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Community-identified strategies to increase physical activity during elementary school recess on an American Indian reservation: A pilot study

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ABSTRACT

The aim of this study was to determine the effect of an 8-week recess intervention on physical activity levels in children attending elementary school on an American Indian reservation during fall 2013.
Physical activity was measured with direct observation in three zones on the playground. Lines were painted on existing pavement in zone 1. Zone 2 had permanent playground equipment and was unchanged. Zone 3 contained fields where bi-weekly facilitators led activities and provided equipment. Pre- to post-changes during recess in sedentary, moderate physical activity, moderate-to-vigorous, and vigorous physical activities were compared within zones.
Females physical activity increased in Zone 1 (moderate: 100% increase; moderate-to-vigorous: 83%; vigorous: 74%, $p < 0.01$ for all) and Zone 3 (moderate: 54% increase, $p < 0.01$; moderate-to-vigorous: 48%, $p < 0.01$; vigorous: 40%, $p < 0.05$). Male sedentary activity decreased in Zone 2 (161%, $p < 0.01$). Physical activity changes in Zone 3 were not dependent upon the presence of a facilitator.
Simple and low-cost strategies were effective at increasing recess physical activity in females. The findings also suggest that providing children games that are led by a facilitator is not necessary to increase physical activity as long as proper equipment is provided.

Diabetes in American Indian (AI) children has emerged as a major public health concern. From 1990 to 1998 (Acton et al., 2002), diabetes increased 71% in AIs with 3.5 years being the youngest diagnosed age (Dabelea et al., 1998). Obesity is one of the predominate risk factors for the development of diabetes (Dabelea et al., 1998; U.S. Department of Health and Human Services, 1996; Hannon et al., 2005) and studies show a rise in national obesity prevalence (Ogden et al., 2006). On the Northern Plains, 40% of AI children are overweight (Zephier et al., 2006) and 34% obese (Noonan et al., 2010), respectively. Studies report an association between sedentary activity and obesity (Gahagan et al., 2003; Wareham et al., 2005), both contributors to the diabetes epidemic (U.S. Department of Health and Human Services, 1996; Gahagan et al., 2003; Gahagan, 2003; Moore, 2010). Studies yield that children are more sedentary than ever before (Council on Sports Medicine and Fitness and Council on School Health, 2006), but little is known about physical activity (PA) behaviors in AI children. Collectively, these data underscore the need for daily PA in AI children.

School recess can provide nearly half the minutes necessary to meet the daily PA goal of 60 minutes (Strong et al., 2005). Over the course of a school day, children spend the most amount of active time at recess (Robert Wood Johnson Foundation). That recess presents an opportunity to increase child PA, recess interventions are an ideal approach to help children achieve the recommended PA guidelines (Strong et al., 2005).

School recess interventions have utilized a variety of simple and low-cost strategies to increase child PA. Defining activity zones for daily recess activities showed a 13.1% and 9.6% increase in moderate and vigorous PA for all children (Huberty et al., 2011). Painting game lines on the playground resulted in 13.6% and 4.5% more moderate and vigorous PA for both genders (Stratton and Mullan, 2005). Others provided equipment and activity cards that instruct children how to play games that yielded a significant increase in moderate and vigorous PA (Verstraete et al., 2006). These studies were done in Wales (Stratton

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and Mullan, 2005), Belgium (Verstraete et al., 2006), and the Midwest US (Huberty et al., 2011) in non-Indian children. No recess interventions have been implemented to evaluate if similar PA improvements would occur in children living on an AI reservation.

Children provided equipment, supervision, and organized PA engage in more moderate-to-vigorous PA compared to other contextual conditions (Saint-Maurice et al., 2011). Howe et al. (2012) offered structured recess led by trained staff and report a reduction in sedentary activity and an increase in moderate-to-vigorous PA in children over the course of 9 weeks. Others provide multiple activities on the playground coupled with teacher encouragement and once-a-week teacher participation and report a significant increase in the proportion of children that engage in moderate-to-vigorous PA (Janssen et al., 2013). These studies suggest that providing equipment with facilitator-led activities may increase child PA. No studies have examined how PA levels are affected when equipment is provided, but activities are only facilitated bi-weekly for multiple weeks.

The purpose of this study was two-fold: 1) to determine changes in child PA from baseline to intervention in three different activity zones and 2) to determine differences in child PA during facilitator- and non-facilitator-led activities when equipment is provided.

Methods

Community-based participatory research approach

This study was conducted October–December 2013 (weather did not have an impact on the study as temperatures ranged from 54 °F to 18 °F (mean temperature 36.3 °F) with 0.00 inches of precipitation) with an AI tribal community in Northwestern Montana. The small reservation community has a population of less than 1000 persons (The United States Census Bureau, 2010). The elementary school (3rd–6th grade) offers one recess period per day in the afternoon for 10 minutes and follows a 4-day school week (Monday–Thursday). The study employed a community-based participatory research (Israel et al., 1998) approach that actively engaged community members in all aspects of the process. During the formative phase, 4th, 5th, and 6th grade children and adult community members identified strategies that were implemented in the recess intervention. All 3rd, 4th, 5th, and 6th grade elementary school children (approximately 150) had recess at the same time and were eligible to participate in the recess activities. Letters were sent home to parents/guardians notifying them of the recess intervention. Any parents/guardians that did not want their child to participate in the intervention were instructed to contact the investigator—no one opted out via passive consent.

Institutional review board (IRB) approval for this study was obtained from The Rocky Mountain Tribal IRB in Billings, Montana. Additional approvals were obtained from the school board, principal, superintendent, and tribal council.

Procedure

Prior to any interventions, baseline (pre-test) PA was collected during recess for 1 week on all 3rd, 4th, 5th, and 6th grade children playing in the activity zones (described below). A camera was stationed at each zone to videotape the 10 minute recess period every afternoon. Video cameras (in the exact same location and field of view throughout the study) recorded the three zones approximately 2 minutes prior and approximately 1 minute after the bell(s) that marked the start and end of recess. The field of view of the three cameras did not cover the entire playground, thus the counts represent a sample of all children. The children were free to move between the three zones.

The Friday following baseline measures, four-square, nine-square, and hopscotch lines were painted on the concrete in Zone 1. No changes were made to Zone 2 where permanent playground equipment was located. The playground equipment consisted of slides, swings, ladders, monkey bars, and various climbing structures. Zone 3 was an open field appropriate for games such as football, soccer, and other sports. This area was used for facilitated activities every other week. Appropriate balls and equipment were available during every recess in Zone 3.

The recess intervention began in week 2. Data were collected for all children playing in the activity zones. In Zones 1 and 2, no facilitation was provided other than the painted lines on the pavement. In Zone 3, a facilitator led the first week of recess activities focusing on the same activity for the entire week. The following week, the facilitator was absent—a boundary for the prior week's activity was defined with cones, and the equipment necessary to play the game was provided (e.g., if the facilitator played football the prior week, a football was provided the week of his absence). This bi-weekly configuration of facilitator/no facilitator continued throughout the 8 week intervention. The four activities that were offered for 2 weeks at a time were football, soccer, basketball, and ultimate frisbee (Fig. 1).

Observation instrument

The System for Observing Play and Leisure Activity in Youth (SOPLAY) was used to calculate child PA. This direct observation

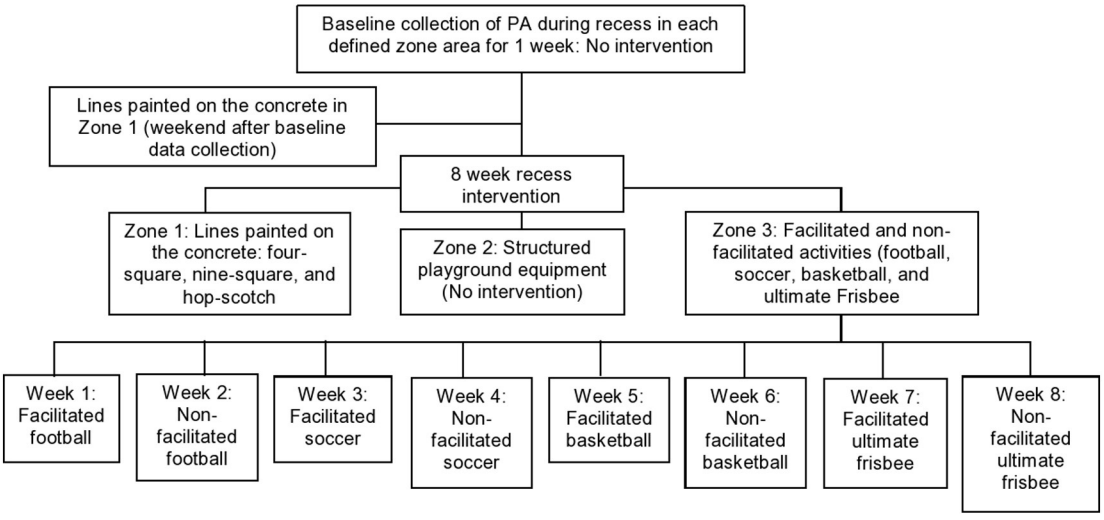

Fig. 1. Flow diagram depicting the study design and procedure.

Table 1
Physical and demographic characteristics of the 4th, 5th, and 6th grade children.

	n (%)	Mean (SD[a])
Physical characteristics		
Weight (kg)	61	43.5 (13.9)
Height (m)	61	1.4 (0.1)
WC[b] (cm)	61	72.9 (11.9)
BMI[c]	61	66.5 (30.3)
Age	61	11 (0.9)
Gender		
Boys	28 (46)	
Girls	33 (54)	
Ethnicity		
American Indian	28 (46)	
White	33 (54)	

[a] Standard deviation.
[b] Waist circumference.
[c] BMI for age- and sex-specific percentiles.

instrument is based on momentary time sampling and has been previously validated to obtain data on leisure and play time child PA (McKenzie et al., 1991). The SOPLAY instrument was used to analyze each recess video recording to count the number of children in sedentary, walking, or active intensities. An MVPA category was created by summing the walking and active categories (McKenzie et al., 2000). The activity categories were recorded by gender. Observers determined gender based on the children's dress and hairstyle to the best of their ability.

Video recordings of each zone during each recess period for the baseline and 8 intervention weeks were analyzed by three trained assessors—each assessor was assigned a zone that they analyzed for the remainder of the study. The procedure was consistent with the protocol designed by McKenzie (McKenzie). Females engaging in sedentary activity were scanned first. The assessors conducted a left-to-right scan using a mechanical counter to calculate the number of females observed in sedentary activity. Scans lasted approximately 10 seconds for each dependent variable (sedentary activity, MPA, and VPA). The assessors recorded how many counts were observed and then scanned for females in the walking and active categories. This procedure was then repeated for males. If gender was in question during a scan, the choice to count or omit the child was based upon the assessor's discretion. A child was eligible to be counted only once for each dependent variable scan. However, if a child counted as sedentary was still in the zone when scanning for MPA, that child was eligible to be counted during the MPA scan. It was possible for a child to be counted in one zone, and then counted again after moving to a different zone (e.g. running from Zone 1 to Zone 2). The average counts for each variable per zone were used for the data analysis.

Assessors reviewed the SOPLAY protocol and were trained to properly calculate PA counts. Reliability tests included assigning four assessors to the same 72 observations to scan and calculate child PA for each dependent variable. The assessors were blind to the observations selected and conducted their scans independent of one another. In cases of large discrepancies between assessors ($r < 0.80$), the time point was reanalyzed. Intra-class correlation coefficients were calculated at $r = 0.89$ (95% CI: $r = 0.84$–0.93) between assessors.

Ancillary measures

A cohort of students in grades 4–6 completed anthropometric measures and a brief demographic survey as part of an ancillary study. These students had the ability to participate in the recess intervention reported here. Body weight was recorded to the nearest 0.1 kg using a digital scale (Seca, Ltd, Birmingham, UK), height was measured to the nearest 0.1 cm using a calibrated stadiometer (Seca Ltd, Birmingham, UK), and waist circumference was measured to the nearest 0.1 cm using a standard tape measure.

Data analysis

Mean and standard deviations were used for descriptive statistics of the PA variables. Four days of baseline PA data within each zone were averaged within gender and overall. All days of the intervention PA data within each zone were averaged within gender and overall. Additionally, all PA data in Zone 3 for facilitated weeks were averaged within gender and overall and the same averages were calculated for non-facilitated weeks. Two-tailed independent *t*-tests were used to compare the difference in sedentary activity, MPA, MVPA, and VPA (separately) between baseline and intervention within gender, and overall. In addition, differences between facilitated and non-facilitated weeks were also evaluated. This analysis was performed in R 3.0.3. Statistical significance was set at $\alpha \leq 0.05$.

Results

Physical characteristics and demographic measures

Descriptive measures for a cohort of children ($n = 61$) in the 4th, 5th, and 6th grade are reported in Table 1. These participants were

Table 2
Mean (SD) of physical activity counts across time and gender in Zone 1, Zone 2, and Zone 3 during baseline and during the 8 week recess intervention.

	Mean physical activity counts[a] during baseline			Mean physical activity counts[a] during intervention		
	Zone 1	Zone 2	Zone 3	Zone 1	Zone 2	Zone 3
Females						
Sedentary	2.4 (1.4)	12.2 (3.6)	1.0 (0.0)	2.4 (2.9)	7.9 (3.7)*	0.6 (0.7)*
Moderate	2.1 (1.5)	4.8 (1.9)	1.3 (0.7)	4.2 (2.6)*	4.6 (2.0)	2.0 (1.4)**
MVPA[b]	4.8 (2.9)	12.8 (3.1)	2.3 (0.7)	8.8 (3.6)*	12.1 (4.1)	3.4 (2.4)*
Vigorous	2.7 (1.5)	8.0 (2.1)	1.0 (0.0)	4.7 (2.6)*	7.5 (3.4)	1.4 (1.4)**
Males						
Sedentary	2.4 (1.5)	4.7 (2.2)	1.0 (0.9)	1.8 (1.9)	1.8 (1.4)*	0.9 (1.4)
Moderate	4.0 (1.6)	5.1 (2.2)	4.3 (2.6)	4.1 (1.9)	3.9 (2.2)	4.6 (2.7)
MVPA[b]	7.8 (2.8)	9.8 (4.2)	8.3 (3.2)	7.4 (2.6)	7.3 (3.7)	9.1 (3.9)
Vigorous	3.8 (2.1)	4.7 (2.8)	3.9 (2.7)	3.3 (1.8)	3.4 (2.3)	4.6 (3.1)
Overall						
Sedentary	2.4 (1.4)	8.5 (4.8)	1.0 (0.6)	2.1 (2.5)	4.9 (4.1)*	0.8 (1.1)
Moderate	3.0 (1.8)	4.9 (2.0)	2.8 (2.4)	4.2 (2.3)**	4.2 (2.1)	3.3 (2.5)
MVPA[b]	6.3 (3.2)	11.3 (3.8)	5.3 (3.8)	8.1 (3.2)**	9.7 (4.6)	6.3 (4.3)
Vigorous	3.2 (1.9)	6.4 (2.9)	2.5 (2.4)	4.0 (2.3)	5.4 (3.6)	3.0 (2.8)

[a] Activity counts refer to the number of children observed doing that intensity of PA.
[b] MVPA, moderate-to-vigorous physical activity.
* Significantly different from baseline at $p < 0.01$.
** Significantly different from baseline at $p < 0.05$.

Table 3
Mean (SD) of physical activity counts for facilitator-led and non-facilitator-led activities in Zone 3 during the 8 week recess intervention.

	Facilitator	No facilitator
Females		
Sedentary	0.5 (0.6)	0.8 (0.7)
Moderate	2.1 (1.5)	1.9 (1.4)
MVPA	3.5 (1.9)	3.3 (2.8)
Vigorous	1.3 (1.0)	1.4 (1.6)
Males		
Sedentary	1.1 (1.6)	0.8 (1.3)
Moderate	4.7 (2.1)*	4.5 (3.1)*
MVPA	9.3 (2.6)*	9.0 (4.8)*
Vigorous	4.6 (2.0)*	4.6 (3.8)*
Overall		
Sedentary	0.8 (1.2)	0.7 (1.0)
Moderate	3.4 (2.2)	3.2 (2.7)
MVPA	6.4 (3.7)	6.2 (4.7)
Vigorous	3.0 (2.3)	3.0 (3.3)

* Males significantly higher than females, $p < 0.001$.

part of the larger group of children who had the ability to be observed during the recess intervention.

Baseline compared to intervention

Descriptive measures for PA in males and females separately and combined from baseline to the intervention are reported in Table 2. The data represent an average of all days during the two periods: baseline and intervention.

The results for PA in males and females (combined) reveal a significant decrease in sedentary activity in Zone 2 ($p < 0.01$). Significant increases in MPA ($p < 0.05$) and MVPA ($p < 0.05$) were seen in Zone 1.

The results for PA in males and females (separately) reveal a significant decrease in sedentary activity for both genders (males, $p < 0.01$; females, $p < 0.01$) in Zone 2. In addition, a significant decrease in sedentary activity for females ($p < 0.01$) was observed in Zone 3.

The findings also indicate a significant increase in MPA, MVPA, and VPA in females in Zone 1 ($p < 0.01$) and Zone 3 ($p < 0.05$). There were no increases in MPA or VPA in males.

Facilitator-/non-facilitator-led activities

The impact of different sporting activity was not evident in our initial analysis. The decision to combine (i.e., average) across facilitated weeks and compare them to the combined non-facilitated weeks (for each dependent variable by gender separately and combined) was made (data not shown). These data reveal no difference in sedentary activity, MPA, MVPA, and VPA when activities were facilitated and when they were not (Table 3). Males had significantly higher MPA, MVPA, and VPA compared to females both when a facilitator was present and when a facilitator was absent (Table 3).

Discussion

The purpose of this study was to examine the effect of a recess intervention on PA in 3rd, 4th, 5th, and 6th grade elementary school children in an AI tribal community. To our knowledge, this is the first recess intervention conducted in an AI tribal community as well as the first study that assessed the effects of providing facilitator- and non-facilitator-led activities (Ickes et al., 2013). This novel approach provided the children three different choices of activities during recess, while affording them the opportunity to play games with a facilitator that taught technique, rules, and sportsmanship. This is a relatively unexplored topic and may help schools, communities, and investigators determine effective and sustainable strategies to increase child PA in AI reservation schools.

Females significantly increased MPA, VPA, and MVPA in the area with painted lines (Zone 1) and in the area with facilitated/non-facilitated activities (Zone 3) before and after the intervention. Prior studies done in this area demonstrate the variability in child PA improvements. Stratton and Mullan (2005) painted lines on the playground and report a significant increase in MVPA for both genders (Stratton and Mullan, 2005). Other interventions that contained activity zones (Huberty et al., 2011) or provided children structured games complete with equipment and instruction (Verstraete et al., 2006) report a significant increase in MPA, MVPA, and VPA for all children (Huberty et al., 2011; Verstraete et al., 2006). A study by Janssen et al. (2013) that contained games and structured recess activities report that the effect of the intervention was stronger for females compared to males. The increase in female PA may be attributed to reduced competition for playground space because there were new, additional opportunities available to females in the activity zones. Boyle et al. (2003) observed playground behavior between females and males during recess and discovered that females are much more social and territorial on the playground than males. Perhaps this same dynamic is taking place among females in Zone 1. Further, females are significantly more likely to participate in "jumping-skipping games" (Blatchford et al., 2003) and "jumping activities" (Saint-Maurice et al., 2011) compared to males. The games in Zone 1 fit these descriptions (four-square, nine-square, and hopscotch). The emphasis in Zone 1 is having fun and socializing during recess rather than competition, which was the emphasis in Zone 3. Although female PA significantly improved in Zone 3, it was nearly a two-fold PA increase in Zone 1 (Table 1). Many females also identified the Zone 1 games during the formative phase of this study, which may explain why PA increased more in females than males.

There were no differences in child PA between facilitator- and non-facilitator-led activities. These findings differ from previous studies that report significant improvements in child PA after incorporating structured recess activities led by trained research staff (Howe et al., 2012), and multiple intervention components coupled with teacher supervision and once-a-week teacher participation (Janssen et al., 2013). Others report that providing equipment coupled with supervised and organized PA elicits the highest amount of child PA during recess (Saint-Maurice et al., 2011). No studies have determined how PA is affected when a facilitator actively engages in a weekly activity, and then removed for a week, over the course of multiple weeks. The findings from the current study suggest that the effect of facilitator-led activities carry over into the next week where children actively engaged in the same activity that was taught the week prior. There is evidence from a recess intervention that used playground markings and a designated sports area, that moderate-to-vigorous and vigorous PA can be maintained for up to 6 months after the intervention is completed (Ridgers et al., 2007). However, the intervals in our study were only 1 week. Future studies should determine how long it takes before child PA declines after terminating facilitator-led activities.

The PA pattern between genders that emerged in Zone 3 is interesting. Females engaged in significantly more MPA, MVPA, and VPA from baseline to intervention, but males did not improve (Table 2). However, when PA between males and females were compared, males engaged in significantly more MPA, MVPA, and VPA compared to females (Table 3). Although not statistically significant for males, both genders improved their PA levels in Zone 3 after bi-weekly facilitated activities were offered. A systematic review of recess interventions by Ickes et al. (2013) determined that providing equipment and playground zones were one of the most effective strategies to increase PA. Others report that providing sports equipment stimulates PA in 4th and 5th grade children (Willenberg et al., 2010). Children with no equipment engage in 8.2% more sedentary activity and 6.9% less MPA than children who are provided equipment during recess (Ridgers et al., 2010). Additionally, the intervention provided more play space that was under-utilized prior to the implementation

of Zone 3. Others report that allocating more playground space has positive effects on child PA (Huberty et al., 2011; Loucaides et al., 2009) and is a positive predictor of VPA (Ridgers et al., 2010). Our finding supports the literature that ascertains offering more playground space and providing game equipment may prove sustainable and effective for long-term improvements in child PA.

Strengths and limitations

The strengths of this study are attributed to the PA strategies which were identified directly by the children during the formative phase of this project. The painted lines will remain on the playground for children to utilize and represent a sustainable piece of this study. The SOPLAY PA instrument allowed the assessors to distinguish between males and females and calculate PA counts in the three activity zones. This preliminary work revealed that facilitators have a positive influence on AI children when leading recess activities and can engage children on the playground during recess. Collaboration and support were provided by the school, community, and reservation from start to finish.

Limitations of this study include the lack of a comparison group and no randomization scheme. The small sample size in one community makes the findings difficult to generalize to other AI tribal elementary schools. Additionally, the investigators were limited to one 10 minute recess period per day.

Implications and future research

The finding of no difference in child PA between facilitator- and non-facilitator-led activities has direct utility for schools. This suggests that competent personnel can show children how to play games and provide equipment, and children will play these games without sustained facilitation. Community-identified approaches like painting lines on the playground are inexpensive and sustainable strategies that are likely to increase female PA. To our knowledge, no other studies have investigated the effect of a recess intervention in an AI reservation community. Tribal communities are unique and vastly different from places where other recess interventions have been tested due to their rural location, high unemployment rates, low socioeconomic status, high rates of chronic disease, presence of native and non-native children, differences in cultural backgrounds and limited opportunities to be physically active (Noonan et al., 2010; Bandura, 1982; Brown et al., 2010; Nguyen et al., 2014).

That recess accounts for one third of the daily PA recommendations (Ridgers and Stratton, 2005), we suggest efforts to help children increase PA during recess start at the policy level. Research shows that schools are more focused on academics and reduce as much as 28% of recess and lunch time (McMurrer, 2008). Policy changing efforts should increase not only frequency but also duration of recess. Compelling research states that regular PA during the school day has been shown to improve cognition, attention, attendance, behavior, and other factors increasing learning and academic achievement as well as improved health and decreased obesity (Fedewa and Ahn, 2011). These findings underscore the need to increase child PA during the school day.

Conclusion

We found that females engaged in significantly more MPA, VPA, and MVPA from baseline to intervention in the area with painted lines (Zone 1) and in the area where facilitator/non-facilitator activities (Zone 3) were offered. There was no difference in child PA between facilitato- and non-facilitator-led activities in Zone 3.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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