

Systematic Review of Recess Interventions to Increase Physical Activity

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Background: With the rapid increase in obesity rates among youth, efforts to increase physical activity (PA) have become a priority. School-based strategies for PA promotion must be cost-effective, unobtrusive, and linked to improved academic performance. Efforts to maximize recess PA are advocated because of both health and academic benefits. The purpose of this manuscript was to review recess interventions aimed to improve PA among youth, and make recommendations to develop related best practices. **Methods:** An extensive literature search was conducted to include all primary research articles evaluating any recess intervention with PA as an outcome. **Results:** The included 13 interventions represented both settings within the U.S and internationally, among preschools and elementary/primary schools. A variety of strategies were used within the design and implementation of each of the interventions including: added equipment/materials, markings, zones, teacher involvement, active video games, activity of the week, and activity cards. Of the included studies, 95% demonstrated positive outcomes as a result of the recess intervention. **Conclusions:** A number of simple, low-cost strategies can be implemented to maximize the amount of recess time students are allotted. Long-term follow-up studies are warranted for each of the recess strategies identified to be effective.

Keywords: children, playground, playtime, program, study

Schools have long been identified as having an important role in public health. As a result of the rapid increase in obesity rates in youth, efforts to increase the physical activity (PA) levels of youth have become a public health concern.¹ In fact, most recently, schools have been called to lead PA promotion.^{2,3} However, this charge to promote PA coincides with unprecedented levels of accountability for academic achievement. Since the majority of school resources are allocated to improve academic achievement, school-based strategies for PA promotion must be cost-effective, unobtrusive, and linked to improved academic performance for students.²

A multifaceted, comprehensive approach to school-based PA has been advocated by many national organizations, legislation, and initiatives.⁴ In general, this approach targets physical education, school-day PA, out-of-school PA, family/community involvement, and staff involvement. Specifically, school-day PA includes recess during the school day. Recess, defined as “a break period, typically outdoors, for children,”^{5(p.51)} is particularly attractive because the majority of schools already offer recess and thus it does not intrude on the existing daily schedules focused on academics. The most recent data suggest 57% of districts throughout the United States require daily recess and 33% recommend schools provide recess daily.⁶

However, in the U.S., recess is not defined or implemented in a consistent manner, with individual schools and/or school districts generally determining policy.⁷ There also tend to be disparities by socioeconomic status and geographic location, and the opportunity to participate in recess is primarily among elementary school children.⁸ Variances in the focus and importance placed on recess are recognized across other countries. For example, in France, recess is mandated, and in the United Kingdom, recess is offered more frequently and across all ages.⁷ Across all countries, there are substantial benefits of providing recess during the school day.

Providing recess for students has been linked to decreased behavior problems and increased concentration for students; coincidentally, these are 2 often-cited barriers to student learning.⁹ Similarly, recess has also been associated with brain, social, emotional, and language development.¹⁰ Although the benefits of recess should be apparent, many schools, in the U.S. and internationally, are minimizing recess to focus on academic preparation.⁸ A recent review of the role of recess in schools concluded, “ironically, minimizing or eliminating recess may be counterproductive to academic achievement.”^{8(p.524)} Thus, the debate concerning recess in schools continues, and more evidence must be provided to support school policies to integrate recess into the school day.

Along with positive academic outcomes,⁷ recess also provides health benefits from its unique role of providing PA for children. Although the benefits of targeting recess PA are attractive, the evidence suggests PA levels

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of students during recess are low. Ridgers and Stratton found boys and girls engaged in moderate to vigorous physical activity (MVPA) 31% and 24% of allocated recess time.¹¹ Other research suggests both boys and girls engaged in MVPA for 15% of recess during the summer months and 29% and 23% during the winter months, respectively.¹² When examining the segmented day using pedometers, Tudor-Locke et al¹³ found boys accumulated nearly 1500 steps and girls 1100 steps during a 15-minute recess. Other research found boys accumulated 1262 and girls 918 steps during a 15-minute recess.¹² Tudor-Locke and colleagues¹³ found that 2 15-minute recess periods yielded approximately 25% of the students' daily steps. When examining the impact of recess PA on school day PA, a 15-minute recess contributed between 17%–44% of PA during the school day.¹⁴ A review of children's physical activity during school recess/playtime indicated that boys accrue 5%–40% of their daily physical activity from recess, while girls accumulate between 5%–31%.¹¹

Beighle et al¹² measured volume of activity time and found boys were engaged in PA 11.7 minutes and girls 9.4 minutes of the 15 minutes allocated for PA. While these figures are higher than the MVPA figures described above, this value includes all activity, not just MVPA. The authors suggest the types of activities the students engaged in during recess were highly active and likely influenced by the physical education curriculum. As the data suggest, efforts to maximize the PA levels of youth during the already provided recess time is warranted. Furthermore, currently a summary of best practices for maximizing PA during recess is not available. Researchers and practitioners working to increase PA during recess could benefit greatly from such a comprehensive evidence-base.

Purpose

Therefore, the purpose of this manuscript was to review recess interventions published between 1986 and May 2011 aimed to improve PA among youth. In addition, recommendations to develop best practices for recess interventions targeting PA levels are discussed.

Methods

Study Abstraction

An extensive literature search was conducted independently by 2 researchers to collect studies for inclusion in this review to increase the likelihood that all pertinent articles were retrieved. Searches were performed using the databases Academic Search Premier, CINAHL, ERIC, MEDLINE, and SPORT Discus. Various combinations of the following keywords were used: recess, playtime, OR playground, AND program, intervention, OR study. Limits of scholarly journals (peer reviewed) were set. More than 1800 articles were originally identified using these search criteria. Additional articles were identified by searching each included article's reference section. See

the PRISMA flow diagram in Figure 1 for a summary of the systematic search.

Inclusion/Exclusion Criteria

Inclusion criteria in this review were 1) publication in the English language, 2) a primary research article evaluating any recess intervention with PA as an outcome, and 3) publications in peer reviewed journals between 1986 and May 2011. Exclusion criteria were articles in languages other than English, case studies and allocation of additional recess time. Studies were not required to be randomized controlled trials (RCTs) because this is a relatively new area of research, and due to the fairly small amount of studies targeting this specific setting, all were included as a first step in understanding the existing evidence on recess interventions targeting PA.

Data Extraction

Data from the studies were extracted using a standardized form developed by the authors. Extracted data included: lead author, publication year, location of study, description of participants, theoretical framework used to guide intervention design and implementation, research design, primary and secondary outcomes, measures used to obtain collected data, description of intervention, and main findings. Many of the variables extracted are summarized in Tables 1 and 2.

Results

This review was limited to interventions in which PA was included as an outcome. The included 13 interventions are summarized in Tables 1 and 2, giving a description of the target population, research design, primary and secondary outcomes, measures used, data analyses, purpose and description of the intervention, and salient findings. In 2 cases, there were multiple articles reporting information on the same intervention; therefore, those articles were combined to be considered as 1 intervention. The interventions have been arranged alphabetically by first author's last name.

Design and Sample

This review included settings within the U.S.^{15–18} (n = 4) as well as those conducted internationally^{19–27} (n = 9). The age of participants in the interventions ranged from 3–12 years, with populations recruited from preschools^{15,16,20} (n = 3) and elementary/primary schools^{17–19,21–30} (n = 10). A few of the interventions mentioned recruiting specific populations within low-income areas^{24,26} (n = 2) and children who were predetermined to be sedentary.¹⁵

It is necessary to consider the design of the study when interpreting the results. Almost half of the interventions used an experimental design (RCT; n = 5),^{20,21,23,25,27,30} which has been considered the “gold standard” against which all other designs are judged. In

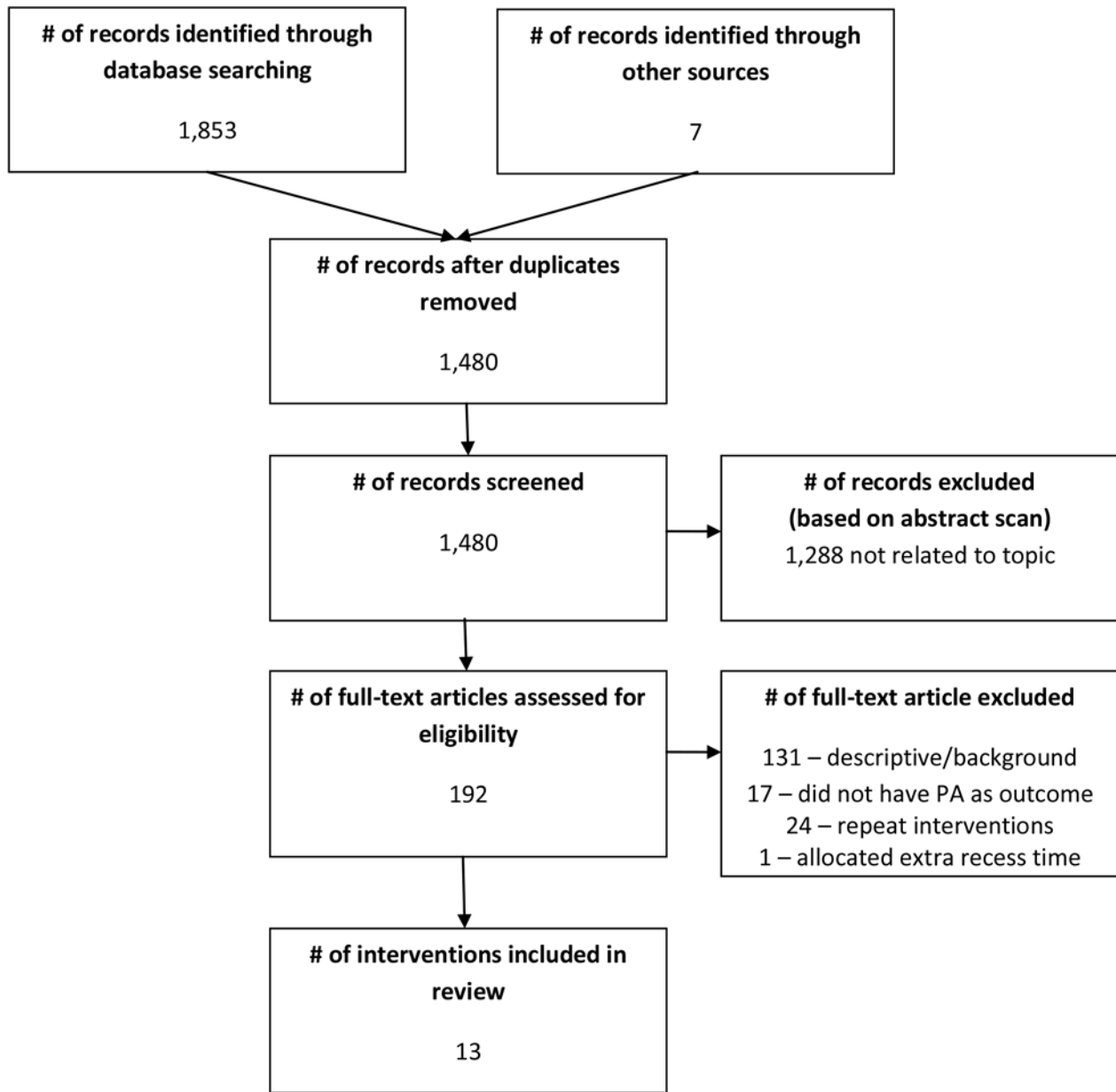


Figure 1 — Flow diagram of search results.

these studies, randomization occurred at either the individual (student) level or by school. Two of the interventions were quasi-experimental which did not randomize the participants/schools, yet still had a control or comparison group.^{24,26,28,29} Among these studies using either experimental or quasi-experimental designs, 2 mentioned gender stratification when allocating participants to intervention or control group.^{24,25,28–30} A nonexperimental design was used in 6 of the interventions, in which control and/or comparison groups were not delineated.^{15–19,22} One of the studies which used a nonexperimental design also

incorporated the use of a mixed methods approach, by including both quantitative and qualitative measures.¹⁹

The number of participants within each intervention was extremely varied. To differentiate, interventions were categorized from very small to extra large sample sizes. There was 1 intervention which was very small (under 10 participants),¹⁵ 3 which were small (11–50 participants),^{19,21,25,30} 4 which were medium (51–150 participants),^{16–18,26} 3 which were large (151–300 participants),^{22,23,27} and 2 interventions which were considered to have very large sample sizes, with 470^{24,28,29} and 588 participants.²⁰

Table 1 Summary of Study Sample, Design, Theoretical Framework, and Outcome Measures of Recess Interventions to Increase Physical Activity (By Intervention Strategy)

Study	Sample	Design	Theoretical framework	Primary/secondary outcome variables and measures	Data analyses
Bundy et al, 2009	Children: N = 12, Teachers: N = 9; mainstream primary school in Sydney, Australia; children ages 5–7 years, in Kindergarten and year 1; teachers all female with 1–25 years experience	Nonexperimental mixed methods design; first families to respond children were included in study; teachers were selected by principal	None mentioned	<p>Primary quantitative outcome = PA</p> <ul style="list-style-type: none"> Measured at baseline and postintervention (11-weeks) via accelerometers Mean was taken from the 31 data points (representing 31 minutes) recorded during the middle of lunch time for each child <p>Primary qualitative outcome = teachers' perceptions</p> <ul style="list-style-type: none"> Semistructured interviews conducted 	<p>Wilcoxon signed rank test; qualitative interviews coded ($P < .05$)</p>
Hannon & Brown, 2008	N = 64 children; 1 university research-oriented preschool in the U.S.; boys = 30, girls = 34; age of participants: 3 years = 23, 4 years = 25, 5 years = 16; mostly Caucasian	Nonexperimental design; opened to all preschoolers enrolled in school, those whose families gave permission included	None mentioned	<p>Primary outcome = PA</p> <ul style="list-style-type: none"> Accelerometers (15-second sampling interval) Measured 5 days prior and 5 days postintervention <p>Secondary outcome = prompts to be more physically active</p> <ul style="list-style-type: none"> OSRAC-P Measured 5 days (15–20 mins.) before intervention and postintervention One boy and one girl randomly chosen to be observed; the same children were observed both pre- and postintervention <p>Primary outcome = PA</p> <ul style="list-style-type: none"> Accelerometers (1-minute epoch) Measured 1 recess period (30 minutes) at baseline and 1 recess period (30 minutes) postintervention (second week) 	<p>Repeated measures; general linear models ($P < .05$)</p>
Lopes et al, 2009	N = 158 children; 2 elementary schools in Portugal; boys = 66, girls = 92; 6–7 year boys = 26, 8–12 year boys = 40, 6–7 year girls = 40, 8–12 year girls = 52; mean BMI (kg/m ²): 6–7 year boys = 16.8 (SD = 2.6), 8–12 year boys = 17.8 (SD = 3.2), 6–7 year girls = 16.4 (SD = 3), 8–12 year girls = 17.7 (SD = 3.6)	Nonexperimental design; open to all students enrolled in both schools, those whose families gave permission included; children grouped according to age in 2 groups (6–7 years & ≥ 8 years)	None mentioned	<p>Primary outcome = PA</p> <ul style="list-style-type: none"> Accelerometers (1-minute epoch) Measured 1 recess period (30 minutes) at baseline and 1 recess period (30 minutes) postintervention (second week) 	<p>Repeated ANOVA ($P < .05$)</p>

(continued)

Table 1 (continued)

Study	Sample	Design	Theoretical framework	Primary/secondary outcome variables and measures	Data analyses
Playground markings and zones Stratton, 2000; Stratton & Leonard, 2002	N = 47 children; 2 primary schools situated in northwest England; INT boys: N = 14, INT girls: N = 13, CON boys: N = 9, CON girls: N = 11; age 5–7 years	Experimental design; children randomly selected from a stratified sample by gender and school year; 1 control school, 1 intervention school	None mentioned	Primary outcome = PA • Heart rate monitoring (5-second epochs) • One morning, lunch and afternoon playtime • Measured over a span of 4 weeks at baseline and over 4 weeks postintervention • Oxygen consumption and heart rate collected during 4 conditions (lying quietly, sitting upright, walking, running); this information used to quantify the amount of energy expended during recess	2 × 2 ANOVA, ANCOVA (P < .05)
Stratton & Mullan, 2005	N = 99 children; 4 INT schools located in Northeast Wales, areas of deprivation, 4 CON schools in NW England; 2 early primary (aged 4–7 years) and 2 late primary (aged 7–11 years) schools; early primary INT boys/girls: N = 17/19, late primary INT boys/girls: N = 18/13, early primary CON boys/girls: N = 8/10, late primary CON boys/girls: N = 8/6	Quasi-experimental design; 4 intervention schools and 4 matched control schools	None mentioned	Primary outcome = PA • Heart rate telemeters • One morning, lunch and afternoon recess, on 3 separate days during the same week—baseline (June; over a 4-week time span) • One morning, lunch and afternoon recess postintervention (September/October of same year; over a 4-week time span)	2 × 2 ANCOVA (P < .05)

(continued)

Table 1 (continued)

Study	Sample	Design	Theoretical framework	Primary/secondary outcome variables and measures	Data analyses
Planned activities/teacher involvement					
Brown et al, 2009	Study 1: N = 3, Study 2: N = 2; preschool program in the U.S.; boys = 1, girls = 4; age = 4 years; determined to participate primarily in sedentary activities during recess; Study 1: participants had age-appropriate skills in motor and physical development; Study 2: participants were those "at risk of school failure"	Nonexperimental design; Study 1: single-case withdrawal of intervention design, Study 2: single-case alternating treatment design; participants selected by teachers	"Plan, Do, and Review" process	Primary outcome = MVPA on an interval-by-interval basis <ul style="list-style-type: none"> • Observational System for Recording PA in Preschoolers (OSRAC-P) • Observation during 19 play periods • 5 seconds to observe and 25 seconds to record (5-7 minutes) Secondary outcome = Teacher participation (arrangement and encouragement) <ul style="list-style-type: none"> • OSRAC-P 	MVPA graphed for each student across intervention period
Stellino et al, 2010	N = 65 children; elementary students from Midwestern U.S.; boys = 30, girls = 35; 1st and 2nd graders: N = 32, 3rd and 4th graders: N = 33; overweight/obese students: N = 20, normal weight: N = 45; Caucasian = 89.6%, Asian = 6.2%, African American = 3.9%, Multiracial = 0.4%; free/reduced lunch = 24.7%	Nonexperimental design	None mentioned	Primary outcome = PA <ul style="list-style-type: none"> • Pedometers • Measured 5 consecutive days for 4 consecutive weeks • Included week of baseline and the 3 intervention weeks • Collected each day (children put on before recess and removed when reentering building) 	Mean weekly step counts, repeated measures factorial ANOVA ($P < .05$)
Active video games					
Duncan & Staples, 2010	N = 30 children, INT and CON: N = 15 (each); 2 primary schools in central England; boys = 12, girls = 18; mean age = 10.4 years (SD = 0.5); body fatness: INT = 20.2% (SD = 4.6), CON = 19.9% (SD = 4.2)	Experimental design; children randomized into control or intervention group	None mentioned	Primary outcome = PA <ul style="list-style-type: none"> • Pedometers (steps/min) • Heart rate monitors used to get MVPA levels • Measured at weeks 1, 3, and 6 	3 × 2 ANCOVA ($P < .05$)
Multiple strategies					
Cardon et al, 2009	N = 588 children; 4 preschool programs in Belgium; boys = 52%, girls = 48%; mean age = 5.3 years (SD = 0.4)	Experimental design; cluster randomization by preschool into 1 of 4 conditions (n = 10/condition), including a control group	None mentioned	Primary outcome = PA <ul style="list-style-type: none"> • Measured 1 recess period at baseline and 1 at 4-6 weeks after intervention • In each school, 12-20 children randomly selected to wear accelerometers (15-second sampling interval) 	Multilevel models using restricted maximum likelihood estimation, logistic regression ($P < .05$)

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Table 1 (continued)

Study	Sample	Design	Theoretical framework	Primary/secondary outcome variables and measures	Data analyses
Huberty et al, 2011	N = 93 children; 3rd-5th graders in 2 elementary schools in the Midwest U.S.; boys = 50, girls = 43; public school: N = 45, parochial school: N = 48; mean age = 9.6 years; mean BMI: 18.9 kg/m ² public, 18.8 kg/m ² parochial	Nonexperimental design; opened to all 3rd-5th graders enrolled in both schools, those who families gave permission included	Ecological model	Primary outcome = PA <ul style="list-style-type: none"> • Accelerometers (5-second epochs) • Measured 5 consecutive school days prior and 5 consecutive days postintervention • Teachers used stopwatches and logs to record times children participated in physical activities throughout each day 	Random intercept linear regression models ($P < .05$)
Loucaides et al, 2009	N = 247 children; 3 elementary schools in Cyprus; INT School 1: N = 89, INT School 2: N = 89, CON School: N = 69; mean age = 11.1 years (SD = 0.3)	Experimental design; schools randomly selected to 1 of 2 interventions or control	None mentioned	Primary outcome = PA <ul style="list-style-type: none"> • Pedometers • Measured 4 days before intervention (baseline) • Children recorded steps before and after recess, at end of school day, immediately before bed • Measured 4 days postintervention (4 weeks after intervention began) 	3-way ANOVA ($P < .05$)
Ridgers et al, 2007a, 2007b, 2010	N = 470 total children (2007b): 26 elementary schools in an urban city within NW England, considered high deprivation areas, INT = 15 schools, CON = 11 schools; the following represents a summary of children randomly selected for accelerometer measures (n = 298): boys/girls CON: N = 74/74, INT: N = 76/73; mean age: CON boys = 7.8 (SD = 1.5), CON girls = 7.9 (SD = 1.4) years, INT boys = 8.3 (SD = 1.8), INT girls = 8.3 (SD = 1.9) years	Quasi-experimental design; schools selected to intervention or control group; students randomly allocated and stratified by gender to wear either 1 or 2 activity monitors	None mentioned	Primary outcome = PA <ul style="list-style-type: none"> • Accelerometers (5-second epoch) • Worn by 11 children per school at 1 measurement period before intervention and postintervention • Measured at 6-weeks, 6-months, and 12-months • HR telemetry (all students measured at 6-week, 6-month and 12-month) 	Independent <i>t</i> tests, multilevel modeling ($P < .05$)
Verstraete et al, 2006	INT = 122 (4 schools), CON = 113 (3 schools); 7 elementary schools, 5th and 6th graders in Belgium; INT boys/girls: N = 75/47, CON boys/girls: N = 46/67; mean age INT = 10.8 years (SD = 0.6), CON = 10.9 years (SD = 0.7)	Experimental design; participating schools were randomly assigned to INT group or CON group	None mentioned	Primary outcome = PA <ul style="list-style-type: none"> • Accelerometers (1-minute epochs) • Measured 1 day at morning recess and lunch recess during baseline week • Measured 1 day at morning recess and lunch recess at postintervention 3 months later 	Repeated-measures ANOVA ($P < .05$)

Table 2 Description of Intervention Purpose, Strategies, and Key Findings of Recess Interventions to Increase Physical Activity (By Intervention Strategy)

Study	Purpose of intervention	Description of intervention	Key findings
Bundy et al 2009	To (1) increase PA throughout an intervention which loose parts were made available on school playground, (2) examine teachers' perceptions regarding the benefits and consequences of changing the level of "risk" in school grounds.	"Loose parts" or "scrounging materials" were made available on the playground for 11 weeks during the winter. An example of materials included: car and bicycle tires, hay-bales wrapped in plastic, cardboard boxes, plastic barrels and water containers, lengths of tubing, pieces of fabric, crates, garbage bin lids, strips of foam, and a swivel chair on casters. Materials were regularly changed during the study period.	Children's PA was greater than before the intervention. Mean counts increased from 1028 (SD = 770) to 1612 (SD = 491); Wilcoxon signed rank test, $P = .014$ Teachers reported an increase in more physically active play; not only in the form of aerobic exercise, but also resistive exercise. It was reported that children who previously preferred sedentary activities were now more active as a result of the materials. Teachers still worried about safety, despite no more injuries as a result of the equipment.
Hannon & Brown, 2008	To assess whether PA levels increased during outdoor play in 5 observation days after the introduction of activity-friendly play equipment.	Duration = 3 months New play equipment was set up by 2 research assistants in 10 mins. before beginning of intervention days. Equipment was strategically placed based on recommendations by an early childhood movement specialist (perimeter of playground in clusters). Equipment included: hurdles, hoops, tunnels, balance beams, target toss/throw sets, bean bags, and balls. Equipment availability and observations were conducted for 5 consecutive days.	Relative to preintervention, children decreased postintervention percentage of time spent in sedentary activities by 16% (from 57.2% to 41.2%). All other PA intensities increased: light (by 3.5% from 30.6% to 34.1%); moderate (by 7.8% from 9.8% to 17.6%); vigorous (by 4.7% from 2.3% to 7.0%). The multivariate intervention effect was significant ($P < .001$). There was a significant age by intervention multivariate interaction ($P < .01$). Younger children have more moderate activity than older children, while older children have more vigorous activity than younger children.
Lopes et al, 2009	To examine the effects of an intervention during the school recess on PA levels of children by gender, age and BMI	Duration = 1 week Introduction of extra outdoor play equipment on the playground (eg. balls, skipping ropes, arches, hood horses and painting the floor). No stimuli or prompts to play with equipment provided. Duration = 2 weeks	Significant intervention effects were found for percentage of time spent in total PA ($P < .001$). There was a significant interaction between gender and age group such that younger girls had the largest increase ($P = .009$). No significant effects were found by BMI. No significant intervention effects were found for time spent in MPA. Significant interaction effects were found for gender and interaction such that girls' MPA increased ($P < .001$). Significant interaction effects were found for BMI and gender such that the overweight/obese girls' MPA increased ($P = .012$). Time spent in vigorous and very vigorous PA (VVVPA) increased significantly with the intervention ($P = .001$). Younger children benefited significantly more from the intervention; boys benefited more than girls; overweight/obese boys increased significantly more in VVVPA than normal weight boys.

(continued)

Table 2 (continued)

Study	Purpose of intervention	Description of intervention	Key findings
Playground markings/zones Stratton, 2000; Stratton & Leonard, 2002	To investigate the effects of painting a school playground with bright and colorful markings on the MVPA of primary school children, and second, to investigate the effects of painting a school playground with bright and colorful markings on children's energy expenditure	EXP school playground was painted with 10 markings: a castle, a dragon, pirate ship, clock face, flower maze, fun trail and dens, hopscotch, letter squares, snakes and ladders, and circular maze. One soccer ball was allowed in the EXP school playground area. CON school had no markings but children were allowed limited equipment during baseline and intervention periods. Duration = 4 weeks	A significant interaction for MVPA ($P < .01$) and a significant main effect for intervention were found ($P < .05$). No main effect was found for groups. There was a significant interaction for VPA ($P < .05$) but not for intervention or for groups. There was a significant interaction for mean HR and a main effect for intervention ($P < .01$), but not between groups. A significant interaction between time and group was found for energy expenditure (EE) during play and total EE with EXP group increasing their rates of EE and total EE ($P < .02$).
Stratton & Mullian, 2005	To: (1) examine whether painting playgrounds with multicolored markings would increase the percent of recess time spent in MVPA and VPA in girls and boys, and (2) quantify the contribution recess makes to national recommendations for young people's physical activity	4 INT school playgrounds were painted with multicolored markings. Early primary (EP) schools received castles, dragons, clock faces, mazes, fun trails, dens, hopscotch, letter squares, snakes and ladders, and various animals that were popular in those schools. Late primary (LP) schools received markings for netball, football, and short tennis, and targets for games related skills. CON schools had no markings. Small pieces of playground equipment such as skipping ropes and footballs were prevalent in all playgrounds. Duration = 4 weeks	A significant interaction ($P < .01$) was found such that MVPA in INT group increased from 36.7% (23.9) to 50.3% (28.9) of playtime compared with decrease in CON group from 39.9% (21.1) to 33.4% (18.4). No significant main effects were found. EP children increased MVPA from 40.9% (19.5) to 43.3% (23.8). LP children increased MVPA from 33.5% (26.7) to 40.4% (30.1). Boys increased MVPA from 40.6% (23.3) to 44.8% (26.6) and girls from 35.2% (21.9) to 39.8% (25.1). No significant age by time or sex by time interactions occurred for MVPA. A significant interaction ($P < .01$) was found for VPA such that INT VPA increased from 7.9% (10.9) to 12.4% (15.8) while CON VPA remained at 8.0% (10.1) and 8.0% (10.9) before and after. EP children increased VPA from 7.5% (8.7) to 9.1% (10.9) and LP children from 8.8% (13.1) to 12.9% (18.3). Boys increased VPA from 9.8% (11.9) to 12.6% (15.5) and girls from 5.9% (8.4) to 7.9% (11.4) of recess before and after. No significant age by time or sex by time interactions occurred for VPA.
Planned activities/teacher involvement Brown et al 2009	Develop, implement, and empirically validate acceptance and feasibility of teacher-implemented interventions to enhance young children's MVPA on playgrounds.	Teacher led large group discussion about importance of MVPA (3-5 mins.); Teachers and children planned PA; Dance Party and Track Team 2 potential activities; Participation of children and teacher in 1 of the 2 activities (5-7 mins.); teacher gave frequent encouragement throughout, and praised children for participating, children received stickers; brief discussion of activity afterward (3-5 mins.) Duration = 5 days (Study 1) Duration = 6 days (Study 2)	Improved percentage of intervals of MVPA during intervention periods. Participants change in % intervals of MVPA summarized below—baseline, intervention, baseline 2 (study 1), enhanced intervention (study 1). Participant 1 (23%, 60%, 27%, 75%) Participant 2 (23%, 40%, 7%, 80%) Participant 3 (26%, 70%, 30%, 80%) Participant 4 (10%, 92%) Participant 5 (10%, 72%)

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Table 2 (continued)

Study	Purpose of intervention	Description of intervention	Key findings
Stellino et al, 2010	To examine whether 3 different recess activities of the week (RAWs) would influence children's free time or recess PA levels	All children received a new RAW each week for 3 weeks. RAW 1 was a no intervention week. RAW 2 was a circuit course resembling a walking/fitness trail consisting of 4 different stations: jump ropes, large playground balls, bean bags, and hula hoops. RAW 3 was an obstacle course placed on the periphery of the playground area, which consisted of 4 obstacles: zigzag balance beam, hula hoop tire course, poly spots, and jump ropes. RAW 4 included Frisbees, and students could throw at targets, with a partner, or for total distance. Duration = 3 weeks (one week of each RAW)	<p>No significant interaction effects among demographic variables and PA were found. Four separate significant main effects were found:</p> <p>(1) Children were significantly more active during the no intervention week and RAW 2 (circuit course) than during RAW 4 (Frisbee; $P = .000$).</p> <p>(2) Boys were significantly more active than girls during RAW 3 (obstacle course; $P = .008$).</p> <p>(3) 3rd and 4th grade children were significantly more active than 1st and 2nd grade children during the no intervention week and Raw 4 (Frisbee; $P = .034$).</p> <p>(4) Children with healthy BMI were significantly more active during RAW 2 (circuit course) than those with an overweight/obese BMI ($P = .038$).</p>
Active video game			
Duncan & Staples, 2010	To assess PA levels during active video game play over time and compare this to "free play" associated with recess activity in a sample of British primary children over a 6-week period.	The intervention group ($N = 15$) participated twice a week in active video game play instead of regular recess period. Wii activity games were used. The control group participated in the normal recess periods. Duration = 6 weeks	<p>Number of steps/min were greater for INT group in first week of intervention ($P = .03$) but were lower than the CON group at weeks 3 and 6. Percent MVPA was significantly lower in INT group throughout the 6-weeks ($P = .0001$).</p> <p>Steps/min. Week 1: INT = 28.9 (8.6), CON = 27.0 (4.2); Steps/min. Week 3: INT = 18.9 (8.5), CON = 25.1 (6.9); Steps/min Week 6: INT = 19.3 (5.6), CON = 25.1 (3.7); MVPA % Week 1: INT = 15.9 (8.3), CON = 23.1 (8.9); MVPA % Week 6: INT = 12.1 (6.0), CON = 25.1 (11.2)</p>
Multiple strategies			
Cardon et al 2009	Determine if providing play equipment, playground markings, or providing both playground markings and play equipment are effective to increase PA levels and decrease sedentary activities in preschoolers.	Preschools were allocated to 1 of 4 conditions. One group received playground equipment (PE) including a variety of balls, throwing discs, throwing rings, aiming rings, bean bags, hoops, colored wipes, and jumping bags. Group 2 had markings (M) painted onto the playground which consisted of a trail river with crossings and flower-shaped hopscotch. Group 3 received both PE and M. Group 4 was the control. The recess after the lunch break was targeted for PA measurement. Duration = 4 weeks	<p>None of the interventions resulted in significant increase or decrease of posttest activity percent and/or average activity level.</p> <p>Sedentary Activity % Pre/Post: CON = 64.2%/59.3%, PE = 60.1%/57.1%, M = 59.5%/59.8%, PE + M = 60.8%/57.8%; Moderate & Vigorous PA % Pre/Post: CON = 6.1% & 4.0%/6.6% & 4.8%, PE = 7.2% & 4.3%/6.5% & 6.0%, M = 7.1% & 4.8%/6.4% & 4.5%, PE + M = 7.3% & 3.9%/7.0% & 5.7%</p>

(continued)

Table 2 (continued)

Study	Purpose of intervention	Description of intervention	Key findings
Huberty et al, 2011	To determine the initial effectiveness of an elementary school recess intervention (staff training, recreational equipment, and playground markings) on the amount of MPA and VPA during recess and the school day.	Initial training session provided to principals, teachers and recess staff to share strategies for maximizing PA during recess. Booster training provided 1 week after baseline data collected. Playground equipment and activity zone maps provided to each school. The PE teacher, a recess staff champion, and a research team member planned daily recess activities during biweekly meetings. Second booster training provided during the colder months for indoor recess activities. Duration = 7 months	Participation in MPA and VPA significantly higher at posttest for both recess and school day outcomes. MPA increased from 18.1% to 31.2% of total recess time (~3 min of 20 min). VPA increased from 7.2% to 16.8% (~2.2 min of 20 min). When controlled for demographic variables, BMI, and total length of recess or school day, increase of 2.5 ($P < .001$) and 2.2 ($P < .001$) recess minutes of MPA and VPA, respectively; an increase of 51.2% and 112.2% of MPA and VPA, respectively. There was an increase of 18.7 ($P < .001$) and 4.7 ($P < .001$) school day minutes of MPA and VPA; represented an increase of 92.2% and 71.6% of MPA and VPA, respectively.
Loucaides et al, 2009	To (1) examine the effectiveness of allocating space and allocating space plus markings and jump ropes on boys' and girls' activity levels during the 20-minute school break period and (2) examine the intervention's effect on boys' and girls' after school PA.	INT School 1 allocated play space for team games to either 5th or 6th grade children on alternate days of the week, provided playground markings, and provided long and short jump ropes. INT School 2 allocated play space for team games without the playground markings or jump ropes. CON School did not allocate play space, have playground markings or jump ropes. Duration = 4 weeks	A significant interaction was found between school and gender, with boys in the INT schools having higher PA than boys in the CON school ($P < .01$). Girls in INT School 1 had higher PA than girls in the other 2 schools. A significant time by group interaction was found at postintervention with children in INT schools having higher PA than children in the CON school ($P < .05$). No differences were observed between the 2 INT schools at postintervention. For after school PA, there was a significant main effect for gender with boys displaying higher PA than girls ($P < .001$).
Ridgers et al, 2010; Ridgers et al, 2007 a,b	To investigate the impact of a playground redesign intervention on children's MVPA and VPA using accelerometer, and second to determine the potential influence of pupil-level and school-level moderating variables on intervention effects.	Received multicolor playground markings and physical structures where playground was divided into 3 colored zones: red zone (sports area), blue zone (fitness and skills area), yellow zone (chill out area). The markings in each zone were relevant to the physical activity and social behaviors desired for that area. Schools were encouraged to explain the aims of the zones to the children through class time, and reinforce during the recess periods. Duration = 6 weeks (Ridgers et al, 2007a); 6-month follow-up (Ridgers et al, 2007b); 12-month follow-up (Ridgers et al, 2010)	INT group had 5.95% more MVPA ($P = .049$) and 1.7% VPA ($P = .45$) compared with CON group at 6-week measures. Sex and BMI were sig. negative exploratory variables of recess MVPA following the intervention. Boys engaged in 7.2% more MVPA than girls. The intervention was also stronger for younger children ($P = .01$ MVPA, $P = .09$ VPA). At the 6-month measures, there was a sig. positive intervention effect across time for MVPA and VPA ($P < .05$), with the INT group reporting 4% and 2% more respectively. At the 12-month measures, there was a sig. positive intervention effect for VPA during lunch recess ($P < .05$), with the INT group reporting 1.4% more VPA.

(continued)

Table 2 (continued)

Study	Purpose of intervention	Description of intervention	Key findings
Verstraete et al, 2006	To evaluate the effects of providing game equipment on children's PA levels during recess and lunch break	Each INT class group received game equipment and activity cards. Research staff trained the children how to use the equipment and cards. Teachers were asked to stimulate the children to use the equipment during recess and lunch breaks. Equipment consisted of 2 jump ropes, 2 double dutch ropes, 2 scoop sets, 2 flying discs, 2 catch balls, 1 poco ball, 1 plastic ball, 2 plastic hoops, 2 super grips, 3 juggling scarves, 6 juggling rings, 6 juggling beanballs, 1 diabolo, 1 angel stick, 4 spinning plates, 2 sets of badminton racquets, and 2 sets of oversized beach paddles. Duration = 3 months	<p>Recess: At baseline, children were engaged in MVPA 56% (26) of the time; with boys 68%(21) and girls = 42% (23) of the time. Significant intervention effects found for LPA ($P < .05$), MPA ($P < .001$), and MVPA ($P < .01$). MPA time increased significantly for INT. MVPA time decreased significantly for CON. Time spent in LPA increased significantly for CON. Significant gender differences were found for LPA ($P < .001$), MPA ($P < .01$), and MVPA ($P < .001$) for girls. MPA significantly increased and LPA significantly decreased for INT girls. Time spent in MVPA significantly increased in INT girls. No significant differences were found between active and less active children.</p> <p>Lunch: At baseline, children were engaged in MVPA 51% (24) of the time; with boys 57% (24) and girls 44% (22) of the time. Significant interaction effects found for LPA, MPA, VPA, and MVPA ($P < .001$). Time spent in MPA, VPA, and MVPA significantly increased for INT group. Time spent in LPA decreased in CON group. No significant gender differences or activity group (active vs. less active children) were found.</p>

Theoretical Framework

Very few of the studies mentioned the use of theory or models as a guiding framework when designing the intervention. In fact, only 1 used a known model, the ecological model, which relates to making the school environment more conducive to PA.¹⁷ Brown and colleagues¹⁵ mentioned using the “Plan, Do, and Review Process” as a guiding framework in which the intervention was designed and implemented. Specifically, the children and teachers planned the PA, performed it, and then briefly discussed the activity afterward. The other 12 studies did not mention use of a theory or guiding framework.

Description of Intervention

All of the interventions were school-based, conducted during scheduled time within the school day, in either a preschool or elementary/primary school. Duration of the interventions ranged from 1 week^{15,16} ($n = 2$) to 12 months²⁹ ($n = 1$). Most of the interventions lasted between 2–6 weeks ($n = 7$),^{18,20–23,25,26,30} with 2 lasting around 3 months,^{19,27} and 1 lasting 7 months.¹⁷

A variety of strategies were used within the design and implementation of each of the interventions. Most of the interventions added equipment or materials to the regular playground offerings ($n = 7$),^{16,17,19,20,22,23,27} although equipment provided varied. Bundy and colleagues¹⁹ provided “loose parts” or “scrounging materials” such as tires and barrels while others provided items such as balls, rings, hoops,^{20,22} balance beams and hurdles,¹⁶ long and short jump ropes,²³ scoop sets, badminton racquets, and flying discs.²⁷

Playground markings were frequently used as well, with 5 of the interventions incorporating the use of this strategy.^{20,23–26,28–30} Cardon and colleagues²⁰ painted a trail river with crossing and flower-shaped hopscotch. The research team collaborated with preschool teachers, considering what would promote activity among the children. Similarly, Stratton and colleagues^{25,30} painted 10 markings: a castle, a dragon, pirate ship, clock face, flower maze, fun trail and dens, hopscotch, letter squares, snakes and ladders, and circular maze.

Playground markings were also used to divide the playground area into specific gaming areas or “zones.” For late primary schools, Stratton & Leonard²⁶ used markings for netball, football, and short tennis, as well as targets for game-related skills. Ridgers and colleagues^{24,28} used the multicolor playground markings to divide the playground into 3 colored zones: red zone (sports area), blue zone (fitness and skills area), and yellow zone (chill out area). The markings in each zone were relevant to the PA and social behaviors desired for that area. Loucaides and colleagues²³ used playground markings and allocated play space to increase PA. Huberty et al¹⁷ also used zones, providing activity zone maps to each school.

Teacher involvement was also integrated into 3 of the interventions.^{15,17,27} Teachers played an influential role in one of the interventions, in which they led group

discussions about the importance of PA, helped the children plan the activity for the day, actually participated with the children, and then had a brief discussion afterward.¹⁵ Huberty and colleagues¹⁷ also recognized the importance of including teachers and staff in the intervention implementation, and recruited the physical education teacher and a recess staff champion to plan daily recess activities. Three of the interventions urged teachers to give encouragement during recess time¹⁵ and to stimulate the children to use the equipment during recess breaks,²⁷ or to reinforce the purpose of the zones and encourage participation.^{24,28,29} Other strategies used included active video game play instead of normal recess,²¹ new PA choices each week¹⁸ or the use of activity cards.²⁷ Five of the interventions used multiple strategies in combination to evoke change.^{17,20,23,24,27}

Intervention Outcomes

All of the interventions included PA as an outcome, although it was measured by various means: accelerometers ($n = 8$),^{16,17,19–22,24,27–29} pedometers ($n = 3$),^{18,21,23} and heart rate telemetry ($n = 3$).^{24–26,28–30} Brown et al¹⁵ used the Observational System for Recording Physical Activity in Preschoolers (OSRAC-P), where they observed for 5–7 minutes during 19 play periods. Three of the studies used multiple measures to quantify PA.^{21,24,25,28–30} Other measured outcomes included teacher participation and prompts to be more physically active using OSRAC-P,^{15,16} teacher perceptions via semistructured interviews,¹⁹ and changes in energy expenditure.²⁵

Over 90% ($n = 12$) of the interventions reported success (ie, improvement in PA as an outcome). These results have been summarized in Table 2. PA measures were generally conducted immediately postintervention. Ridgers and colleagues, however, conducted 3 separate measures, at 6 weeks, 6 months, and 12 months to determine sustainability.^{24,28,29} Improvement in PA levels was sustained throughout the 12-month timeframe. At 6 weeks, the intervention group had 5.95% more MVPA and 1.7% VPA. At the 6-month measures, the intervention group reported 4% and 2% more respectively, and at the 12-month measures, the intervention group reported 1.4% more VPA.^{24,28,29}

A few of the studies mentioned other outcome measures beyond PA levels (eg, sedentary time, energy expenditure, type of physically active play). Hannon et al¹⁶ reported a 16% decrease in postintervention percentage of children’s time spent in sedentary activities. In the studies on playground markings, a significant interaction between time and group was found for energy expenditure (EE) during play and total EE with the intervention group increasing their rates of EE and total EE ($P < .02$).^{25,30} In the Bundy et al study, teachers reported an increase in more physically active play; not only in the form of aerobic exercise, but also resistive exercise. It was reported that children who previously preferred sedentary activities were now more active as a result of the materials. Teachers still worried about safety, despite no more injuries as a result of the equipment.¹⁹

Intervention Limitations Noted

Although most of the interventions achieved some sort of success, the authors also noted limitations within their studies. Similar themes emerged throughout the review: small sample size, issues in measurement, short duration, and lack of control group. Small sample size was mentioned by 5 of the studies,^{15,16,18,21,23} which may limit generalizability.

Several of the studies also discussed issues in measurement. The means selected for measurement could have been a limitation in itself. Duncan and Staples²¹ recognized the potential limitations of using pedometers and heart rate for PA measures. Similarly, the use of pedometers did not account for intensity,¹⁸ and mode of PA was difficult to detect with heart rate monitors.^{25,30} Loucaides et al²³ acknowledged student self-report of PA steps with pedometers could have presented potential for error.

In addition, 2 of the interventions noted they only took measurements during 1 recess period at baseline and postintervention.^{20,22} Assessing only short-term changes gives no indication of long-term effects of the intervention. Two of the interventions mentioned specifically measuring short-term effects, potentially limiting the sustainability of the intervention strategies.^{16,22} Brief and intense interventions may be successful when measuring short-term outcomes, but long-term effects are not known.¹⁵

Two of the interventions considered lack of a control group as a potential limitation, which might limit the validity of causal inference.^{17,22} When working with schools and children in a natural setting, it is difficult to control for all extraneous variables, which may influence PA in addition to the strategies used throughout the interventions.²⁶ Other studies commented on lack of control by researchers to play equipment access,^{20,24} as well as the lack of monitoring of the method of supervision and potential encouragement occurring during recess time.^{24,27} The effect on overall PA, beyond recess time, was not measured.²⁴ One author noted that the schools participating in the intervention were interested in increasing recess PA, which may lead to a bias in outcome results.¹⁷

Discussion

As a whole, recess interventions with intention of improving PA outcomes for students are relatively new. Although only 13 school-based recess studies have been conducted with PA outcomes reported for youth, 12 reported improvement in PA, which is promising. Strategies for increasing student PA fell into 6 distinct categories: added equipment/materials, playground markings, playground zones, teacher involvement, planned activities/activity cards, and active video game play. Reflecting on the most efficacious recess strategies to increase PA is necessary when designing future recess interventions.

Most Effective Recess Strategies

Of the recess interventions used, the most effective approaches included added equipment/materials,

playground markings, playground zones, teacher involvement, and planned activities/activity cards. Differences in PA as an outcome were evaluated to determine efficacious strategies. All 7 studies that incorporated additional equipment or materials for students during recess revealed increased PA of the students, both in short-term studies (1–2 weeks) and over the course of a school year (7 months). In one study, the simple addition of preschool playground equipment was followed by decreased sedentary activity levels and increased light, moderate, and vigorous activity levels. The intervention suggests a short-term intervention effect, as the outcome did not diminish across the 5 postintervention measurements.¹⁶ Another study increased the percentage of time elementary students were active during recess time, particularly for young girls.²² The intervention was effective for overweight and obese children, as overweight/obese girls increased their time in MPA, while overweight/obese boys increased their time in very VPA as a result of additional playground equipment.²²

Offering new activity-friendly outdoor play equipment has benefits for PA levels, and may be looked upon favorably by schools. Even if the effect wears off over a period of time, it is worth looking into whether new infusions of different equipment could reinstate the positive effects found. Equipment should be geared toward the age and developmental levels of the participants, as different age groups reacted differently to the variety of equipment/materials provided.¹⁸

Playground markings, which involve painting items such as castles, dragons, mazes, hopscotch, and other images throughout the playground areas using bright fluorescent colors, were also demonstrated to positively influence student children's PA of all intensity levels.^{25,30} Playground markings should be catered to different age groups and developmental levels to promote PA.^{20,24} They have been shown to help students obtain the recommendation of 50% or more MVPA during recess time.²⁶

Activity zones were another strategy targeted by a number of researchers. Zones, or areas on the playground designated for specific activity types, also resulted in increased PA intensity for participants in all of the documented studies. In the Loucaides et al²³ study, allocating a larger play space during recess on alternating days was effective in significantly increasing PA levels. However, in this particular study, the inclusion of additional equipment and markings along with the larger play space did not significantly increase children's PA, suggesting that 1) the allocation of play space may be more important than extra equipment, 2) the effect of equipment may be dependent upon age and interest of the participants, and 3) motivation and/or interest with equipment may wear off after a certain amount of time passes.

Involving teachers as proponents of PA was found to be effective for students of all age ranges within the review. Brown and colleagues¹⁵ found that brief bouts of teacher-implemented physical activities were feasible and practical procedures for enhancing children's MVPA on playgrounds. The immediate decrease in MVPA during nonintervention play periods indicated that teachers'

ongoing support may be an especially important factor in early attempts at promoting preschoolers' PA. This further highlighted the importance of teacher enthusiasm and participation in the activities themselves.¹⁵ Other studies which incorporated teachers stimulating students to use equipment and be active had positive student PA outcomes,^{17,27} however, both of these studies involved multiple intervention strategies, and the impact of teacher involvement was not controlled for, limiting the authors of this review to determine if individual recess strategies or a combination of recess strategies was most effective.

Presenting recess activities of the week and activity cards for the students to use during recess were also shown to increase PA levels of students. As with methodologies of some of the other studies, the activity card strategies were combined with additional equipment and teacher prompts for students to be active, so it was difficult to assess whether the cards themselves led to the improvements or if it was a combination of strategies. The recess activity of the week concept showed positive PA outcomes during different activities for different students.¹⁸ For instance, the baseline and circuit course activities resulted in higher activity levels overall than the Frisbee activity. Boys were more active than girls during the obstacle course, and older children were more active than younger children for the baseline and Frisbee weeks. Children of healthy BMI were more active during the circuit course week than those with an overweight/obese BMI. These outcomes suggest that schools should consider factors such as elementary level (primary vs. intermediate), BMI and gender when creating recess activity of the week ideas. A one-size-fits-all approach for promoting PA during recess should be avoided and efforts to enhance motivation to be physically active among diverse groups of students need to be considered.¹⁸

Implications

With competing academic interests, and the push to minimize recess across U.S. school districts, it is important to consider lessons learned from this systematic review of recess interventions to increase student PA. A number of simple, low-cost strategies can be implemented to maximize the amount of recess time students are allotted. Use and availability of space on the playground may be an important factor in increasing PA levels,^{17,23,24,30} and more importantly, this particular strategy does not require any additional funding. Planning ahead to organize designated areas and place equipment in the appropriate locations is the only additional necessity. Providing areas or zones for different types of activities appears to be effective in addressing the PA wants and needs of multiple students concurrently. Adding more equipment or materials as well as markings to foster PA was also worthwhile in improving PA levels of students of all ages, gender, and weight status.

One promising strategy for increasing student PA was teacher/staff involvement. Utilizing staff to serve as models, leaders, and promoters of PA lends itself to

a semistructured recess environment. Although national U.S. recommendations define recess as "unstructured physical activity" or "free play,"⁸ periods involving teacher or staff involvement are not entirely structured. The purpose of these strategies is to offer a variety of physical activities that are led or prompted by teachers. The children in these environments still have a choice to participate in teacher-led activities or other activities of their choice. Thus, these are not "structured" recess periods, *per se*. Rather, they are semistructured because they still provide the children with choice in their activities.

In accordance with a teacher/staff involvement strategy, Brown et al¹⁵ and Huberty et al¹⁷ described how teachers were trained and involved in planning recess sessions: these studies reiterate that recess staff should implement a recess environment conducive to PA. It is also evident that training future preschool and elementary teachers with regard to maximizing student PA during recess is necessary. This may increase the teachers' ability, confidence, and positive attitude to integrate PA into their daily lessons.²⁰ Preschool teacher trainings may also enhance knowledge capacity of the teachers and effectiveness of their role in modeling and prompting PA for students.¹⁶ Two potential barriers to incorporating teacher/staff involvement are the cost that may be involved for training the teachers and the time and/or effort required by the teachers to explain and demonstrate activities to the students at recess. Future studies should address the impact of trainings on student PA during recess, teacher attitudes toward promoting PA on the playground, and appropriate frequency and duration of the training and booster sessions.

A number of the studies identified in this review used multiple strategies for increasing student PA at recess concurrently; however, only 2 used methods in which each arm of the intervention could be controlled for. Cardon and colleagues²⁰ used a cluster randomized control trial using 4 conditions: equipment; markings; equipment and markings; and control. They found no increases in student PA for any of the conditions. Loucaides et al²³ randomized schools into 3 conditions: space reallocation, markings and equipment; space reallocation only; and control. They found increases in PA for both intervention groups, but not the control group, indicating that reallocating space during recess was effective as well as providing equipment and markings.

Three studies that used multiple strategies did not control for individual strategies within their intervention. In the Huberty study,¹⁷ the intervention combined additional equipment, zones, and teacher training. The PA outcomes were positive, yet, it is difficult to pinpoint if all 3 strategies equally predicted those changes. Ridgers and colleagues^{24,28,29} incorporated sport action zones and markings to improve student PA. Student PA increased for those in the intervention schools, yet, it is unknown if the outcomes were due to the zones, markings, added equipment, or a combination of all 3 strategies. In the Verstraete study,²⁷ additional equipment, teacher prompting, and activity cards were combined as the intervention.

Again, student PA levels increased as a result, but it is difficult to determine if it was the combination of all 3 strategies that caused the increase or if 1 or 2 of the strategies had more of an effect. Future studies with methods allowing the additive effects of each of these intervention strategies will paint a clearer picture of “what works” for maximizing PA at recess. In addition, future recess interventions should incorporate RCTs to improve methodological limitations garnered with many of the current studies. This would enable improved generalizations and capability of addressing larger segments of the population, whether conducted in the U.S. or internationally. In many cases, children receiving 1 type of intervention have been different from those receiving an alternate strategy, making it difficult to attribute differences in outcomes to the intervention.³¹

Overall, recess interventions intended to increase PA for youth have not been highly studied. Areas of focus for future recess interventions include PA measurement, study locations (ie, U.S. compared with different countries, various SES regions, rural versus urban, etc.), and theoretical frameworks. Currently, the differences in measurement approaches from the various studies make it difficult to compare results between studies. As noted in the limitations of several of the interventions, PA measures vary widely.^{18,21,23,30} Therefore, it is necessary to use multiple measures to measure PA outcomes. Long-term follow-up studies are warranted for each of the recess strategies identified to be effective. Currently, only 1 research group has followed up with students 1 year from implementing the intervention.²⁸ At 12 months, only VPA levels were significantly higher, suggesting that a combination of strategies may be required to maintain the impact of these interventions, such as training of supervisors and an increase in the availability and variety of playground equipment.²⁹ The lasting effects of the remaining recess strategies are unknown, and there is no evidence suggesting that novelty effect is not the cause of increased PA.

There were only 4 recess intervention studies conducted in the United States, thus replication of these strategies in different regions of the country and the world, along with their implementation at different times of the year (eg, varying temperatures and climates) would add valuable information to the literature base for recess PA. Similarly, lessons can be learned from the number of international studies, to help inform recess interventions in the U.S. Because recess is not mandatory in the U.S. as it is in several European countries,³² the first step for health and PA professionals in the U.S. is to advocate for more recess for children in U.S. schools. The next step for health and PA professionals across the globe is to examine “what works” from this review and replicate those strategies during recess/playtime in all schools.

While some intervention strategies were associated with increased PA more than others, it is worth emphasizing that individual strategies should form part of a sound intervention model. The use of theory-based programs aid in the development of measurable program outcomes,

help in the design of interventions, provide a framework for effective programming strategies, and increase the likelihood of successful replication.³³ Therefore, a planned approach to intervention design is recommended. Consequently, select intervention strategies to maximize recess PA would be effectively tailored for the target population and setting.³⁴

Limitations

It is important to note the limitations of this review. This is a narrative review and not a quantitative meta-analysis. Hence, comment on aspects such as effect sizes for all studies, correlation coefficients and other quantitative measures cannot be made. Further, the interventions included were limited to those in the English language, published between 1986 and May 2011 in the selected databases. Only interventions with PA as an outcome were included, thus other interventions conducted during recess time which focused on mental, behavioral, or social aspects were not commented on.

Conclusion

With the implications obesity has on the future of our Nation’s health, the call for schools to lead PA promotion^{2,3} becomes even more important. Efforts to maximize recess PA are advocated because of both health and academic benefits. The results of this review indicate a variety of recess interventions has been used and found to be effective in increasing student PA. It is known that school-based strategies for PA promotion must be cost-effective, unobtrusive, and linked to improved academic performance for students.² Additional approaches for increasing PA during recess should be studied. Policies and practices for implementing successful strategies should continue to be explored via school wellness policies,¹⁷ engaging physical education teachers in teaching recess activities of the week, training teachers and staff to maximize the space available and allocate space to different types of activities, and providing additional play equipment and markings for student use. Only then will PA during recess, as well as the related benefits, be maximized.

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