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Come together, play, be active: Physical activity engagement of school-age children at Play Streets in four diverse rural communities in the U.S.

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ABSTRACT

Across the U.S., Play Streets — temporary street closures creating safe places for play for a few hours— are being implemented in urban areas during summer. Play Streets have never been implemented or evaluated in rural communities but have the potential to address challenges residents face accessing safe physical activity opportunities in these areas. Community organizations in four diverse low-income rural communities (selected to represent African American, American Indian, Latino, or White, non-Hispanic populations) received mini-grants in 2017 to implement four, three-hour Play Streets during the summer focusing on school-aged children in elementary-to-middle school. Physical activity was measured using Digi-walker (Yamax-SW200) pedometers and the System for Observing Play and Recreation in Communities (SOPARC/iSOPARC). Sixteen Play Streets were implemented in rural Maryland, North Carolina, Oklahoma, and Texas communities during June–September 2017. A total of 370 children (mean age = 8.81 years [SD = 2.75]; 55.0% female) wore pedometers across all 16 Play Streets (μ = 23.13 [SD = 8.59] children/Play Street). School-aged children with complete data (n = 353) wore pedometers for an average of 92.97 min (SD = 60.12) and accrued a mean of 42.08 steps/min (SD = 17.27), with no significant differences between boys (μ = 43.82, SD = 15.76) and girls (μ = 40.66, SD = 18.34). iSOPARC observations revealed no significant differences in child activity by sex; however, male teens were more active than female teens. Most adults were sedentary during Play Streets according to pedometer and iSOPARC data. Children in diverse rural communities are physically active at Play Streets. Play Streets are a promising intervention for promoting active play among children that lack safe opportunities to be active.

1. Introduction

Evidence consistently supports numerous health benefits for youth engaging in regular physical activity at a minimum of 60 min of moderate-to-vigorous physical activity a day, including improved mental, cognitive, emotional, social, and physical health, in addition to reduced risk of chronic disease (e.g., diabetes, obesity) and depression(2018 Physical Activity Guidelines Advisory Committee, 2018; U.S. Department of Health and Human Services, 2018). Physical activity has many health benefits; however, < 60% of children (ages 6–11) and 30% of adolescents (ages 12–15) in the United States (U.S.) report meeting physical activity guidelines, with even lower estimates for girls and children of color (U.S. Department of Health and Human Services, 2018; Bai et al., 2016).

While most U.S. families reside in urban areas, up to 21% of the population (about 65 million people) resides in rural America, with the most dramatic rural population growth occurring among communities of color (Federal Office of Rural Health Policy, 2018). People living in rural communities experience disparities in chronic diseases and conditions associated with insufficient physical activity (e.g., diabetes,

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obesity), with a greater prevalence of obesity among rural children (22% prevalence rate) as compared to urban children (17%), and rural children of color with the highest prevalence (Davis et al., 2011; Kenney et al., 2014). However, it is unclear in much of the literature whether rural school-aged children are less physically active than urban-suburban children, with evidence suggesting no difference; although, one study suggests rural middle-school youth are less physically active than those residing in urban areas (Davis et al., 2011; Kenney et al., 2014; Moore et al., 2013).

Rural residents face obstacles to engaging in daily physical activity that are unique from urban areas yet common across rurality. These include dispersed land use, fewer walkable destinations, and scarcely available infrastructure (e.g., parks, sports/recreation facilities, playgrounds), all of which can negatively impact utilitarian forms of physical activity (e.g., walking or cycling for transportation purposes) and recreational physical activity and active play(Hansen et al., 2015; Umstattd Meyer et al., 2016). Many rural areas can be considered active play deserts, which have been described as areas lacking viable, safe places for physical activity or places where existing places cannot be accessed or are underutilized(Bartram, 2014). This is evident considering often pronounced equity challenges related to physical activity engagement, lack of accessible places and opportunities for physical activity and active play, significant geographic dispersion, persistent poverty, limited preventive resources, and related disease burden (e.g., obesity, diabetes, cardiovascular disease, cancer) seen in rural areas (Hansen et al., 2015; Umstattd Meyer et al., 2016; National Rural Health Association, 2019; Bashir, 2013). With many natural and built resources being underutilized, rural areas can experience the concept of an “unbuilt environment” or underutilized environment where the infrastructure is present, but it is not used by the community. To help combat this phenomenon, communities need to be encouraged to activate and use both built and natural existing spaces to support structured and unstructured physical activity among rural youth (Perrin et al., 2016).

Across the U.S., Play Streets are being implemented in urban areas (e.g., Chicago, San Francisco, New York City) during the summer months as temporary street closures (recurring or episodic) that create safe places for active play for a specified time period (3–5 h). Play Streets address inequities in access to children's physical activity by providing safe places for play in neighborhoods which might not have access to safe, well-maintained parks and playgrounds (Ground Play, 2017). As documented through systematic reviews of the academic and grey literatures, Play Streets are an effective way to engage youth in physical activity but have not yet been implemented or evaluated in rural communities (Umstattd Meyer et al., 2019; Bridges et al., 2019). When physical activity has been measured in previous studies, evidence supports Play Streets as an effective way to engage youth in physical activity by providing an opportunity for children, who would normally be non-active indoors, to be active outdoors and increasing the percentage of children meeting pedometer derived physical activity guidelines, when Play Streets are present in the neighborhood (Umstattd Meyer et al., 2019).

Given the shared need for more low-cost physical activity opportunities in urban and rural communities, the purpose of this broader study focused on examining implementation and feasibility of Play Streets in rural communities. The purpose of the exploratory investigation reported in this article was to examine school-aged children's physical activity during Play Streets implemented in rural communities. Given the importance of adults for physical activity behavior of school-aged children, a secondary aim was to examine physical activity engagement of adults attending these Play Streets. Considering the unique characteristics of rural communities described above (e.g., fewer streets, greater geographic dispersion), we acknowledged that Play Streets in rural communities could potentially look different than those in urban settings and allowed each rural community organization to identify the best publicly-accessible place to host Play Streets in their community, even if not on a street.

2. Methods

2.1. Overview of the Play Streets Intervention

This research was part of a larger implementation study of Play Streets. Detailed methods have been reported elsewhere (Pollack Porter et al., n.d.), and manuscripts documenting our formative research and implementation are under review and in preparation, respectively. Briefly, based on funding available for this research, in 2017, we recruited four organizations (church, local health department, county extension office, and a tribal health center) from our existing networks located in low-income, rural communities in various regions of the U.S. Each organization had experience implementing community events, but not Play Streets.

The communities were selected to represent one of the following racial/ethnic populations: African American, American Indian, Latino, or White, non-Hispanic, using data from U.S. Census and the U.S. National Center for Educational Statistics to identify prevalence of race/ethnicity within each community and school district serving the community (U.S. Census Bureau, 2010a; U.S. Census Bureau, 2010b) (National Center for Education Statistics, 2019). Communities were located in small towns with varying degrees of rurality using the rural-urban commuting area (RUCA) codes which focus on both population size and adjacency to urban/metropolitan areas (Umstattd Meyer et al., 2016; Economic Research Service, n.d.). Communities had to be designated as non-metropolitan in the RUCA continuum (RUCA code ≥ 4.0) to be considered. Selection of partnering community organizations was also determined by an organization's readiness (previous experience implementing community events and working with volunteers), willingness, and commitment by a champion or lead organizer.

The four communities were located as follows: one in Maryland (town population = 2008; county RUCA = 10.3[1]; 96.3% of children White, non-Hispanic), one in North Carolina (town population = 1040; county RUCA = 10.2[2]; 65.8% of children African American), one in Oklahoma (town population = 1006; county RUCA = 9.0[3]; 58.0% of children American Indian), and one in Texas (town population = 5457; county RUCA = 7.1[4]; 47.9% of children Latino) (U.S. Census Bureau, 2010a; U.S. Census Bureau, 2010b) (National Center for Education Statistics, 2019). All communities were considered low-income, with 2016 county median annual household incomes < 80% of state median annual household incomes (U.S. Department of Housing and Urban Development, 1984), ranging from 59% ($46,277 in the Maryland county) to 76% ($37,548 in the Oklahoma county). Actual town median annual household incomes where the Play Streets occurred ranged from $26,938 (Oklahoma) to $32,917 (Maryland) (U.S. Census Bureau, 2010a; U.S. Census Bureau, 2010b).

Community organizations in the four communities received mini-grants ($6000) to implement four three-hour Play Streets during the summer that focused on school-aged children in elementary-to-middle school (pre-K [age 3–4 years] through final grade in middle school [age 14–15 years] in each community). The funds could be used at each organization's discretion to purchase food and drinks (healthy options were encouraged), rent inflatables (e.g., bounce houses), or cover some staff time; $1000 had to be used to purchase reusable materials such as balls and jump ropes.

[1] Rural area: primary flow to a tract outside an urbanized area (UA) or urban cluster (UC), secondary flow 30–49% to a small UC.

[2] Rural area: primary flow to a tract outside an UA or UC, secondary flow 30–49% to a large UC.

[3] Small town high commuting: primary flow 30% or more to a small UC.

[4] Small town core: primary flow within a small UC, secondary flow 30–49% to an UA.

Organizations were instructed to implement 16 Play Streets during summer of 2017 (June–September) so they fit the context of their community. Implementation included determining when and where to hold the Play Streets, marketing efforts, and which activities to offer. The communities relied heavily on publicly available implementation materials from the Chicago *PlayStreets* program, and selected activities they felt would promote active play and be enjoyed by school-aged children (Pollack Porter et al., 2019a). Organizations considered and selected various publicly-accessible locations within their community such as streets, existing parks, a school yard, and open fields next to public buildings (i.e., community center, library, church) to host the Play Streets, with only one Play Street being held on an actual street. Non-street locations were selected by organizations since closing a street segment was not always feasible in a rural community. All Play Streets provided adult supervision by volunteers throughout the entirety of each Play Street.

2.2. Evaluation study participation

A cross-sectional design without a comparison group was used to examine physical activity at the Play Streets. Evaluation data were collected at all 16 Play Streets (four/community). All children entering elementary or middle school in the fall of 2017 and all adults attending a Play Street were eligible for participation in the evaluation study. The research team set up tables under an 8-ft × 8-ft canopy-tent near an entrance point to the Play Streets area, and research assistants spoke with Play Streets attendees as they arrived and/or approached the evaluation tent. Children and parents/guardians were asked the grade level each child was entering in fall 2017. If a child was entering elementary or middle school, including pre-K if offered in that school district, the child and accompanying adult were told about the study, and both were offered the opportunity to participate. Parental/guardian permission (consent) forms were signed by the accompanying adult, and if a child was at least 7 years of age, the child also provided verbal assent prior to data collection. The age of asset was determined as 7 years of age to comply with the IRB for both institutions. While child participation in the evaluation study included both wearing a pedometer and completing a short interviewer administered survey, a child could skip survey items, stop answering survey items, or stop wearing the pedometer at any time. Thus, sample size varied by survey item, pedometer use, and total pedometer wear time. All participating children received either a water bottle or a jump rope when returning the pedometer.

Adults provided written consent prior to participation. Adult participation included pedometer wear and basic socio-demographic information (sex, age, ethnicity/race). All participating adults received their choice of either a water bottle or a miniature bug spray keychain upon returning the pedometer.

2.3. Surveys

2.3.1. Child survey

Participating children completed a 13-item interviewer-administered survey designed to collect basic socio-demographic information, a child's perception of the community and community physical activity spaces, whom the child attended the Play Streets with, and a child's day-to-day physical activity behaviors. The survey included items from previously validated measures, including the Youth Risk Behavior Surveillance Survey (e.g., Are you Hispanic or Latino? What is your race?) (Centers for Disease Control and Prevention (CDC), 2017), Open Streets Measuring Success (e.g., I feel safe at a Play Street.) (Hipp et al., 2014), and the Physical Activity Questionnaire for Older Children (PAQ-C), which is an instrument developed to assess general physical activity levels for children approximately 8–14 years of age (e.g., Mark how often you did physical activity for each day last week) (Kowalski et al., 2004). Although originally developed for children ages 8–14, it has been found reliable for use with children as young as five after accounting for lower reading levels (Bervoets et al., 2014), supporting an interviewer-administered approach. Each item in the PAQ-C receives a physical activity-composite score, with a score of '1' indicating low physical activity and a score of '5' indicating high physical activity. In this study, only the physical activity composite score for the items used is reported, not the overall summary score.

Items addressing age, grade level the child was entering in the fall, barriers to normal physical activity, and what children like to do when they play were all open-ended. Children were asked to choose how much they agree with statements about perceived safety and community physical activity spaces (questions from the Open Streets Measuring Success) using a 5-point Likert scale (i.e., strongly agree – strongly disagree) (Hipp et al., 2014). A 5-point Likert scale from 1 (none) to 5 (very often) was also used when asking children how often they did physical activity for each day of the past week (Kowalski et al., 2004). Children could respond yes or no to the following items: "Are you Hispanic or Latino?," "Have you played at a Play Streets event before?," and "Were you sick last week, or did anything prevent you from doing your normal physical activities?" Children were given the option to choose more than one answer when asked to identify their race (i.e., American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, White) and who they attended the Play Street with (i.e., alone, sibling, friend, cousin, other).

2.3.2. Physical activity measurement during Play Streets

Physical activity during Play Streets was measured using Digi-walker (Yamax SW200) pedometers and the System for Observing Play and Recreation in Communities (SOPARC/iSOPARC) (McKenzie et al., 2006; Santos et al., 2016; McNamara et al., 2010; Tudor-Locke et al., 2002).

2.4. Pedometers

2.4.1. Child pedometers

After survey completion, children were fitted with a numbered and sealed pedometer on the right hip of their waistband. Pedometers were sealed to reduce potential reactivity and tampering (Scott et al., 2014). Children were instructed to not remove the pedometer while they were at the Play Street and to return to the table to have the pedometer removed when they no longer wanted to wear it. If the pedometer came off while a child was playing, children were instructed to ask a researcher to re-secure the pedometer. Digi-walker (Yamax SW 200) pedometers were used due to established reliability, validity, and affordability for child, adolescent, and adult physical activity (McNamara et al., 2010; Tudor-Locke et al., 2002). When pedometers were provided to a child, a research assistant recorded the pedometer number, child's age and sex, and the time the pedometer was distributed. When a child returned a pedometer, a researcher recorded the time it was returned, the number of steps, and any notes (e.g., pedometer was wet from playing in water). Incomplete data (n = 19) resulted from pedometers that were cleared due to participation in water activities, pedometers that were taken home, accidental count reset, disinterest in wearing the pedometer, missing data for wear time, and three children older than 15 years.

2.4.2. Adult pedometers

A trained research assistant demonstrated how to properly attach the pedometer to the right hip of the waistband. The following information was recorded for each adult participant as the pedometer was distributed: pedometer number, age, sex, and time the pedometer was distributed. When the participant returned the pedometer, the research assistant recorded the time it was returned, number of steps recorded, and any notes (e.g., on left hip when returned). Incomplete data was due to missing data for wear time (n = 3).

2.5. Systematic observations (iSOPARC)

Activity at Play Streets was also observed using SOPARC (McKenzie et al., 2006) methodology, specifically with the iSOPARC® iPad application (Santos et al., 2016). SOPARC has been used as a reliable instrument to measure physical activity in community settings by using systematic observations (McKenzie et al., 2006). Twenty research staff were trained in SOPARC procedures using revised and updated SOPARC training materials in May 2017 (McKenzie et al., 2006). Initial training was followed by onsite reliability practice sessions and "booster-trainings" in the field as needed (Santos et al., 2016). More details on the training and adaptation of SOPARC/iSOPARC® methods for use in a Play Streets setting are reported elsewhere (Umstattd Meyer et al., n.d.), but are described briefly here. iSOPARC® is a free-to-download interactive application compatible with iPad devices. The main functions of iSOPARC® are similar to the SOPARC original protocol with the exception that race/ethnicity of individuals cannot be recorded (McKenzie et al., 2006), with observations recorded by age (child, teen, adult, older adult), sex (female, male), and activity level (sedentary, walking, vigorous). The app allows for streamlining of data processing, quick exportation options, mapping tools, and secure data storage. The latest version of the app (v. 1.85) was used.

Target areas were determined on site prior to observations. A primary observer completed six iSOPARC® observation rotations during each Play Street (starting 15 min after a Play Street began; 15 min and 45 min past the hour of each hour). To assess reliability of coding, an additional (secondary) observer completed three iSOPARC® observation rotations during the 2nd, 4th, and 6th observation rounds at each Play Street. Reliability in this study was moderate to substantial for activity items (kappa range = 0.39–0.59). Observation rounds from the primary observers were totaled for each Play Street so that numbers presented reflect all six observations and may include individuals more than once. Target areas were categorized by type of activities present post hoc to assist in comparisons across Play Streets; inflatables, general activities, sport courts or fields, permanent play structures, open fields, food areas, sedentary activities, and community gardens. Any inflatable play space, no matter the shape, size, or if water was incorporated, was included in the "inflatables" category. General activities included any organized/structured games that were not sports-specific, or where loose equipment was provided (e.g., hula hoops, jump ropes, Frisbee, bubbles, tag, etc.). Any areas where sports could be played (permanent or temporary), regardless of whether loose equipment was provided, were categorized as sport courts or fields. Any existing permanent structures that could be used for active play, such as climbing structures, slides, and swings, were categorized as permanent play structures. Any open space where organic play could happen was categorized as open fields. Even though "open spaces" did not have loose equipment laid out during set-up, throughout the Play Street these target areas could become equipped if loose equipment was brought into the area. Food areas were defined as anywhere that included food or water or where food could be eaten (e.g., picnic tables). Any planned sedentary activities (e.g., arts and crafts, board games) were included in the "sedentary activities" category, and permanently available community garden spaces were included in the "community gardens" category. All activities and target areas were provided by and set-up by the hosting community partner, not the evaluation team (Umstattd Meyer et al., n.d.).

2.6. Analyses

Despite collaborating with four distinct communities, tailoring in implementation was not observed across the communities; thus, we combined the data across all four sites for analyses (Pollack Porter et al., 2019b). Pedometer data are presented as mean steps per minute for school-aged children and adults. Potential differences between female and male children and adolescents were examined using independent *t*-tests for the sample overall and by age groups (3–5, 6–9, 10–11, and 12–15 years of age), with $p \leq 0.05$ indicating significance. These age groups were defined a priori to correspond with grade levels for elementary and middle-school aged children (Kindergarten -3rd grade; 4th–5th grade; 6th–9th grade), which were the chosen population group for this study. Mean wear time was examined and is reported by sex and by age groups, with differences examined using t-tests. SPSS v.25 was used to conduct pedometer analyses.

Data from iSOPARC observations were grouped by sex, age group, and activity level for each of the Play Streets target areas. Previous studies using SOPARC recommended grouping activity level into dichotomous variables of sedentary and physically active, which includes both walking and vigorous modes (Evenson et al., 2016). Adult and senior age categories were also grouped together due to the limited number of seniors observed (6% of observations). Odds ratios were conducted to determine any differences in the proportion of individuals observed as active related to sex or age category. Odds ratios were also calculated to determine differences in the proportion of active individuals by sex and age category in each target area type. SPSS v.25 was used to conduct analyses.

3. Results

3.1. Overall description and survey results

A total of 376 children completed surveys across 16 Play Streets; mean age was 8.86 years (SD = 2.74). Most (59.7%) children (n = 372) reported they had not attended a Play Street before, with this percentage being much higher during the first Play Street in each community (76.9%–100%). The majority (79.3%) of children (n = 372) agreed or strongly agreed that their town has friendly (safe/attractive) places to walk and/or bike. After arriving at a Play Street, almost all (95.9%) children (n = 367) agreed or strongly agreed they felt safe at a Play Street, with most children completing the survey shortly after arriving at the Play Street. About half (58.6%) of the children (n = 365) said they were physically active quite often (5–6 times) or very often (7 or more times) during their free time in the last 7 days, with a mean physical activity composite score of 3.68 (SD = 1.33). According to the physical activity composite score, the school-aged children in this study reported participating in moderate levels of physical activity in their free time. Table 1 includes demographics and Play Street attendance characteristics of the school-aged children who participated in the survey.

3.2. Pedometer results

A total of 372 elementary-to-middle school-aged children wore pedometers at the Play Streets (μ = 23.13 children/Play Street, SD = 8.59). The mean age was 8.86 years (SD = 2.78) and 54.6% were female. Among the 353 children with complete pedometer data (55.0% female, μ = 8.81 years, SD = 2.75), pedometers were worn for an average of 92.97 min (SD = 60.12) and a mean of 42.08 steps/min (SD = 17.27) was accrued during wear time at a Play Street, with no statistically significant differences (p = 0.09) overall between boys (μ = 43.82, SD = 15.76) and girls (μ = 40.66, SD = 18.34) for the overall sample. When examining differences between boys and girls by age category, a statistically significant difference in steps per minute between boys and girls was only observed for adolescents ages 12–15 years, with boys recording significantly greater steps per minute than girls (p = 0.047). Significant differences in mean pedometer wear time were observed between boys and girls for the overall sample (p = 0.001) and 3–5-year-old children (p = 0.007). See Figs. 1 and 2 for comparisons.

Table 1
School-aged child demographic and play street information from surveys (n = 376).

Variable	n (%)
Grade level	
Elementary (pre-k–5th)	268 (71.3)
Middle school (6th–9th grade)	108 (28.7)
Age group	
3–5 years	50 (13.3)
6–9 years	155 (41.2)
10–11 years	106 (28.2)
12–15 years	65 (17.3)
Sex	
Boy	168 (44.7)
Girl	208 (55.3)
Race/ethnicity[a] (n = 348)	
African American	90 (25.8)
American Indian	92 (26.4)
Asian American	5 (1.4)
Pacific Islander	4 (1.1)
White, non-Hispanic	204 (58.6)
Latino (n = 357)	39 (10.9)
Who children attended a Play Street with[b] (n = 376)	
Alone	44 (11.7)
Cousin	56 (14.9)
Friend	77 (20.5)
Sibling	177 (47.1)
Other	209 (55.6)

[a] Children were allowed to select more than one answer choice.
[b] Children were allowed to select more than one answer choice; "Other" was an open-ended response with answers including mom, aunt, grandma, family, babysitter, friend's mom, etc.

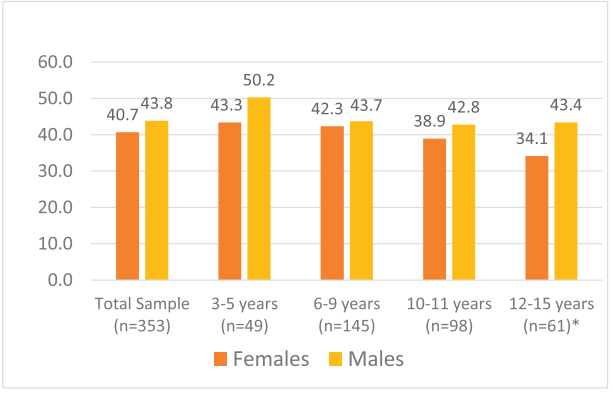


Fig. 1. Mean steps per minute for female and male youth (n = 353) across all play streets (n = 16) by age groups.
* Indicates a significant difference (< 0.05) between groups (p = 0.047).

3.3. SOPARC results

Observers recorded 1750 children across all 16 Play Streets: 1007 males (57.5%) and 743 females (42.5%). A total of 489 teens: 225 males (46%) and 264 females (54%), were also observed. See Fig. 3 for a visual depiction of the number and percentage of the target area categories utilized across Play Streets. On average, 109.4 children and 30.6 teens were observed per Play Street, which accounts for all observations made over the six time points at a specific event. Roughly half (48.6% of males, 48.7% of females) of all children observed were active; see Fig. 4 for complete data describing activity levels by sex and age group. There was no significant difference in observed activity level based on sex of a child (OR = 0.99, 95% CI: 0.82–1.2). However, male teens (47.6% active) were significantly more likely to be observed as active when compared to female teens (35.8% active) (OR = 1.7, 95% CI: 1.18–2.44). Children were more likely to be observed as physically active at Play Streets when compared to teens (OR = 1.38, 95% CI: 1.13–1.69).

SOPARC target areas (n = 189 across all 16 Play Streets) were divided into 8 categories; inflatables (i.e., bouncy houses; n = 38), general activities (n = 35), sport courts or fields (n = 31), permanent play structures (n = 28), open fields (n = 26), food areas (n = 26), sedentary activities (n = 3), and community gardens (n = 1).

Target areas containing inflatables had the highest percentage of physically active children (67%) followed by sport fields and courts (54%), and general activities (50%). Teens were the most physically active (percent active) in sport fields and courts (54%), open fields (52%), and inflatables (51%). However, there were more total physically active teens in target areas with inflatables (n = 61) than in sport

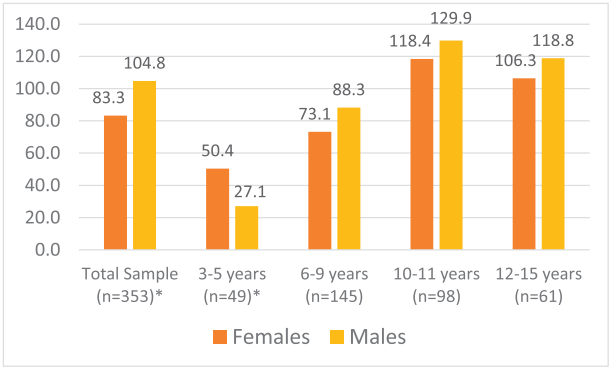


Fig. 2. Mean pedometer wear time for female and male youth (n = 353) while attending a Play Street across all Play Streets (n = 16) by age groups.
* Indicates a significant difference between groups (all ages: p = .001; 3–5 years: p = .007).

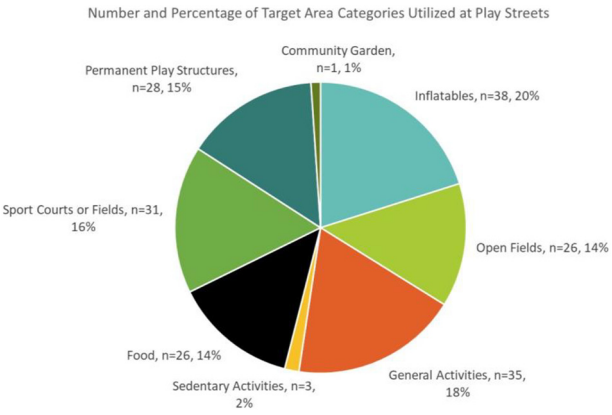


Fig. 3. Number and percentage of target area categories used at play streets.

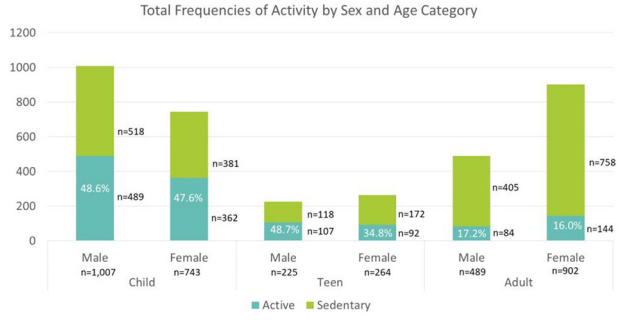
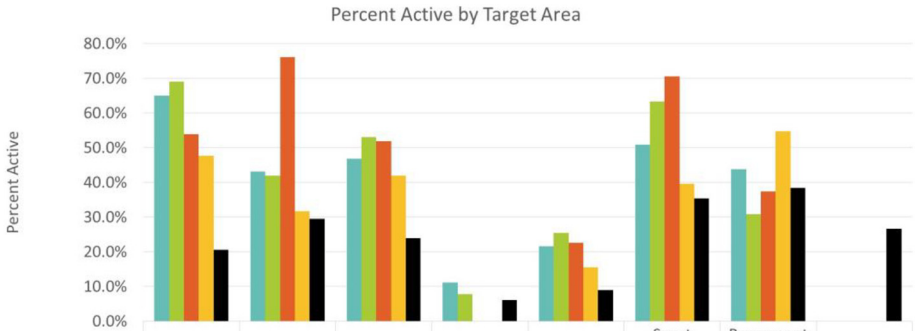


Fig. 4. Frequencies of observations by activity level and sex for children, teens, and adults.



	Inflatables	Open Fields	General Activities	Sedentary Activities	Food	Sport Courts or Fields	Permanent Play Structures	Community Garden
Male Children	64.9%	43.0%	46.8%	11.1%	21.6%	50.9%	43.8%	0.0%
Female Children	69.1%	41.9%	53.0%	7.7%	25.4%	63.3%	30.8%	0.0%
Male Teen	53.9%	76.0%	51.8%	0.0%	22.6%	70.5%	37.3%	0.0%
Female Teen	47.6%	31.6%	41.9%	0.0%	15.6%	39.5%	54.7%	0.0%
Adult	20.6%	29.4%	24.0%	6.1%	9.0%	35.3%	38.4%	26.7%

Fig. 5. Percent of male and female children, teens, and adults engaging in physical activity by target area category, including the total amount of active individuals and total amount of individuals observed in each category.

fields and courts (n = 32) and open fields (n = 19) combined. Fig. 5 displays percentage of children and teens engaging in physical activity in each target area category. Male children (n = 126) were significantly more likely to be observed in sport courts and fields when compared to female children (n = 50; OR = 1.97, 95% CI 1.40–2.77). However, while not significant (OR = 0.58, 95% CI 0.3–1.14), a higher percentage of female children (63.3%) were physically active in sports courts and fields as compared to the percentage of male children (50.9%) observed doing physical activity in sports courts and fields.

3.4. Adult physical activity engagement

A total of 65 adults wore pedometers across all 16 Play Streets (μ = 5.33 adults/Play Street, SD = 3.68). Adults that were present at Play Streets include parents/guardians, family members, babysitters, etc. Some adults were present at Play Streets to supervise their children, while others were there as volunteers to participate in the Play Streets or events hosted in conjunction with the Play Street (e.g., church picnic, back-to-school event)." Mean age was 45.05 years (SD = 16.29), and 83.1% were female. Among the 62 adults with complete pedometer data (83.9% female [n = 52]; μ = 45.27 years, SD = 16.11; 24.2% were ≥60 years of age), pedometers were worn for an average of 91.34 min (SD = 99.38), and adults had a mean of 15.34 steps/min (SD = 13.67), with no significant differences overall between men (μ = 13.58, SD = 14.28) and women (μ = 15.68, SD = 13.68). However, there was a significant difference in steps per minute by age category (p = 0.018), with older adults (≥60 years of age, n = 15, μ = 8.13, SD = 10.15) averaging fewer steps/minute than younger adults (n = 47, μ = 17.64, SD = 13.94). There were no significant differences in mean pedometer wear time by sex or age category.

SOPARC observations documented 1391 adults in total across all observations; 489 males and 902 females. This number included Play Streets implementation team members, but not evaluation team members. The majority of male (82.8%) and female (84.0%) adults were observed being sedentary (e.g., eating, playing board games, sitting and talking to another adult or watching their child). Adults were observed as physically active most often in permanent play structures (38.4%) and sport courts or fields (35.3%). However, general activity target areas had the largest total number of active adults, with 72 active adults compared to 10 in permanent play structures and 25 in sport courts and fields. Fig. 5 provides further details on total target area observations and percent physically active by sex and age categories. There was no significant difference in observed physical activity level based on sex (OR = 1.09, 95% CI: 0.81–1.47).

4. Discussion

School-aged children, both boys and girls, were active at Play Streets hosted during the summer in rural communities. When comparing mean steps per minute (μ = 42.08) of children at Play Streets with steps per minute of a similar free/open play setting, steps per minute at Play Streets are similar to studies reporting mean steps per minute of children or adolescents during recess (Gutierrez et al., 2016; Huberty et al., 2013; Zerger et al., 2017; Beighle et al., 2006; Barfield et al., 2004). However, Play Streets are longer in duration (up to 3-h) and with promise for addressing physical activity disparities often seen for girls. Attending the full 3-h of a Play Street could allow a child to accrue up to a mean of 7574 steps, which would account for over 50% of the estimated steps required for children to meet moderate-to-vigorous physical activity recommendations of 60-min/day (boys: 13,000–15,000 steps/day; girls: 11,000–12,000 steps/day)(Tudor-Locke et al., 2011). Alternatively, when considering the mean wear time of pedometers at Play Streets in this study (μ = 92.97 min), a child would accrue on average 3912 steps during this time. Across existing studies, children of varying ages accrue on average 918–1943 steps while in 15–29 min of recess, usually without the potential of additional time available for recess (Gutierrez et al., 2016; Zerger et al., 2017; Beighle et al., 2006; Barfield et al., 2004). Our findings are particularly encouraging given the ability of children and adolescents to engage in physical activity at a Play Street up to a duration of 3 h. This research did not measure total physical activity; thus, the total contribution of Play Streets to physical activity is unknown. Future research should use a more rigorous design to determine how much Play Streets contribute to total physical activity, as well as document attendance time of participants at Play Streets (beyond our evaluation documentation) and investigate approaches for encouraging attendees to participate for the entire duration of a Play Street.

Play Streets offer a promising solution to summer declines in physical activity as evidenced in recent data demonstrating lower levels of physical activity in summer months for low-income youth across various race/ethnicity subgroups (Sallis et al., 2019). Play Streets offer a low-cost solution for how to activate both publicly accessibly non-physical activity spaces (e.g., open fields, parking lots, streets) and permanent physical activity spaces, like parks, to encourage physical activity engagement to address research that recently identified that parks are under-utilized in low-income communities of color even when

they do exist (Huang et al., n.d.). This is important in rural communities where funding and resources to create physical activity spaces or implement programming is limited and few opportunities exist for children to come together and engage in unstructured or semi-structured active play during the summertime. Many physical activity opportunities available in rural communities revolve around structured sports (e.g., baseball, football, soccer), which do not appeal to all children, youth, or genders (Umstattd Meyer et al., 2016), or which often are not affordable for many families. The findings of comparable activity levels of boys and girls in the present study (< 12 years of age) also support Play Streets as a solution to address the multitude of data showing that boys are consistently more active than girls (U.S. Department of Health and Human Services, 2018; Marquet et al., n.d.). This research shows that children are physically active at Play Streets, which is consistent with previous Play Streets research (Umstattd Meyer et al., 2019). Further research is needed to determine how to best disseminate, implement, and sustain Play Streets across U.S. communities (Umstattd Meyer et al., 2019; Bridges et al., 2019).

Although we observed a lower proportion of teens that were active during a Play Street as compared to children, and fewer female teens being physically active as compared to males, close to half of Play Street youth attendees were observed as physically active. During Play Streets, children and teens - both males and females - were observed most frequently in target areas with inflatables, with most male children and teens and female children physically active in this setting. The largest number of physically active female teens was also seen in target areas with inflatables, even though just fewer than half of all female teens in target areas with inflatables were physically active. Inflatables seem to be an equalizer across sex and age in four geographically and demographically distinct rural communities. It should be noted that teens were more likely to be observed in inflatables that had additional elements (e.g., obstacle courses, jousting, and slides; $n = 90$) as compared to traditional square bouncy "houses" ($n = 50$). Despite teens spending more time in inflatables, the percentage of active teens was not significantly different (OR = 0.78, 95% CI 0.39–1.56) between inflatables with additional elements (47% active) and traditional inflatables (53% active), supporting the universality of inflatables of any kind as supporting active play for both children and teens. Future Play Streets planners should consider incorporating inflatables because they facilitate moderate-to-vigorous movement such as jumping and climbing and are popular with school-aged children. When they are included, they should be securely placed to avoid risk of injury, especially from falling and or high winds without proper anchoring (Thompson et al., 2012; Corominas et al., 2018). Also if possible, multiple inflatables should be used so there is a separate inflatable for the "little kids" and for the "bigger/older kids," which could not only promote safety but also allow for them to account for varying levels of ability and complexity (Corominas et al., 2018).

Future Play Streets planners should also consider the other target area activities that engaged girls and teens in more physical activity, and plan accordingly. These include sport areas (e.g., sport balls, equipment), permanent play structures (e.g., playgrounds, basketball hoops) that can be incorporated into Play Streets as additional activity areas, and general activities that facilitate movement (e.g., hula hoops, jump ropes, frisbees). Future Play Streets implementers should note that school-aged children were observed being physically active in every type of activity area, even in sedentary activity areas (e.g., areas planned for board games or arts and crafts) and food areas, suggesting that many children simply need the "invitation" and a safe place to actively play. This may be as simple as hosting a Play Street with loose physical activity or sport equipment, supplying minor supervision, and sending an invitation, so that children can create their own active play and fun. Such low-cost approaches may be particularly sustainable and appropriate for low-income rural communities.

Adults were observed to be largely sedentary while at Play Streets. While most of the activities may have been directed towards child physical activity, one location incorporated line dancing activities to engage the adults. Adults at this location were more likely to be observed as active while in the dance floor target area when compared to all other target areas at the location (OR = 5.69, 95% CI 3.29–9.86). This result suggests that Play Street implementers may wish to have specific activities for adults to encourage physical activity for all Play Streets attendees. In addition to adult-oriented activities, co-participation (i.e., engagement of an adult with a child in physical activity) and modeling (i.e., observational learning) may be additional ways to increase adult physical activity at Play Streets. Of the physically active adults observed at Play Streets, 58% were in the presence of a physically active child. Increasing opportunities for adult activity could in turn increase activity of school-aged children as researchers have noted that paternal modeling increase female child activity four-fold compared to children with inactive fathers ($n = 1978$, north-central Spain, 12–16 year olds) (Odds Ratio: 4.07 CI [1.59,10.42] (Sanz-Arazuri et al., 2012), and maternal co-participation was directly associated with child moderate-to-vigorous physical activity (Cleland et al., 2011). Activities that involve adults as active participants and not just sedentary supervisors (e.g., sports equipment, hula hoops, jump ropes, line dancing) as well as an invitation or "permission to play" may encourage this co-participation. Adult physical activity in this setting is not just important for the adults, but also for children, as children were more likely to be observed as sedentary if there was a sedentary adult in the target area (OR = 2.77, 95% CI 2.26–3.4).

4.1. Limitations

Although these findings highlight important information about physical activity achievement at Play Streets through use of pedometers, this study was unable to determine if physical activity levels on Play Street days is different from physical activity on non-Play Street days. Future research could use accelerometers to measure total physical activity among children to determine if there are significant differences in physical activity whether school-aged children participate in Play Streets or not. There were some challenges experienced with the use of pedometers, which reduced the total sample. For example, pedometers would be zeroed out if they were submerged in water (which did occur when children played on water inflatables), and participants did not always wear pedometers the entire time they were playing at the Play Street. Many of the adults that attended Play Streets did not want to wear a pedometer, leaving a small sample of adults. Future research should consider using strategies to specifically engage adults as well as children during Play Streets. Another challenge the research team experienced was administering the brief surveys to very young children (aged 3–5 years). Although the survey used items found to be reliable in children as young as five years of age, when accounting for readability, which was addressed through interviewer-administered surveys, several younger pre-K children were unable to answer the questions, resulting in missing data. Future work should consider alternative approaches to collect this information.

Finally, there is a potential limitation resulting from the team's choice regarding race and ethnicity data collection. The geographic locations of each site were selected a priori to represent a different race and ethnic population because of hypotheses related to cultural tailoring of the Play Streets. Because of this choice, the team did not collect race and ethnicity data for the participants wearing pedometers or participants observed through iSOPARC, which does not include race/ethnicity, consistent race and ethnic categories were assumed at each Play Street. Thus, potential step differences or observations of activity by race and ethnicity could not be analyzed. Future research should consider collecting race and ethnicity measures and analyzing how Play Streets possibly impact each race and ethnicity group differently.

Another potential limitation of this study was the dichotomization of activity levels related to SOPARC results. This recommendation has

been made previously in other work (Evenson et al., 2016). However, aggregating these data did not allow us to differentiate between light/moderate and vigorous physical activity observed at Play Streets. The dynamic nature of Play Streets made SOPARC target areas particularly difficult to observe at times when activities (e.g. equipment, games) would appear, disappear, and reappear throughout a Play Street. We also combined the adult and older adult age categories to avoid misclassification, as it was difficult for observers to determine if an individual was an older adult or middle-aged adult. Researchers looking to use SOPARC in temporary spaces such as Play Streets should take this into consideration. Further challenges, modifications, and recommendations regarding the use of SOPARC at Play Streets have been described previously (Umstattd Meyer et al., 2019; Umstattd Meyer et al., n.d.).

One final potential limitation is that nearly all the Play Streets did not occur on streets, which is most common in urban and suburban areas (Umstattd Meyer et al., 2019; Pollack Porter et al., 2019a). In rural communities it is often impossible to temporarily close what may be the only street in a town for a Play Street. The research team supported the communities in using existing publicly accessible spaces (e.g., parks, school yards, parking lots, fields, or streets) for Play Streets, because these locations were appropriate in these communities. However, one may argue that non-street locations are inherently different from streets and examine a different strategy to promote active play. Future research should examine implementation of Play Streets in rural, suburban, and urban areas to determine similarities and differences, and whether Play Streets in more open publicly-accessible areas have impacts similar to those that occur on streets.

4.2. Conclusions

This study showed that school-aged children in diverse rural communities were physically active at Play Streets, and children had the potential to achieve over half the recommended daily steps if they participated in the full 3-hour events. Mean steps per minute accrued during Play Streets were similar to studies reporting mean steps per minute of children during open/free play during recess. Although we were unable to examine total physical activity, Play Streets were longer in duration and the typical differences between boys' and girls' physical activity were not found. Play Streets are one promising strategy to promote physical activity among children in low-income rural communities that lack access to safe opportunities to be active.

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