

BMJ Open COVID-19 pandemic and changes in children's physical activity in a rural US community: a mixed methods study

Debra K Kellstedt ¹, Ann M Essay,² Michaela A Schenkelberg,³ Marisa S Rosen,² Mary J Von Seggern,² Regina Idoate,² Gregory J Welk,⁴ Richard R Rosenkranz,⁵ David A Dzewaltowski²

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¹AgriLife Extension Unit of Family & Community Health, Texas A&M University System, College Station, Texas, USA

²Health Promotion, University of Nebraska Medical Center, Omaha, Nebraska, USA

³School of Health and Kinesiology, University of Nebraska Omaha, Omaha, Nebraska, USA

⁴Department of Kinesiology, Iowa State University, Ames, Iowa, USA

⁵Kinesiology & Nutrition Sciences, University of Nevada Las Vegas, Las Vegas, Nevada, USA

Correspondence to

Dr Debra K Kellstedt;
debra.kellstedt@ag.tamu.edu

ABSTRACT

Objectives To examine differences in rural community children's moderate-to-vigorous physical activity (MVPA) and participation in out-of-school activities from fall 2019 to fall 2020 and explore enacted PA opportunity modifications post initial COVID-19 disruption.

Design Mixed methods study using the validated Youth Activity Profile (YAP), administrator reports and stakeholder surveys and semistructured interviews.

Setting Children and community stakeholders from one rural US Great Plains community in the state of Nebraska were recruited.

Participants Third through fifth graders in fall 2019 (n=144) and fall 2020 (n=174) reported MVPA and participation in out-of-school activities using the YAP. School administrators reported weekly physical education (PE) and recess minutes. Community stakeholders reported pandemic-related changes in community social structures in semistructured interviews (n=4) and surveys (n=19).

Results Average daily MVPA minutes increased from 2019 to 2020 (75.0 vs 81.3, SE=1.6, p<0.05). Minutes of MVPA increased during: school hours (MD=2.7, SE=0.5, p<0.5); out-of-school time on weekdays (MD=3.9, SE=1.3, p<0.5); and on weekends (MD=5.5, SE=2.4, p<0.5). On average, fewer children participated in youth sport (42.5% vs 47.2%), youth clubs (10.3% vs 16.0%) and other out-of-school activities (24.1% vs 38.2%) in 2020, compared with 2019. Weekly PE/recess minutes increased from 208.3 to 241.7 from 2019 to 2020. Stakeholder surveys revealed community-driven modifications to PA opportunities, and interviews suggested children played outside more frequently, especially when school was closed and out-of-school activities were shut down.

Conclusions Increased minutes of PE and recess, and decreased out-of-school activity participation may have increased children's overall free play and MVPA during the pandemic. Free play was an important contributor to children's PA during the pandemic and should be prioritised by educators, coaches and other leaders of child PA opportunities.

Trial registration number NCT03380143.

INTRODUCTION

The COVID-19 pandemic has disrupted most aspects of daily life in communities around the world. Across the USA, in-school and

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ To the authors' knowledge, this article is the first to examine children's self-reported physical activity (PA) levels pre and post initial pandemic contextualised by stakeholders' reports and perspectives.
- ⇒ The Youth Activity Profile is a validated PA measurement tool.
- ⇒ The out-of-school time participation measure included questions selected from a national survey, which affords comparison with other representative sample populations.
- ⇒ While the results may be unique to one rural US Great Plains community, the study was conducted, over time, among a representative sample of children and stakeholders and analysed through a systems-thinking lens, making the findings more generalisable.
- ⇒ Prior to the COVID-19 event, the Great Plains community in Nebraska was previously involved in the Wellscapes Community randomised trial targeting PA promotion among youth (ClinicalTrials.gov Identifier: NCT03380143). Because of this, we cannot determine whether the increase in PA observed during the disruption would have occurred without prior intervention.

out-of-school activities underwent modifications in March 2020 to reduce viral spread, starting with school closures and programme cancellations.^{1 2} Other modifications to in-school and out-of-school activities, based on WHO and Centers for Disease Control and Prevention (CDC) spring 2020 guidelines, included maintaining a distance of 6 feet or more between people, wearing masks, increasing ventilation by moving activities outside and frequent sanitisation of surfaces.³⁻⁶ Pandemic response varied by state and region in the USA, with Great Plains states such as Nebraska and Missouri, and in particular rural areas in those states, enacting policies later in spring 2020 and with fewer restrictions compared with other geographic regions such as urban centres on

the east and west coasts.⁷ Regardless of the timing, there are widespread concerns about the short-term and long-term negative impacts of these COVID-19-related policies on the physical and mental health of children.⁸ One such concern is the long-term effect of setting changes in school and cancelled out-of-school activities on children's physical activity (PA) patterns and behaviours.

The health benefits of PA are well established,⁹ and there are specific short-term and long-term benefits to being physically active starting at a young age.¹⁰ PA not only improves physical health outcomes from childhood through adulthood but it also promotes better cognitive and mental health.^{10 11} The importance of PA on mental health and quality of life during the COVID-19 pandemic was documented in adults,¹² but less work has examined implications in children and youth.

The US Department of Health and Human Services recommends that children aged 6–17 years take part in moderate-to-vigorous PA (MVPA) for at least 60 minutes a day.¹³ Yet, prepandemic, the CDC reported that only 21% of US children were meeting PA recommendations.¹⁴ Children in rural communities are at higher risk for obesity and other poor health outcomes that can be linked to physical inactivity and nutrition behaviours,^{15 16} but due to varying definitions of rural and inconsistent data collection methods, there is much to learn about children's MVPA levels in rural versus urban areas.¹⁷

To understand PA behaviour among children, it is necessary to investigate where and how children are physically active—especially before, during and after a disruption such as the COVID-19 pandemic. Historically, children's PA took place in neighbourhood yards, streets and playgrounds—with little adult supervision—in a way that some researchers refer to as 'free range'.^{18 19} More recently, studies show that prepandemic opportunities for PA happen in mostly adult-organised activities—both in-school and out-of-school.^{20 21} At school, PA can occur during classroom time, in the hallways between classes, at recess and in physical education (PE) classes; out-of-school PA can happen in and around children's homes, but is occurring more frequently in afterschool programmes, youth clubs (eg, 4-H, Girl Scouts, etc) or youth sports.^{22 23} Research confirms that adult-organised out-of-school activities such as youth sport, youth clubs and afterschool programmes greatly contribute to the amount of PA children accumulate, and free play opportunities within those settings are especially advantageous.²⁴ Children who participate in adult-organised out-of-school activities are generally more active than their non-participating peers.²⁵

Have children's PA patterns changed as a result of the pandemic? Early research found that in the initial phases of the COVID-19 shutdowns, children's PA decreased,²⁶ sometimes dramatically, but some children were engaged in more free play and walking.²⁷ Dunton *et al* conducted surveys in the spring of 2020 among US parents of children (ages 5–13 years) and found a perceived decrease in PA and increase in sedentary behaviour during the

early-COVID-19 period.²⁷ The study also found that children were most likely to engage in PA at home, on sidewalks or neighbourhood streets and that children were participating in more free play and walking during the pandemic than they did pre pandemic.²⁷ Another study conducted in 14 countries found that 3-to-5-year-old children who could go outside during the pandemic were more likely to meet PA guidelines than those who could not.²⁸ In a Canadian study conducted by Moore *et al* in April 2020, a national sample of parents was asked to compare their children's current activity and sedentary behaviours to prepandemic behaviours. The study found significant declines in children's PA—especially in outdoor settings.²⁹ Data collected in April 2020 in a Croatian study showed declines in adolescent PA due to COVID-19 restrictions, with more pronounced PA decreases among urban youth as compared with those living in rural settings.³⁰ Though most early reports indicated disruptions to children's everyday routines such as school shutdowns and cancelled out-of-school activities had a negative impact on children's PA, there is still much to learn about the system and structural determinants of children's PA before, during, and after the pandemic.

The community is a complex social system and COVID-19 has been a disruption to this system that causes the system to reorganise, thereby changing structure and practices to influence PA outcomes. To address long-term impacts and to better understand system drivers of PA, it is important for us to examine children's participation in adult-organised settings and PA behaviours, not only immediately after the initial COVID-19 disruption but also during the course of the first year of the pandemic. In fall 2020, schools across the USA were either closed and offering remote online learning; open fully but with modifications that included mask-wearing, new cleaning protocols and distancing; or semiopen with a hybrid approach that may have staggered the days students attended and/or offered the choice to attend remotely or in person. Fall 2020 school operation policies in the USA varied by state, and in Great Plains states such as Nebraska and Missouri, communities were given local control over managing the pandemic at the schools in their districts.³¹ Communities in these states also had local control over the opening, closing and restrictions applied in out-of-school activities such as youth sport and youth clubs.³¹

The first aim of this mixed methods study was to examine differences in child-reported in-school and out-of-school MVPA in a rural Great Plains community from fall 2019 before the COVID-19 pandemic to fall 2020 during the pandemic. The second aim was to examine differences in children's participation in adult-organised out-of-school activities over this same timeframe. The third aim of this study was to explore enacted modifications for child PA for both in-school and out-of-school activities that could elucidate differences in child-reported MVPA and participation outcomes.

METHODS

Participants and recruitment

This study reports results from one US rural Great Plains community in Nebraska (population=3460) with rural defined using US Department of Education definitions.³² According to 2010 American Community Survey 5-Year estimates, 98.2% of residents in this community were non-Hispanic white,³³ and according to Nebraska Department of Education 2019–2020 Data Reports, 32.9% of students in the school district were eligible for free and reduced lunch.³⁴ Children and community stakeholders were recruited in 2018–2019, and a representative sample of a cohort of third through fifth graders in fall 2019 (n=144, 82.3% participation) and fall 2020 (n=174, 84.5% participation) from the community's only elementary school completed the calibrated online Youth Activity Profile (YAP) assessment,³⁵ along with a supplemental assessment of out-of-school activities using items from the National Survey of Children's Health (NSCH).³⁶

Stakeholder interviews (n=4) were conducted by researchers in summer 2020 with adult community members such as coaches, educators and club leaders who organised out-of-school activities, including youth sport, youth clubs and an afterschool programme. A survey (n=19) conducted in fall 2020 examined community social structures and stakeholder responses to the COVID-19 pandemic. School administrators reported minutes of school PE and recess in 2019 and 2020.

Measures

Demographics

Covariates included grade and sex. Children identified as being in third, fourth or fifth grade and either male or female.

Child MVPA

Children's self-reported MVPA was obtained from the YAP, a calibrated 15-item tool designed to estimate children's in-school and out-of-school PA behaviours, as well as sedentary screen time behaviour.³³ The school where this study was conducted started the academic year in August 2020 using a hybrid approach, but by the end of September 2020, the school was fully in person. In fall of 2019, the YAP was completed between 6 September 2019 and 18 September 2019; in fall of 2020, the YAP was completed between 9 October 2020 and 26 October 2020, after the school was fully reopened. Under teacher supervision, students completed the YAP during the school day and were reminded to report on their behaviours in the last week.

Child participation in adult-organised out-of-school activities

Participation in adult-organised out-of-school activities was reported prior to the YAP assessment using items adapted from the NSCH.³⁶ Children responded 'yes' or 'no' to questions about participation in the past month in afterschool programmes, sports teams or lessons, clubs or

organisations (eg, 4-H, Girl Scouts, etc) and other organised activities (eg, music, dance, etc).

Modification in children's PA opportunities

School administrators reported weekly minutes of school PE and recess in fall 2019 and fall 2020. A stakeholder survey taking about 15 min to complete asked stakeholders (administrators and leaders) from different school, afterschool programmes, youth club and youth sport activities the degree to which children's PA opportunities in those activities were influenced by COVID-19. For each activity, respondents indicated whether they were not influenced at all, held with regular frequency but with modifications, held with less frequency but with modifications, or cancelled.

In semistructured interviews respondents were asked questions about how and why they provided or led group opportunities for PA. In these interviews, stakeholders were asked to comment on how COVID-19 influenced their ability to provide or lead group opportunities for PA.

Patient and public involvement

There were no patients involved in this study, but community stakeholders (eg, educators, youth sport coaches, club leaders, etc) participated in workshops that included following key conditions in a capacity improvement process.³⁷ As part of this process, community stakeholders participated in the data collection protocol and in the systematic collection of data. The community also received quarterly community data reports summarising the findings from the YAP.³³

Analyses

To measure community changes, we sampled classrooms at both time periods to control for any grade and age effects of following a cohort. Analysis of Variance (ANOVA) models examined main effects and interactions of grade, sex, child participation in adult-organised out-of-school activities and year on MVPA with the mixed procedure from SAS/STAT software, V.9.4 of the SAS System for Windows.³⁸ Backward elimination of non-significant interaction terms was used.³⁹ Descriptive statistics were examined to summarise child participation in adult-organised out-of-school activities. The SAS/STAT GLIMMIX procedure was used to test the significance of main effects and interactions of grade, sex and year on the dichotomous variable of child participation in adult-organised out-of-school activities.³⁸ It would be possible to delve deep into numerous interactions, which were likely due to unique characteristics to the community being studied. Rather than reporting these interactions, we are reporting the more generalisable main effects. All interview data related to the degree to which COVID-19 influenced PA opportunities were identified by searching transcripts for participant responses that included the following keywords: lockdown, quarantine, inside, outside, COVID-19, corona, virus, zoom and technology. All data specific to COVID-19 were analysed for an

Table 1 Child demographics

	Fall 2019	Fall 2020
YAP participants, n, (% of enrolment)	144 (82.3)	174 (84.5)
Grade, n (%)		
3	50 (34.7)	57 (32.8)
4	52 (36.1)	48 (27.6)
5	42 (29.2)	69 (39.7)
Sex, n (%)		
Female	82 (56.9)	90 (51.7)
Male	62 (43.1)	84 (48.3)

overarching theme, and salient quotes from stakeholder interview transcripts are provided.

RESULTS

Demographics

As shown in [table 1](#), a total of 144 (82.3%) 3rd–5th graders self-reported MVPA and participation in out-of-school activities in fall 2019 and 174 (84.5%) reported in fall 2020. Participation was approximately evenly distributed by grade and sex. Overall, 82 (56.9%) females and 62 (43.1%) males completed the YAP in 2019; 90 (51.7%) females and 84 (48.3%) males completed the YAP in 2020. Fifty (34.7%) third graders, 52 (36.1%) fourth graders and 42 (29.2%) fifth graders completed the YAP in 2019; 57 (32.8%) third graders, 48 (27.6%) fourth graders and 69 (39.7%) fifth graders completed the YAP in 2020.

Child MVPA

As shown in [figure 1](#), average daily MVPA significantly increased from fall 2019 to fall 2020 (75.0 min vs 81.3 min, SE=1.6, $p<0.05$). In-school, out-of-school, weekday out-of-school and weekend MVPA also all significantly increased from fall 2019 to fall 2020.

Child participation in adult-organised out-of-school activities

[Figure 2](#) shows that children, on average, reported less participation in 2020, compared with 2019, in youth sport (47.2% vs 42.5%), youth clubs (16.0% vs 10.3%) and other organised activities (38.2% vs 24.1%), with overall

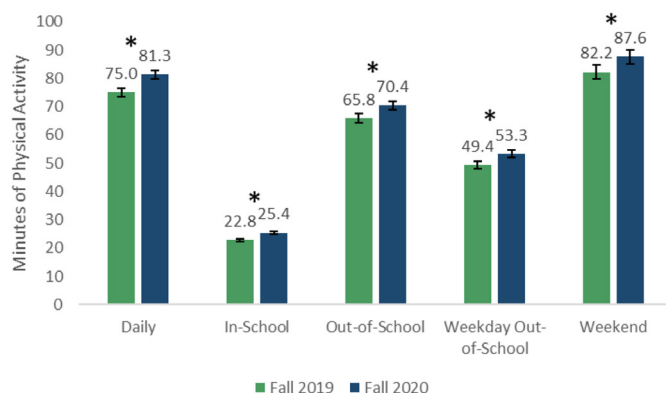


Figure 1 Changes in moderate-to-vigorous physical activity. * $P<0.05$.

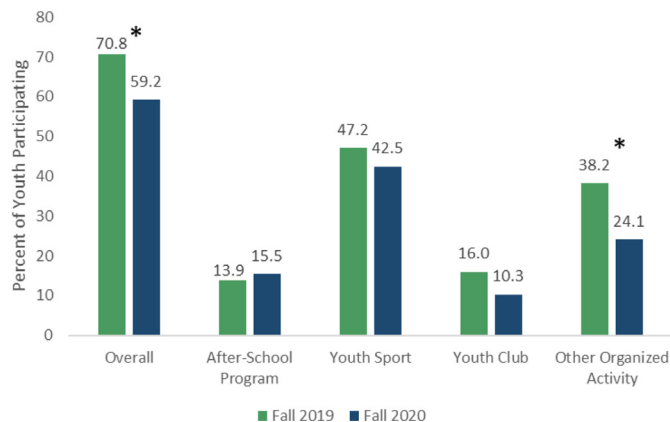


Figure 2 Child participation in out-of-school activities. * $P<0.05$.

participation decreasing by over 10% from 2019 to 2020 ($p<0.05$). Children reported increased participation in after-school programmes (13.9% vs 15.5%) in 2020.

Modifications in provision of children's in-school PA opportunities

As highlighted in [figure 3](#), school administration reported that minutes of PE and recess increased from fall 2019 to fall 2020, with a total weekly increase of 33.4 min.

Modifications in provision of children's PA opportunities by in-school and out-of-school activity

Stakeholders ($n=19$) reported that opportunities for youth PA in school, youth sport, after-school programmes and youth clubs were influenced in some way by COVID-19. Approximately 27% of stakeholders reported that opportunities were held with regular frequency but modified. Modifications included changing the place to increase ventilation, changing the structure to enforce social/physical distancing, changing by wearing face masks, changing how equipment or supplies were shared and changing to an online format. In total, 59% of stakeholders reported that opportunities were held with less frequency but modified, and almost 14% of stakeholders reported that opportunities were cancelled.

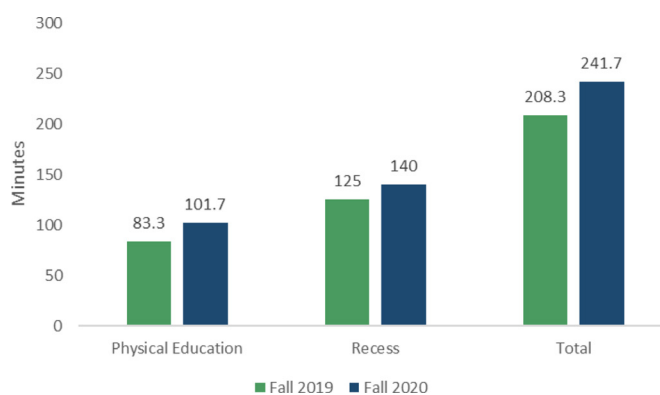


Figure 3 Minutes of physical education and recess time per week.

Stakeholder perspectives on COVID-19 and children's PA

Stakeholders shared in interviews that children were spending more time outside walking, riding bikes and playing in the neighbourhoods. While adult-organised group activities may have ceased, stakeholders continued to engage in physical activities with their own family members, and they virtually facilitated physical activities among community parents and youth. In addition, stakeholders shared that with increased demands on parents, children may have been left to play independently in their neighbourhoods. The following quotes highlight how adults adapted and children's PA opportunities changed during the pandemic:

Well, with us being - with quarantine I'm definitely seeing more activity outside. We live on a semi-busy street, so we see a lot of people walking and riding bikes, and that kind of thing. We've encouraged like our afterschool kids to go on walks, and go on scavenger hunts, that kind of thing. – Afterschool leader

...I think the parents are really overwhelmed with everything, with the schoolwork, and like 'Oh, this is one more activity.' Like, 'Okay, the physical activity they could do it on their own. I'm going to sit inside and I'm going to do what I want to do, or work while the kids play.' – Afterschool leader

Our Cub Scouting, our City Rec programs, both adult as well as the children have all fallen wayside to public policy. We currently are at a standstill for what we can do in group activities where we've had to cancel soccer - the soccer season; we had to cancel our softball season. We're on the cusp of cancelling our baseball season. But individually, it hasn't stopped me or my family when I go to - we go three times a week. We take bike rides; we go on walks. – Parks and Recreation leader

DISCUSSION

Despite an elimination or modification of adult-organised out-of-school activities due to COVID-19 and decreased participation in those activities, minutes of children's MVPA in this community were found to be higher in fall 2020. This finding contrasts with results from Dunton *et al*'s study conducted early in the pandemic where children's PA levels decreased even though some activity took place at home and in neighbourhoods.²⁷ Increased minutes of recess and PE sessions and decreased participation in of out-of-school activities may have contributed to increased free play both in-school and out-of-school and, consequently, more PA. Inputs to the pandemic system caused changes to the adult-organised activities, whereby adults may have inserted more 'free range' play into their structured routines as a result of the need to accommodate restrictions put in place due to COVID-19. The results highlight the significance of free play opportunities for children's PA, particularly when

there is a significant system disruption that limits adult-organised PA opportunities.^{40 41} Free play during both in-school and out-of-school activities has been reduced in current highly structured community social systems, yet it performs an important role in helping children to be more active.^{42 43} A variety of studies has shown that offering free play increases MVPA compared with only offering organised, adult-led games.^{24 40 44 45}

In their 2021 concept paper on youth sport and PA trends, Teare and Taks discussed a recent shift—prior to the pandemic—in preferences among children from organised to non-organised sport.⁴⁶ The authors explained that children participate in organised sport for the fun experience and social reasons, but that adults may encourage participation in sport and PA for developmental reasons (eg, skill and character building).⁴⁶ According to this research, children may prefer a less organised, and freer, form of sport play. The highly structured and exclusive nature of the current organised youth sport system may actually be discouraging children from participation and also preventing opportunities for PA. Schlechter *et al* found that youth sport activity segments with the highest percentage of time in MVPA were warm-up, game play and free play, respectively—all of which were about 50% of time. Management, sport skill and strategy were 30% or less of MVPA.⁴⁷

Since children spend many hours of the day in school settings, schools have often been the target for PA interventions.⁴⁸ Based on our results, school-based interventions that provide increased opportunities for free play may see improved PA outcomes. Offering less structured opportunities for PA may also ease the burden on teachers who often do not have enough time in the day to implement new highly structured programmes.⁴⁹ Especially during the COVID-19 pandemic, PA may have provided relief from the stress and isolation experienced from quarantine and social distancing. Our findings align with the evidence-based principle of integrating time periods where the purpose is PA into organisational routines. The principle was documented by a systematic review of school and worksite studies and adopted into school evidence-based practice by the 2012 US Physical Activity Guidelines for Americans Midcourse Report.^{50 51}

Free play and PA can happen in organised out-of-school activities such as youth sport and at school, but it can also occur in neighbourhoods when children have time and freedom to be outside. This phenomenon may have been more realised in rural communities than in urban ones during the pandemic. Stakeholders interviewed in our study indicated that they noticed children and families biking and walking in the neighbourhood. Early into the pandemic, during lockdowns, children's activities outside of the home, even on sidewalks and in parks, may have been heavily restricted, but during the summer and fall of 2020, restrictions were being lifted. During that time,



even with adult-organised activities still shut down, there were opportunities for children to be active, but in less organised ways—such as walking, biking or playing outside. Rural Great Plains communities such as Nebraska and Missouri had fewer restrictions on outdoor activity than some urban and coastal communities, and it was, perhaps, even easier for children to get outside and play. There is sometimes also more availability of safe, open space in rural communities.⁴⁶ A commentary by Bates *et al* encouraged parents during the pandemic to let their children go outdoors and perform activities such as cycling, scootering or skating.¹ The WHO encouraged parents to stay active with their children during the pandemic by playing games and engaging in sports or walking.⁶ Moore *et al* found that, during the pandemic, parent encouragement and participation were associated with more outdoor play for children.²⁹ Getting outside during the pandemic also benefited adults. In a recent study surveying over 800 adults about their prepandemic and current pandemic PA and living behaviours, those adults caregiving and working from home had increased PA levels during the pandemic, and there were increased usage of parks, trails and neighbourhoods for PA.⁵²

Limitations to this study include the relatively small sample of stakeholders available for interviews. We know that some of the availability of stakeholders was due to COVID-19-related time challenges during the summer of 2020 when the interviews were conducted. Nevertheless, the authors feel that the perspectives from the stakeholders in this rural community were sufficient for exploring differences in child-reported MVPA and participation outcomes, and the study is enhanced with its mixed methods design. Additionally, prior to the start of the pandemic, the Great Plains community was previously involved in the Wellscapes Community randomised trial targeting PA promotion among youth (ClinicalTrials.gov Identifier: NCT03380143). Because of this, we cannot determine whether the increase in PA observed during the disruption would have occurred without prior intervention. Finally, this study is a substudy of the aforementioned randomised control trial in two US rural Nebraskan communities during wave 1. We are reporting on one community from wave 1, because, due to COVID-19-related barriers, the other community did not want to collect YAP data from students in the fall of 2020. Plus, the school system in this community case study continued to deliver education on site during COVID-19, which allowed us to continue YAP data collection among the students but did not allow us to compare to other communities. With a representative sample of 3rd–5th grade children (n=144 in fall 2019; n=174 in fall 2020), we felt that we still had meaningful results to report from the single rural community—especially combined with contextual data from stakeholder surveys and interviews. This was an opportunity to have a valid measure of youth population PA over time before and during the COVID-19 pandemic.

Although wave 1 of this programme of research was representative of rural white communities, ongoing data collection in wave 2 is generating data representative of rural diverse communities with a concentration of Hispanic children.

CONCLUSIONS

These findings have implications for how and where we encourage children to be physically active in the future. Local decision-makers who manage opportunities for children's PA should consider incorporating more free play for children into their routines—even within adult-organised groups—now and after the end of the COVID-19 pandemic. Future research specific to free play could also impact local policies that help provide safe opportunities for children's free play in their neighbourhoods—in both rural and urban settings. Indeed, the COVID-19 pandemic also increased attention on diversity and equity issues related to PA and health in communities.⁵³

The COVID-19 pandemic was, and is, a disruptive event that has changed the course of many lives. Disruptive events are not new, though. Many communities, even recently, have faced life-altering natural disasters such as hurricanes, freezes and wildfires. These events, while sometimes tragic and often challenging, can provide the impetus for positive change. We know that COVID-19 has impacted almost every community social system. In a rural Great Plains community in the USA, it provided a disruption to routine practices and perhaps exposure to less structured ways for children to be active—hearkening back to more active, free range days of the past.

Twitter Debra K Kellstedt @dkellstedt

Contributors DKK and DAD conceptualised the idea for the study. DKK, AME, MJVS and RI collected quantitative and qualitative data for the project. DKK, AME and DAD undertook initial quantitative data analysis, and RI, DKK and MJVS conducted thematic analysis of qualitative data. MAS, MSR, GJW and RRR reviewed analyses and provided subject matter expertise. DKK prepared the manuscript, and all authors edited and revised the final version under supervision from DAD who was the guarantor of the project.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants. The Institutional Review Board at the University of Nebraska Medical Center approved data collection procedures in 2018 (IRB #446-18-EP). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Study materials are available upon reasonable request. Interview transcripts are not available due to participant confidentiality.

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ORCID iD

Debra K Kellstedt <http://orcid.org/0000-0002-3737-8627>

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