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The Effectiveness of a Community Playground Intervention

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ABSTRACT *This study assessed whether an upgrade of playgrounds in a community was associated with changes in the physical activity of local children. The study used a natural experiment design with a local authority project to upgrade two community playgrounds as the intervention and a matched control community. Children's physical activity was measured by an Actigraph GT1M accelerometer worn for 8 days, enabling up to 6 days of data to be analyzed. A self-administered parent/guardian questionnaire was used to collect additional data, including perceptions of the neighborhood, school-travel modes, days involved in extracurricular activities, ethnicity, caregiver age, caregiver sex, household vehicle access, and household income. At baseline, 184 children (5–10 years old) participated. Of these, 156 completed the 1-year follow-up assessment (20% lost to follow-up). There was statistically significant evidence that change in mean total daily physical activity was associated with on an interaction between participant's body mass index (BMI) z-score and her or his community of residence (p=0.006), with the intervention being associated with higher levels of activity for children with lower BMIs but lower levels for children with higher BMIs. Physical activity is not the only focus of local authority playground provision as playgrounds also have benefits for social development and fundamental movement skills. However, making sure that physical activity is always included in the design rationale and that playgrounds are designed to encourage and sustain physical activity could be a useful population health intervention. The effects of such interventions on different subgroups are of importance, especially if the effects differ over levels of BMI.*

KEYWORDS *Physical activity, Children, Accelerometer, Natural experiment, BMI*

INTRODUCTION

Playgrounds have been found to be associated with children's physical activity in the scientific literature, and recommendations have been made based on the assumption

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that improved facilities and better access to these facilities would increase physical activity.[1–6] The evidence that playgrounds can increase children's physical activity is, however, unclear. A systematic review of the literature identified nine papers, of which eight reported statistically significant increases in physical activity after school playgrounds were upgraded.[7–15] Cardon et al.[16] concluded that just upgrading playgrounds without providing additional supervision or leadership was insufficient to engage young children in physical activity.

Most of these studies measured playground physical activity with objective instruments, either heart-rate monitors, accelerometers, or pedometers. In these studies, the amount of playground physical activity could be accurately and practically measured using these instruments because they focused on the school setting only. The Farley study[9] considered wider neighborhood physical activity by using the System for Observing Play and Leisure Activity in Youth instrument to measure physical activity in the streets around the intervention playground and in the control neighborhood. None of the upgraded playgrounds in any of these studies were in public parks.

These reports provide little information about how much playground activity contributes to the overall physical activity levels of children. All of these studies focused on schools environments, which may facilitate data capture, but circumvents considering activity taking place in the home, family, and community environments and the possibility of activity compensation.

This manuscript reports on a study, which was undertaken to evaluate changes in physical activity for children when playgrounds located in public parks within their community were upgraded. Baseline data collection and some results that included GPS-located physical activity have been reported,[17] but only accelerometer-measured physical activity is presented in this manuscript. The study hypothesis is that upgrading playgrounds in a community would be associated with an increase in the accelerometer-measured, total daily physical activity (TDPA) of children attending schools located in that community compared with a matched control community.

METHODS

The study design was a natural experiment involving elementary school children (5–10 years at baseline). The "naturally occurring" event, the local authority plan to upgrade playgrounds in a specific community, was the intervention, and children living in that community formed the sample population. The Dunedin City Council (DCC) playground upgrade program identified the intervention community, but because participants could not be randomly allocated to live in either the intervention or the control community, criteria were used to choose a broadly similar community from which to recruit control participants.[18] New Zealand (NZ) central and local government published reports were used to identify potential control communities and provide identifiable and plausible community factors. The factors were: school decile, a socioeconomic indicator assigned by the NZ Ministry of Education;[19] size of school roll;[19] the number of primary schools in area;[19] the local authority's assigned and published play value of existing playgrounds;[20] transportation routes;[21] population characteristics;[22] household income;[22] household vehicle characteristics;[22] potential control community location—physical separation from intervention community (boundaries defined by DCC Play Strategy).[23] The basic assumption for the natural experiment was that participants from the control community should be as similar as possible to those in the intervention community, other than the experience of changes to the playgrounds in their community. There were six communities considered for selection of control community. One appeared to be similar to the intervention community, particularly when comparing the number of state highways in the community and the proportions of low-income households, and it was geographically separated from the intervention community. However, previous upgrades of playgrounds in this community were nearly complete, and it was therefore believed that potential control subjects might not be settled in their patterns of physical activity. Consequently, the next most appropriate community was selected. The mean school size was much larger than that in the intervention community, but this was influenced by one school that had a considerably larger roll. This difference was circumvented by not recruiting from the large school.

The intervention, the playground upgrades, was conceived and managed by the local authority with no influence from the research team. The DCC followed the community consultation processes outlined in their policy documents.[20,23] The results of this process identified two playgrounds selected for upgrading from the six playgrounds in the intervention community. At one playground, ten new components, including play equipment, seating, additional safety surfacing, and waste facilities, were installed, and two existing components were removed. At the other playground, two new play equipment pieces were installed, and a small modification was made to another piece of equipment. No physical changes were made to the playgrounds by the time baseline physical activity measurement was taken. All playground upgrades were completed 3 months before the follow-up physical activity measurement phase. Data were collected in October to December 2007 and during the same months in 2008. This is spring in the southern hemisphere.

Participants

The local authority identified community boundaries for the playground consultation process, and these were used to define the intervention community. A broadly similar control community was also chosen. A two-stage sampling process was used to recruit participants. First, elementary school administrators in the control and intervention communities were asked to provide access to their pupils. Of the six schools in the intervention community, four agreed to participate. In the control community, all four schools who were asked agreed to participate. The second stage of sampling required eligible children to be recruited from the eight participating schools. Inclusion and exclusion criteria were developed and applied uniformly to ensure participants were anticipated to be available for follow-up assessment 1 year later and to maximize the comparability of participants from the two communities. Age and school year criteria were set so that participants were most likely to remain at the same school for assessment the following year. The inclusion criteria were that children must be:

1. Between the ages of 5 and 10 years old (inclusive) at the time of baseline assessment
2. Classified as year 0 to 5 (inclusive) (kindergarten to grade 4)
3. Residing 4 or more nights per week within the defined community

If more than one child per family had consented to participate, one child from that family was selected at random for enrolment in the study.

Without making any assumptions about the correlation between physical activity at baseline and at follow-up, 63 participants in each group would provide 80% power to detect a standardized effect size difference of 0.5 standard deviations in mean physical activity (calculated over 6 days at follow-up) between communities using a two-sided test at the 0.05 level. School design effects were assumed to be negligible or at least low enough to be compensated for by any correlation between measurements at baseline and follow-up. Allowing for a 33% loss to follow-up rate, mostly expected to be from participants moving residence out of the study areas, 100 participants in each group at baseline assessment stage would be sufficient. This required a participation rate of around 30% in each community based on New Zealand Census data on the number of children in each community[22] and 75% of children attending their local school.[24]

The study was approved by the University of Otago Human Ethics Committee. Research consultation with Māori was also undertaken in accordance with University of Otago policy. Informed consent to participate was obtained at three levels: the school principals who enabled recruitment from their students provided a letter of approval, parents/guardians signed a form, consenting to their child's participation and the participating children themselves completed and signed a consent form confirming their willingness to be involved. An information letter and take-home consent form were supplied and distributed by schools for all children in year 5 or below. Children returned their parent/guardian consent form completed and signed if they were willing to participate.

Instruments

The timing of the upgrade process enabled baseline physical activity assessments to be made before the playgrounds were to be upgraded and follow-up assessments to be made 1 year later after upgrades were completed. A GT1M (Actigraph, Fort Walton Beach, FL) was issued to each participant to wear on a waist belt over the right hip over 8 days. Participants were instructed and monitored by a research assistant at their school each day to increase compliance. An incentive was provided (a family swim voucher valued at US$8) to participants for correct and consistent wear when the accelerometer was collected at the completion of each phase. The follow-up data collection and data management adhered to the same protocols and procedures as the baseline data collection, except for the selection of the belt with the accelerometer. Participants were issued with the same belt used in 2007 if it was available; otherwise, they were issued a randomly selected belt. This protocol was acceptable as the Actigraph GT1M has been reported to have sufficient inter-unit variability.[25]

Stata was used to discard the first and return day of each participant as it was considered to be incomplete,[26] leaving up to 6 days of data per participant. The full 24 hours of data available from the accelerometer (12 A.M. to 11:59 P.M.) was used to define the day, as a review of participants' monitoring sheets showed that there were specific records of belts being worn at a variety of times. It was decided, prior to analysis but after data collection, that five or more hours with non-zero counts were required for a daily count total to be included in any analysis. Any or all valid days were included for analysis. More than 5 hours of consecutive zero counts would be assumed to indicate non-wearing of the units, and the remaining data were classified as not valid.[27] Other studies have required 6 hours of non-zero data for data to count in the final analysis,[26] but a lower limit of 5 hours containing some recorded activity was considered appropriate for this study after review of the participants' monitoring sheets. This approach maximized available data and did not rely on assumptions whether other zero counts within the day were from inactive behavior or non-wear. All counts were summed for each valid day, with TDPA used as the primary outcome measure. The daily totals were retained rather than excluding activity within school hours because the contribution of school environments to daily physical activity totals was important.

A self-administered questionnaire was developed to gather additional data about the individual child, the household, the family structure, and the responding adult. Additional questions provided a parental perceptions of neighborhood scale, as these perceptions had previously been found to be associated with children's physical activity and health.[28–32]

The parent/guardian perception of the neighborhood score was calculated from responses to the first 15 questions of the instrument. If five or fewer of the 15 questions were not answered, imputation of the total score using the respondent's mean score for the questions answered was performed. Possible scores ranged from 15 (very negative perceptions) to 90 (very positive perceptions).

This questionnaire underwent pilot testing with results as follows. Of the 15 perceptions of the neighborhood questions, 10 demonstrated good test–retest reliability (intraclass correlation coefficients [ICC] greater than 0.70) and only two had ICCs less than 0.50. These two items were retained in the instrument because the summative score had a test–retest reliability ICC of 0.71. The Cronbach's alpha for the first pilot test was 0.66 and 0.74 for the retest showing acceptable internal consistency.

The questionnaire was mailed to participants' homes at the beginning of each physical activity assessment phase. Gifts were provided to participants and their families if the questionnaires were returned after each phase. At baseline, the gift was a swimming bag (valued at US$3.50). At follow-up, the gifts were a pair of swimming goggles and a Frisbee (total value US$8).

Statistical Analyses

The primary outcome measure for the study was mean TDPA. This measure was selected to capture all and any activity that might occur within the specific locations and also because there was still considerable debate and a lack of consensus regarding appropriate cut-points to use for child moderate to vigorous physical activity.[33,34] Additionally, our sample population had a comparatively wide age range (5 to 10 years at baseline), so there would have been possible changes in cut-points for some participants at follow-up.

Height and weight were measured by trained research assistants at participants' schools, and these data converted to BMI age- and sex-standardized *z*-scores.[17] Age, sex, and BMI have been associated with different levels of physical activity.[35–38] NZDep2006 score, an indicator of socioeconomic deprivation,[39] was obtained from each participant's residential address.

Spatial variables were obtained using ArcGIS 9.3 (ESRI, Redlands, CA) based on the residential address of the participant and park boundary data, including the straight-line distances from the residence to the boundary of the nearest park with any playground. Anthropomorphic data collected directly from participants at their schools enabled age- and sex-standardized BMI *z*-scores to be calculated[40] and age- and sex-specific categories of normal, overweight, and obese to be determined.[41] The NZDep2006 Index of Deprivation score was obtained from a participant's geo-coded home address. This is a score indicating the relative deprivation of the area in which she or he live. The score combines information from the 2006 NZ Census about relative income, home ownership, familial support, employment status, educational qualifications, living space, telephone, and transport access into the index of deprivation score from a 10-point ordinal scale. Other covariates collected by the parent/guardian questionnaire instrument included ethnicity, with the NZ Ministry of Health's prioritization protocol used to determine priority ethnicity;[42] usual travel mode to school and from school; whether the family owned a dog; the number of household motor vehicles; household annual income; whether there were younger siblings; a score indicating the parental perception of the neighborhood; the number of days of organized extra-curricular activities, such as after-school care, music lessons, and sports games or practices; and the number of adults in the home.

All participants who moved away from Dunedin residences between assessments were excluded from the follow-up analyses. The analysis compared the control and intervention groups' mean TDPA, using participants' total daily accelerometer counts for each valid study day. The unit of analysis was child day, clustered within the child, clustered within the school. Log-transformations were used where positive skew and heteroscedasticity was noted in residuals and the transformation improved these. The effect of the upgrade was assessed using a linear mixed model with the mean baseline score for that participant included as a covariate. All models controlled for repeated measures within each child and clustering by schools using random effects. Univariate screening was carried out using $p<0.1$ for inclusion in the final model. A priori specified interactions between community and each of sex, age, and BMI were also investigated. Nonlinearities in associations involving continuous independent variables were examined and where appropriate modeled using fractional polynomials. Data cleaning and all analyses were undertaken using Stata/MP 10.1 and Stata/IC 10.1 (StataCorp LP, College Station, TX).

RESULTS

At follow-up, 156 children participated in the physical activity assessments while still residing in their original community, out of the 184 with baseline assessments (15% loss to follow-up), with the control group losing 10% ($n=9$) and the intervention group 20% ($n=19$) (Table 1). For the characteristics shown in Table 1, there was no statistically significant evidence that there were differences between those lost to follow-up and those who remained in the study ($p>0.120$). The only statistically significant difference between the remaining cohort and those lost to follow-up was the baseline age of the responding parents/guardians (those lost to follow-up had parents who were 4.3 years younger, 95% CI: 1.2, 7.3, $p=0.006$). This difference was similar for both communities (5.1 and 3.4 for control and intervention, respectively). There was less compliance with physical activity measurement protocols at follow-up compared to baseline, but this was still acceptable since four or more days of accelerometer data were recorded for 86% ($n=132$) of the cohort. All participants with at least 1 day of valid data were included in the analyses to maximize statistical power ($n=138$). The parent/guardian questionnaire instrument response rate was excellent. Of the 138 participants in the final cohort, there was questionnaire data for 128 at baseline (93%) and 133 at follow-up (96%). There was no statistically significant evidence that those lost to follow-up in the intervention group were different by baseline physical activity (difference in mean TDPA of intervention group at baseline= 47,653, 95% CI: –26,028, 121,335, $p=0.202$).

Linear mixed models were used to predict follow-up physical activity, which was log-transformed, while controlling for potential confounders (as shown in Table 2) and baseline physical activity levels. As shown in Table 2, there was evidence of statistically significant associations in the final model between follow-up

TABLE 1 Differences between longitudinal cohort and those lost to follow-up—categorical participant demographic characteristics

	Control				Intervention				Total			
	Follow-up $n=79$		Lost to follow-up $n=9$		Follow-up $n=77$		Lost to follow-up $n=19$		Follow-up $n=156$		Lost to follow-up $n=28$	
Child characteristics	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Sex												
Female	48	61	5	56	36	47	10	56	84	54	15	54
Male	31	39	4	44	41	53	9	44	72	46	13	44
Mean age (±SD)	7.5±1.6		8±1.9		7.6±1.6		7.4±1.6		7.6±1.6		7.6±1.7	
5–6	20	25	2	22	22	29	5	29	42	27	7	26
7–8	32	41	3	33	25	32	6	32	57	37	8	30
9–10	27	34	4	44	30	39	8	42	57	37	12	44
BMI *z*-score [31]												
Mean *z*-score (±SD)	0.73±0.90		1.00±0.74		0.69±0.81		0.94±0.91		0.71±0.71		0.97±0.84	
Normal weight	56	71	5	56	57	74	10	53	113	72	15	54
Overweight	13	16	4	44	15	19	5	26	28	18	9	32
Obese	10	13	0	0	5	6	4	21	15	10	4	14
Ethnicity[a]												
NZ Māori	15	19	4	44	18	23	5	26	33	21	9	32
Pacific	4	5	0	0	5	6	1	5	9	6	1	4
NZEO	63	80	5	56	59	77	13	68	122	78	18	64
Missing	6	8	0	0	7	9	4	21	13	8	4	14

NZEO New Zealand European/Other

[a]Participants could select more than one category so percentages may add up to more than 100

physical activity and participant baseline age, school day, usual mode of travel to school, sex, and ethnicity. Also, statistically significant interactions were found between sex and ethnicity ($p = 0.019$) and community and BMI z-score ($p = 0.006$). There was no evidence of any other statistically significant predictors of physical activity levels at follow-up assessment.

The final model without the BMI–community interaction found no evidence that participants in the intervention community had a statistically significant difference in their mean TDPA, compared to those living in the control community. There was, however, statistically significant evidence that the differences in mean TDPA differed depending on participant's BMI z-score and community of residence (interaction $p = 0.006$). For children in the intervention community, compared to the control community, total activity increased for those with BMI z-scores less than 0.4 and decreased for those with BMI z-scores greater than 0.4. This is illustrated in Figure 1.

DISCUSSION

The study hypothesis was that upgrading the play equipment in two playgrounds would increase the TDPA undertaken by children attending schools located in that community. While there was no direct support for this hypothesis, there was evidence of an interaction between BMI and those exposed to the upgraded playgrounds as Figure 1 illustrates. For BMI z-scores typical of children in the study (around 0.7), there was no evidence of an effect. For children with low BMI z-scores, there was statistically significant evidence of a benefit from the intervention. This finding needs to be interpreted with care and be replicated in other studies, particularly given the small numbers of participants. However, if confirmed, it would suggest that upgrading playgrounds may decrease total activity in those with higher BMIs, a group often targeted by physical activity interventions.

There appear to be no published reports of similar evaluations of upgraded playgrounds within a population health framework which included objectively measured physical activity. Studies have also had difficulty detecting community- or population-level changes with other types of interventions, such as a pedometer challenge.[43] In contrast to studies with a population health framework, none of the other studies that found evidence of an increase in physical activity after playground upgrades included any measurement of total physical activity for comparison,[8–16] leaving open the possibility of physical activity compensation leaving TDPA unchanged.

Playgrounds are a primary setting for observational studies to assess child physical activity.[9,44] Of the nine playground intervention studies that measured physical activity within a playground setting, only one study considered physical activity in the wider neighborhood context.[9] The amount of physical activity measured in the neighborhood was still not able to be compared with the overall levels of physical activity undertaken by participants in specific settings. It is possible that our study might not have observed any population level physical activity increase because playgrounds, or even parks, may have less importance for children's overall physical activity than previously thought. Alternatively, such interventions may displace the location of physical activity rather than affecting its magnitude.

This manuscript has not evaluated the merits of the playground changes made by the DCC, but Frost and Woods[45] cautioned against standardized, modular

TABLE 2 Potential Predictors (with reference groups) of follow-up physical activity mean TDPA

Variables	Univariate model ratio of geometric means (95% CI)	*p* Value	Multivariate model ratio of geometric means (95% CI)	*p* Value
Exposure to playground intervention (community of residence) compared to control (when BMI *z*-score is 0)	0.90 (0.69, 1.16)	0.417	1.11 (0.85, 1.44)	0.456
BMI (overall per 1 *z*-score unit increase)	0.96 (0.87, 1.06)	0.388		
For those in the control community (per 1 *z*-score unit increase)			1.19 (1.06, 1.34)	0.005
For those in the intervention community (per 1 *z*-score unit increase)			0.94 (0.83, 1.06)	0.300
Interaction: community by BMI *z*-score				0.006
Ethnicity (Maori/Pacific versus NZEO)	1.16 (0.97, 1.39)	0.099		
NZEO girls (ref. NZEO boys)			0.75 (0.56, 0.99)	0.039
Maori/Pacific boys (ref. NZEO boys)			0.84 (0.66, 1.07)	0.154
Maori/Pacific girls (ref. NZEO girls)			1.24 (0.99, 1.57)	0.062
Interaction of sex and ethnicity				0.019
Participant age (per 1 year increase)	0.92 (0.87, 0.97)	0.004	0.90 (0.85, 0.94)	<0.001
Non-school day (ref. school day)	0.72 (0.63, 0.81)	<0.001	0.72 (0.63, 0.82)	<0.001
Usually walking to school (ref. car or mixed)	1.18 (1.01, 1.39)	0.038	1.16 (1.00, 1.35)	0.046
Usually walking home from school (ref. car or mixed)	1.08 (0.91, 1.27)	0.378		
Dog ownership (ref. none)	1.12 (0.93, 1.35)	0.225		
Household motor vehicles (ref. none)		0.367		
1	0.92 (0.72, 1.18)			
≥2	1.05 (0.82, 1.34)			
Household annual income (ref. <US$25,000)		0.450		
$25,001–$35,000	1.02 (0.79, 1.31)			
$35,001–$55,000	1.07 (0.56, 1.34)			
>$55,000	1.18 (0.95, 1.46)			
Younger siblings (ref. oldest or only child)	1.01 (0.86, 1.18)	0.933		
NZDep2006[a] (per 1 decile increase)	1.03 (0.98, 1.07)	0.282		

TABLE 2 ***Continued***

Variables	Univariate model ratio of geometric means (95% CI)	*p* Value	Multivariate model ratio of geometric means (95% CI)	*p* Value
Parental perception of their neighborhood score (per 1 point increase)	0.99 (0.98, 1.00)	0.207		
Number of days activities (per 1 day increase)	0.96 (0.91, 1.02)	0.187		
Number of adults in the home (per 1 adult increase)	0.99 (0.89, 1.10)	0.809		
Distance between the home residence and the nearest park with a playground (per 100 m)	0.97 (0.93, 1.01)	0.136		
Distance from nearest park with an upgraded playground (per 100 m)	1.00 (0.99, 1.10)	0.569		

BMI body mass index, calculated by dividing weight (in kilograms) by height in square meters; *NZEP* New Zealand European and Other, based on the New Zealand Ministry of Health's prioritization protocol[32]

[a]NZ Index of Deprivation score based of residential address indicating the relative deprivation of the area in which participant's lived. The most deprived areas score ten, and the least deprived, one. The score combines information from the 2006 NZ census about the relative income, home ownership, familial support, employment status, educational qualifications, living space, telephone and transport access into the index score

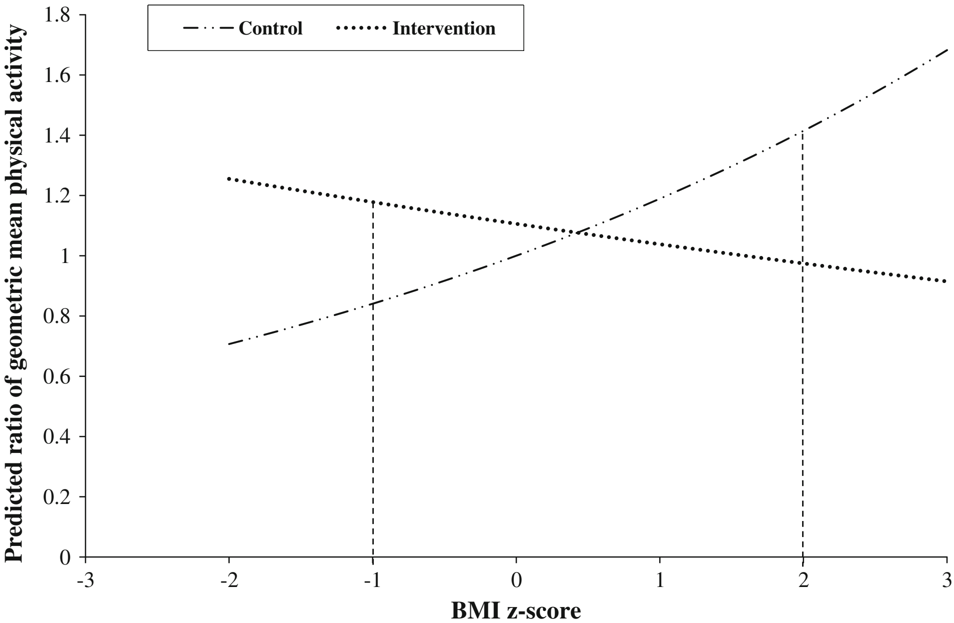

FIGURE 1. Graph showing adjusted community and BMI *z*-score interaction.

equipment in playgrounds. They recommended play environments that offer a range of challenges, with both fixed and complex equipment providing sensory experiences, ranging from functional to aesthetically pleasing. In their view, play environments should be places that maintain the activity of children without guidance by adults. Woolley[46] endorsed a similar, child-centered approach to designing and managing places for children to play. Although physical activity is not usually the only focus of local authority playground provision, making sure that physical activity is always included in the design rationale and that playgrounds are designed to encourage and sustain physical activity behaviors could be a useful population health approach. The degree of promotion of facilities may also influence outcomes.

There were several limitations to this study. The natural experiment design meant it was not possible to randomize participants to intervention or control groups. Despite efforts to select a comparable control community and measure potential confounders (such as income and access to a motor vehicle), important systematic differences between participants from the two communities cannot be ruled out. However, the focus of the study was on changes in TDPA between baseline and follow-up, and it seems unlikely that any such differences would have affected the results. The outcome measure of TDPA does not take into account differences in wear time during pre- and post-assessments. Compliance is an important issue for studies of this nature. It may well have differed between communities or changed between baseline and follow-up. However, there are no reasons to suspect that any changes in compliance between baseline and follow-up would have differed between communities. As we are looking at changes in activity, without such a differential change, the wear-time cannot be a confounder and so does not threaten the validity of the results, although it will add variability to the data, making detecting differences between the communities more difficult. Our two proximity covariates included in our model (Table 2) were determined by straight-line measures between the participant's home address and parks. Distances to parks were also calculated using straight-line measurements which are not as accurate in terms of travel distance as measures based on road networks.[47–49] There were other methodological challenges with the natural experiment design including an incident at one of the control schools that possibly affected recruitment of participants as the tragedy meant the school was closed for a period between consent forms being given to school students and the actual start of baseline physical activity assessment. Additionally, the precision of estimates, as reflected in the widths of confidence intervals, was a result of the relatively small sample size. The small numbers of participants meant few subgroup analyses could be undertaken, although a statistically significant interaction with BMI was noted.

The natural experiment design and measurement instruments of this study, however, enabled a population focus to the research. Other strengths included the use of a control community, comparability between the communities at baseline and follow-up, and individual, family, and household information about participants collected through a pre-tested questionnaire which had a very high response rate.

The main finding from investigating the effect of the playground upgrade was a statistically significant increase in mean physical activity levels for participating children who had low BMI *z*-scores. As this is not a finding that, as yet, can be readily explained, it warrants further research. This study suggests that whereas playgrounds are promoted in the scientific literature as community features that support physical activity, the possible differing effect on different subgroups may be important.

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