PA	Posted Recess Rules	Recess Rules Taught	Formal Training for Recess Monitors	Annual Recess Budget
School 1	X	3	X			X	X	X	X	X
School 2	X	3			X			X		
School 3	X	2				X	X	X		X
School 4	X	1				X				X
School 5	X	2	X		X	X		X	X	
School 6		1			X	X		X		
School 7	X	3		X	X	X	X	X		X
School 8	X	1	X			X		X	X	
School 9	X	1	X		X	X	X	X		X
School 10	X	1				X		X		X
School 11	X	2	X		X	X	X	X	X	X
School 12	X	2	X	X	X	X		X	X	X
School 13	X	2				X		X	X	
School 14	X	2				X		X		
School 15	X	2			X	X		X	X	X
School 16	X	2	X					X	X	
School 17	X	3				X	X	X		
School 18	X	3	X	X		X	X	X	X	X
School 19	X	3	X			X		X		X
School 20	X	3	X			X		X	X	X
School 21	X	3	X			X	X	X	X	
School 22	X	1	X		X	X	X	X		
School 23	X	2	X			X		X		

Note: Coding for daily recess minutes: 1 - less than 20 minutes per day, 2 – 21 to 30 minutes per day, and 3 - more than 30 minutes per day.

Table 3
Effects of recess investment and recess access on BMI.

Parameter	Estimate	Std Error	t-Test Statistic	p-value
Within level				
BMI ON				
Gender	0.132	0.291	0.453	0.651
Age	0.687	0.101	6.811	<0.001
Residual Variance				
BMI	19.446	1.762	11.038	<0.001
Between level				
BMI ON				
Recess Investment	0.260	0.252	1.034	0.301
Recess Access	−0.335	0.155	−2.166	0.030
Intercepts				
BMI	13.318	1.529	8.711	<0.001
Residual Variance				
BMI	0.031	0.130	0.238	0.812

Table 4
Effects of recess investment and recess access on GRF-OT scores.

Parameter	Estimate	Std Error	t-Test Statistic	p-value
Within level				
GRF ON				
Grade	1.205	0.679	1.774	0.076
Residual Variance				
GRF	14.929	2.188	6.822	<0.001
Between level				
GRF ON				
Recess Investment	1.981	0.804	2.465	0.014
Recess Access	−1.076	0.812	−1.324	0.185
Intercepts				
GRF	41.388	3.549	11.663	<0.001
Residual Variance				
GRF	11.658	3.396	3.433	0.001

lower BMI among children are complementary to learning goals, as previous evidence has shown that health status, such as BMI, is associated with cognitive performance in children [4,40]. Therefore, recess and academic time should not be viewed as competing priorities, but rather complementary to children's overall development.

Although policies about recess investment were not found to be significantly associated with children's BMI, they were significantly related to recess quality as measured by the GRF-OT. Previous literature has shown that the quality of the recess environment, specifically adult engagement and supervision at recess, significantly predicts children's physical activity and recess engagement [24], especially for girls' [39]. Furthermore, higher quality recess, as measured by the GRF-OT, has been found to predict adaptive behaviors like social skills, adaptability, and communication among elementary school children [41].

Findings from the current study linking recess access and investment policies to children's BMI and recess quality demonstrates the importance of strong local policies when considering children's health and development across the school day. Additionally, most schools in the present study had a high percentage of low-income students, indicating that recess policies at schools serving predominantly low-income communities might be especially important for children's physical health and recess quality. Previous evidence has documented that children attending schools in low-income communities, often have limited access to recess compared to students attending schools in higher-income communities [15,42]. Children in these communities also have a higher risk of health disparities [43], and schools often do not have robust budgets for recess equipment and playground improvements [44]. However, research evidence has shown that recess improvements at the school-level have increased physical activity, decreased sedentary behavior, improved adult engagement, and availability of recess equipment [25].

While this study has several strengths, it is not without limitations. Firstly, this study did not include a measure of policy implementation. Simply having policies in existence does not mean they are carried out efficiently and consistently. Future research should consider the addition of measures examining policy implementation when examining the impact of recess policy on children's physical health. Secondly, research suggests that the benefits of recess go beyond children's physical health, including improving cognitive and academic achievement. Therefore, examining measures of other development domains might provide additional insight on how school recess policies are related to children's overall development. Despite these limitations, this study highlights the need for and benefits of supporting recess time within the school day as well as the beneficial impacts that recess policy has on children's physical health and the quality of the recess environment.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The study procedures were approved by the Human Research Protection Program at the first author's institution. This research was funded by S.D. Bechtel Jr. Foundation and Playworks Education Energized.

References

[1] U.S. Department of Health and Human Services-National Center for Health Statistics, NCHS Data Brief: Prevalence of Obesity Among Adults and Youth: United States 2015-2016, 2017. Available from: https://www.cdc.gov/nchs/products/databriefs/db288.htm.

[2] Centers for Disease Control and Prevention, Overweight & Obesity: Childhood Obesity Causes & Consequences, 2016. Available from, https://www.cdc.gov/obesity/childhood/causes.html.

[3] National Physical Activity Plan Alliance, The 2018 United States Report Card on Physical Activity for Children and Youth, 2018. Available from, https://www.physicalactivityplan.org/projects/PA/2018/2018_USReportCard_UPDATE_12062018.pdf?pdf=page-image.

[4] U.S. Department of Health and Human Services, Physical Activity Guidelines for Americans, second ed., 2018. Available from, https://health.gov/paguidelines/second-edition/pdf/Physical_Activity_Guidelines_2nd_edition.pdf.

[5] Institute of Medicine, Accelerating Progress in Obesity Prevention: Solving the Weight of the Nation, The National Academies Press, Washington, DC, 2012, https://doi.org/10.17226/13275.

[6] H. Erwin, M. Abel, A. Beighle, M.P. Noland, B. Worley, R. Riggs, The contribution of recess to children's school-day physical activity, J. Phys. Activ. Health 9 (2012) 442–448, https://doi.org/10.1123/jpah.9.3.442.

[7] R. Murray, C. Ramstetter, The crucial role of recess in school, Pediatrics 131 (1) (2013) 183–188, https://doi.org/10.1542/peds.2012-2993.

[8] Robert Wood Johnson Foundation, The State of Play: Gallup Survey of Principals on School Recess, 2010. Available from, https://www.naesp.org/sites/default/files/resources/1/Gallup_Poll/StateOfPlayFeb2010.pdf.

[9] G.M. Glew, M.Y. Fan, W. Katon, F.P. Rivara, M.A. Kernic, Bullying, psychosocial adjustment, and academic performance in elementary school, Arch. Pediatr. Adolesc. Med. 159 (11) (2005) 1026–1031, https://doi.org/10.1001/archpedi.159.11.1026.

[10] K.R. Lodewyk, L. McNamara, P. Sullivan, Associations between elementary students' victimization, peer belonging, affect, physical activity, and enjoyment by gender during recess, Can. J. Sch. Psychol. 35 (2) (2020) 154–170, https://doi.org/10.1177/0829573519856814.

[11] L. McNamara, What's getting in the way of play? An analysis of the contextual factors that hinder recess in elementary school, Can J Action Res 14 (2) (2013) 3–21.

[12] L. McNamara, P. Colley, N. Franklin, School recess, social connectedness and health: a Canadian perspective, Health Promot. Int. 32 (2017) 392–402, https://doi.org/10.1093/heapro/dav102.

[13] L. McNamara, K. Lodewyk, N. Franklin, Recess: a study of belongingness, affect, and victimization on the playground, Child. Sch. 40 (2) (2018) 114–121, https://doi.org/10.1093/cs/cdy006.

[14] N. Tippett, D. Wolke, Socioeconomic status and bullying: a meta-analysis, Am J Public Health 104 (6) (2014) e48–59, https://doi.org/10.2105/AJPH.2014.301960.

[15] R.M. Barros, E.J. Silver, R.E.K. Stein, School recess and group classroom behavior, Pediatrics 123 (2) (2009) 431–436, https://doi.org/10.1542/peds.2007-2825.

[16] Robert Wood Johnson Foundation, Recess Rules: Why the Undervalued Playtime May Be America's Best Investment for Healthy Kids and Healthy Schools Report, 2007. Available from, http://www.rwjf.org/content/dam/farm/reports/reports/2007/rwjf18060.

[17] N.E. Adler, D.H.U.S. Rehkopf, Disparities in health: descriptions, causes, and mechanisms, Annu. Rev. Publ. Health 29 (2008) 235–252, https://doi.org/10.1146/annurev.publhealth.29.020907.090852.

[18] R. Morello-Frosch, M. Zuk, M. Jerrett, B. Shamasunder, A.D. Kyle, Understanding the cumulative impacts of inequalities in environmental health: implications for policy, Health Aff. 30 (5) (2011) 879–887, https://doi.org/10.1377/hlthaff.2011.0153.

[19] U. Bronfenbrenner, Ecology of the family as a context for human development: research perspectives, Dev. Psychol. 22 (6) (1986) 723–742.

[20] K.R. McLeroy, D. Bibeau, A. Steckler, K. Glanz, An ecological perspective on health promotion programs, Health Educ. Q. 15 (4) (1988) 351–377, https://doi.org/10.1177/109019818801500401.

[21] A.C. Barbour, Physical competence and peer relations in 2nd-graders: qualitative case studies from recess play, J. Res. Child. Educ. 11 (1) (1996) 35–46, https://doi.org/10.1080/02568549609594694.

[22] W.V. Massey, M.B. Stellino, M. Holliday, T. Godbersen, R. Rodia, G. Kucher, et al., The impact of a multi-component physical activity programme in low-income elementary schools, Health Educ. J. 76 (5) (2017) 517–530, https://doi.org/10.1177/0017896917700681.

[23] J. Fortson, S. James-Burdumy, M. Bleeker, N. Beyler, R.A. London, L. Westrich, et al., Impact and Implementation Findings from an Experimental Evaluation of Playworks: Effects on School Climate, Academic Learning, Student Social Skills and Behavior, 2013. Available from, https://www.mathematica.org/our-publications-and-findings/publications/impact-and-implementation-findings-from-an-experimental-evaluation-of-playworks-effects-on-school-climate-academic-learning-student-social-skills-and-behavior.

[24] W.V. Massey, M.B. Stellino, M. Fraser, Individual and environmental correlates of school-based recess engagement, Prev Med Rep 11 (2018) 247–253, https://doi.org/10.1016/j.pmedr.2018.07.005.

[25] N. Beyler, M. Bleeker, S. James-Burdumy, J. Fortson, R. London, L. Westrich, et al., Findings from an Experimental Evaluation of Playworks: Effects on Play, Physical Activity, and Recess, 2013. Available from, https://www.mathematica.org/our-publications-and-findings/publications/findings-from-an-experimental-evaluation-of-playworks-effects-on-play-physical-activity-and-recess.

[26] Y. Escalante, A. Garcia-Hermoso, K. Backx, J.M. Saavedra, Playground designs to increase physical activity levels during school recess: a systematic review, Health Educ. Behav. 41 (2) (2014) 138–144, https://doi.org/10.1177/1090198113490725.

[27] M. Bleeker, N. Beyler, S. James-Burdumy, J. Fortson, The Impact of Playworks on boys' and girls' physical activity during recess, J. Sch. Health 85 (3) (2015) 171–178, https://doi.org/10.1111/josh.12235.

[28] M. Siahpush, J.L. Huberty, A. Beighle, Does the effect of a school recess intervention on physical activity vary by gender or race? Results from the ready for recess pilot study, J. Publ. Health Manag. Pract. 18 (5) (2012) 416–422, https://doi.org/10.1097/PHH.0b013e318226ca47.
[29] J. Huberty, D. Dinkel, J. Coleman, A. Beighle, B. Apenteng, The role of schools in children's physical activity participation: staff perceptions, Health Educ. Res. 27 (6) (2012) 986–995, https://doi.org/10.1093/her/cys071.
[30] J.L. Huberty, M.W. Beets, A. Beighle, P.F. Saint-Maurice, G. Welk, Effects of ready for recess, an environmental intervention, on physical activity in third-through sixth-grade children, J. Phys. Activ. Health 11 (2014) 384–395, https://doi.org/10.1123/jpah.2012-0061.
[31] S. James-Burdumy, M. Bleeker, N. Beyler, R.A. London, L. Westrich, K. Stokes-Guinan, et al., Does Playworks work? Findings from a randomized controlled trial, Available from, https://files.eric.ed.gov/fulltext/ED563086.pdf, 2013.
[32] R.A. London, L. Westrich, K. Stokes-Guinan, M. McLaughlin, Playing fair: the contribution of high-functioning recess to overall school climate in low-income elementary schools, J. Sch. Health 85 (1) (2015) 53–60, https://doi.org/10.1111/josh.12216.
[33] M.A. Lounsbery, T.L. McKenzie, J.R. Morrow Jr., S.M. Monnat, K.A. Holt, District and school physical education policies: implications for physical education and recess time, Ann. Behav. Med. 45 (Suppl 1) (2013) S131–S141, https://doi.org/10.1007/s12160-012-9427-9.
[34] L. Turner, J.F. Chriqui, F.J. Chaloupka, Withholding recess from elementary school students: policies matter, J. Sch. Health 83 (8) (2013) 533–541, https://doi.org/10.1111/josh.12062.
[35] W.V. Massey, M.B. Stellino, S.P. Mullen, J. Claassen, M. Wilkison, Development of the great recess framework – observational tool to measure contextual and behavioral components of elementary school recess, BMC Publ. Health 18 (2018) 394, https://doi.org/10.1186/s12889-018-5295-y.
[36] R. Kuczmarski, C. Ogden, S. Guo, CDC growth charts for the United States: methods and development, Vital Health Stat 11 (246) (2000) 1–190, 2000.
[37] L. Muthén, B. Muthén, Mplus User's Guide Version 8.4 [software and Manual], Muthén & Muthén, 2018.
[38] R.A. London, The right to play: eliminating the opportunity gap in elementary school recess, Phi Delta Kappan 101 (3) (2019) 48–52, https://doi.org/10.1177/0031721719885921.
[39] W.V. Massey, M.B. Stellino, J. Geldhof, An observational study of recess quality and physical activity in urban primary schools, BMC Publ. Health 20 (792) (2020) 1–12, https://doi.org/10.1186/s12889-020-08849-5.
[40] K. Kamijo, N.A. Khan, M.B. Pontifex, M.R. Scudder, E.S. Drollette, L.B. Raine, et al., The relation of adiposity to cognitive control and scholastic achievement in preadolescent children, Obesity 20 (2012) 2406–2411, https://doi.org/10.1038/oby.2012.112.
[41] W.V. Massey, S. Alexandra, J. Thalken, L. Neilson, J. Geldhof, Examining the link between recess quality and classroom behavior in elementary school children, Online, in: Proceedings of the US Play Coalition 2020 Conference, US Play Coalition, Clemson, SC, 2020.
[42] O.S. Jarrett, A Research-Based Case for Recess, US Play Coalition, 2013. Available from: https://www.playworks.org/wp-content/uploads/2017/09/US-play-coalition_Research-based-case-for-recess.pdf.
[43] E. Chen, A.D. Martin, K.A. Matthews, Trajectories of socioeconomic status across children's lifetime predict health, Pediatrics 120 (2) (2007) e297–303, https://doi.org/10.1542/peds.2006-3098.
[44] M. Fernandes, R. Sturm, Facility provision in elementary schools: correlates with physical education, recess, and obesity, Prev. Med. 50 (2010) S30–S35, https://doi.org/10.1016/j.ypmed.2009.09.022.