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Correlates of children's independent outdoor play: Cross-sectional analyses from the Millennium Cohort Study

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ABSTRACT

Time spent outdoors is associated with higher levels of physical activity. To date, correlates of independent outdoor play have not been investigated. This study aimed to identify potential demographic, behavioural, environmental and social correlates of children's independent outdoor play.

Data were from the Millennium Cohort Study when children were aged 7 years. Parents reported whether their children played out unsupervised (yes/no) as well as the above mentioned correlates of unsupervised outdoor play. Children's physical activity levels were measured using waist worn accelerometry. Multiple logistic regression was used to examine associations between correlates and odds of independent (unsupervised) outdoor play. Adjusted multiple linear regression was used to estimate associations between independent outdoor play and objective measures of physical activity. Activity was measured as average daily moderate-to-vigorous activity, steps, and sedentary behaviour.

3856 (n = 29%) participants were categorised as engaging in independent outdoor play. Older age, being white British, being in poverty, living in close proximity to both family friends and family, having fewer internalising problems, having more externalising conduct problems and fewer pro-social behaviours were associated with higher odds of independent outdoor play. Independent outdoor play was associated with > 2 additional minutes of moderate-to-vigorous activity (B = 2.21 95% CI, 1.09 to 3.34), > 330 additional steps per day (B = 336.66 95% CI 209.80 to 463.51), and nearly 5 min less time spent sedentary per day (B = −4.91 95% CI −7.54, −2.29)

Younger children, those from a higher socio-economic-status, those isolated in location from family friends and family, and those with high levels of prosocial behaviour have lower levels of independent outdoor play. Independent outdoor play was associated with higher levels of physical activity and less time sedentary. Future interventions to promote independent outdoor play should target such populations.

1. Introduction

Regular participation in physical activity provides a plethora of health and wellbeing benefits for children (e.g., see review by Janssen and Leblanc, 2010). Consequently, many national and international guidelines have been developed advocating the importance of physical activity. UK guidelines recommend that children and young people should take part in at least 60 min of moderate-to-vigorous physical activity (MVPA) daily (Craig et al., 2009). Yet, just 22% of young people in England meet these recommendations (Scholes, 2016). Effective physical activity promotion interventions are needed.

Although recent data are not available, a study published in 2000 suggested that outdoor play is in decline, with a 25% decrease in time spent playing observed between 1981 and 1997 in US children aged 6–8 years old (Hofferth and Sandberg, 2000). This is of concern as outdoor play contributes to active play which is a domain of physical activity. Moreover, children have been shown to be inherently more active when outside (Cooper et al., 2010; Cleland et al., 2008).

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Children's independent outdoor play is likely to be more active than that of supervised outdoor play (play with a parent/guardian; Page et al., 2009). However, to date the relationship between independent outdoor play and physical activity has not been investigated.

Identifying correlates of physical activity can inform intervention development, by highlighting potentially modifiable correlates that may bring about physical activity (e.g. physical environment), or identify characteristics of target groups most in need of intervention (e.g. demographics). A large body of literature exists on correlates of children's total physical activity (Sallis et al., 2000), time-specific physical activity (school break time and after school periods; Stanley et al., 2012), active travel (Panter et al., 2008), and sport (Allen and Vella, 2015). However, correlates of children's outdoor play (active play) have been studied less although interventions have been carried out to increase children's outdoor play with some success (Farley et al., 2007; Colabianchi et al., 2009). Demographic (sex, age, ethnicity, and socio-economic-status), behavioural (TV viewing), environmental (proximity to key locations), and social (pro-social behaviour) correlates have been consistently shown to be associated with physical activity domains (Sallis et al., 2000; Farley et al., 2007; Vancampfort et al., 2016; Smith et al., 2017). Research to investigate whether such correlates are associated with outdoor play is warranted.

The aim of the present study was to investigate associations between demographic, behavioural, environmental, and social correlates and children's independent outdoor play in a large population based sample of children residing in the UK. An additional aim was to investigate the association between independent outdoor play and activity levels.

2. Methods

The Millennium Cohort Study (MCS) is a prospective study of children born at the turn of the century (between September 2000 and January 2002) in the UK. Infants who were alive and living in the UK at age 9 months were drawn from child benefit registers, a state-provided welfare payment that covers nearly all families in the UK apart from a small group of children with non-national parents with recent or temporary immigration status. Disproportionately stratified sampling at electoral ward level ensured adequate representation of disadvantaged and ethnic minority areas. Information was collected on 18, 818 children at 9 months of age from 1 parent (usually the child's mother). Further surveys were administered at the ages of 3, 5, 7, and 11 years. All measures were collected in the child's home. In order to maximise sample size the present study used data from the age 7 survey only, where physical activity was objectively measured using waist worn accelerometry. Ethical approval was granted by the South West and London Multi-Centre Research Ethics Committees.

2.1. Exposure variables

Exposure variables were selected based on correlates that were available within the present dataset, and have been consistently shown to be associated with other physical activity domains (Sallis et al., 2000; Farley et al., 2007; Vancampfort et al., 2016; Smith et al., 2017).

2.1.1. Demographic

Parents/carers reported child(ren)'s sex, age, ethnicity (classified as White British or Other) and income (classified as above or in poverty). Trained interviewers measured children's height and weight from which body mass index (BMI) was calculated using standard formulae.

2.1.2. Behavioural

Parents were also asked to report the number of hours their child spends watching television/videos/DVDs ("on a normal week day during term time, how many hours does [child] spend watching television, videos or DVDs"). Response options were "none/less than an hour/1 h to less than 3 h/3 h to less than 5 h/5 h to less than 7 h/or 7 h or more". TV time was further categorised as low (< 1 h/d) and high (≥ 1 h/d).

2.1.3. Environmental

To assess the proximity with which children lived to family friends and family, parents were asked "do you have any friends/family living in this area" response options were "yes, friends/yes, family/yes, both/no."

2.1.4. Social

Parents also completed the Strengths and Difficulties Questionnaire for their child(ren), which consists of 25 items on psychological attributes. The 25 items cover 5 sub-scales relating to emotional problems, conduct problems, hyperactivity, peer problems and pro-social behaviour. Parents are required to report to what extent a series of statements apply to their child. Response options for each statement were not true (0), somewhat true (1) or certainly true (2). Scores from the emotional and peer problems subscales were combined into an 'internalising' subscale and conduct problems and hyperactivity were combined into an 'externalising' subscale. Scores on the internalising and externalising subscales could range from 0 to 20, with a higher score indicating more difficulties. The pro-social behaviour sub-scale was used alone and therefore this subscale could range from 0 to 10, with a higher score indicating more pro-social behaviours. Scores from the emotional problems, conduct problems, hyperactivity and peer problems subscales were combined to generate a total difficulties score. The Strengths and Difficulties Questionnaire is considered a valid and reliable measure of child behavioural and emotional problems (Goodman et al., 2000).

2.2. Outcome variable

2.2.1. Active play

Parents were asked "Are there any parks, playgrounds or public spaces in the area where you live where your child(ren) can play outdoors either alone or supervised" response options were yes/no. Parents that responded yes were then asked "Does your child(ren) ever play outside on the street or in other public spaces in this area without close supervision" response options were yes/no. Only children whose parent answered yes to the first question were included in the present analyses. If parents also answered yes to the second question, the child was categorised as engaging in "independent outdoor play". If parents answered no to the second question, the child was categorised as engaging in "no independent outdoor play."

2.2.2. Objective physical activity data

Physical activity and sedentary time were measured objectively using Actigraph GT1M accelerometers (Actigraph, Pensacola, Florida) during the fourth wave of data collection when participants were 7 years of age (between May 2008 and August 2009). Actigraph accelerometers are a valid and reliable way to measure physical activity in young people. Full details on the accelerometry procedures have been published previously (Griffiths et al., 2013). In brief, accelerometers were delivered by mail to consenting participants and programmed to record data at 15-second intervals (15-second epoch length). Participants were instructed to wear the accelerometers around their waists during waking hours, and to take them off during water-based activities, for 7 consecutive days. Devices were returned and information was downloaded using Actigraph software. A total of 6497 children (3176 boys) met the inclusion criteria, which was set as having at least 2 days with 10 h or more of wear time. Time spent engaging in physical activities of varying intensities was derived using cutpoints generated from a prior calibration study in 7-year-old children (Pulsford et al., 2011). Specifically, time sedentary was classified as fewer than 100 counts per minute, and time in MVPA was classified as $>$ 2241 counts per minute.

2.2.3. Analyses

Characteristics of the study population were summarised using descriptive statistics. Multiple logistic regression was used to examine the association between exposure variables (sex, age, ethnicity, BMI, income, proximity to family and family friends, TV viewing time, and strength and difficulties scores) and odds of independent outdoor play. Models were mutually adjusted for all exposure variables, excluding total difficulties score. In an additional analysis, adjusted multiple linear regression was used to estimate associations between independent outdoor play and objective measures of physical activity. Activity was measured as average daily moderate-to-vigorous activity, steps, and sedentary behaviour. This model was adjusted for age, sex, ethnicity, income, BMI and total difficulties score. These covariates were selected because they were hypothesised to be independently associated with both the exposure and the outcome.

3. Results

3.1. Correlates of independent outdoor play

In this sample of 7-year old children, 29% (n = 3856) were categorised as engaging in independent outdoor play (Table 1). Older age, being male, being white British, being in poverty, living in close proximity to both family friends and family, having fewer internalising problems, having more externalising conduct problems and fewer prosocial behaviours were associated with higher odds of independent outdoor play (Table 2).

3.2. Independent outdoor play and activity levels

In an additional analysis, 6442 children had valid accelerometry data. Compared to the accelerometry sample, children excluded from the accelerometry analysis (n = 6727) were more likely to be overweight or obese (24% vs. 17%), come from Black and Minority Ethnic Groups (18% vs. 11%), and have higher levels of psychological distress (strengths and difficulties score: 8.2 vs. 6.7). In the accelerometry sample, independent outdoor play was associated with > 2 additional minutes of MVPA per day (B = 2.21 95% CI, 1.09 to 3.34), > 330 additional steps per day (B = 336.66 95% CI 209.80 to 463.51) and nearly 5 min less time spent sedentary per day (B = − 4.91 95% CI − 7.54, − 2.29) after adjusting for a number of confounding factors (Table 3).

Table 2
Odds of independent outdoor play (n = 13,169).

	OR (95% confidence intervals)
Sociodemographics	
Age (years)	1.45 (1.24, 1.69)
Sex	
Female	1.00
Male	1.08 (1.00, 1.17)
Ethnicity	
White British	1.00
Black and minority ethnicities	0.49 (0.43, 0.55)
Income	
Not in poverty	1.00
In poverty	1.39 (1.27, 1.52)
Environmental factors	
Proximity to friends and family	
No friends or family in area	1.00
Close to friends	1.15 (0.95, 1.40)
Close to family	1.09 (0.85, 1.40)
Close to both	1.39 (1.16, 1.67)
Health and behavioural factors	
BMI	
Health weight	1.00
Overweight	1.06 (0.95, 1.18)
Obese	0.98 (0.84, 1.16)
TV viewing	
Low	1.00
High	0.99 (0.90, 1.09)
Strengths and difficulties	
Internalising problems[a]	0.97 (0.96, 0.99)
Externalising conduct[a]	1.04 (1.03, 1.05)
Pro-social behaviour[a]	0.97 (0.94, 0.99)

[a] Entered as a continuous variable (scored 1–10).

Table 3
Association between independent outdoor play and objectively measured physical activity and sedentary time (n = 6442).

	B (95% confidence intervals)
Sedentary time (mins/day)	− 4.91 (− 7.54, − 2.29)
MVPA (mins/day)	2.21 (1.09, 3.34)
Steps (per/day)	336.66 (209.80, 463.51)

Adjusted for age, sex, ethnicity, income, BMI, strengths and difficulties score and accelerometer wear time.

Table 1
Descriptive characteristics and objectively measured activity levels.

	Survey sample (n = 13,169)			Accelerometry sample (n = 6442)		
	No.	%	Mean (SD)	No.	%	Mean (SD)
Age (years)			7.2 (0.3)			7.2 (0.3)
Male	6671	50.7%		3151	48.9%	
White British race/ethnicity	11,234	85.3%		5730	88.9%	
Poverty-level income	3783	28.7%		1396	21.7%	
Overweight/obese	2720	20.7%		1115	17.3%	
High TV time				5106	79.3%	
Proximity to friends and family						
No friends or family in area	688	5.2%		311	4.8%	
Close proximity to friends	2892	22.0%		1588	24.7%	
Close proximity to family	708	5.4%		282	4.4%	
Close proximity to both	8881	67.4%		4261	66.1%	
Internalising problems score			2.7 (2.8)			2.5 (2.6)
Externalising problems score			4.7 (3.6)			4.3 (3.3)
Prosocial behaviour score			8.6 (1.6)			8.7 (1.5)
Independent outdoor play	3856	29%		1894	29.4%	
Accelerometry						
Sedentary time (min/day)						393.2 (67.0)
Steps (per/day)						10,227.4 (2463.4)
MVPA (min/day)						62.3 (22.3)
Wear time (min/day)						735.92 (61.94)

4. Discussion

In this large population based sample of children aged 7 years residing in the UK, several correlates of independent outdoor play were identified. Outdoor play was more likely among children who were older, white British, in poverty, living in close proximity to both family friends and family, having fewer internalising problems, having more externalising conduct problems, and/or had fewer pro-social behaviours.

The present findings support previous research that has shown that, as children become older, they gain licence to be more independently mobile (Fyhri and Hjorthol, 2009). Research has also shown that levels of independent mobility differ by ethnicity (Tava'e et al., 2010) likely owing to difference in parental styles and social norms between ethnicities (Phoenix and Husain, 2007). Similarly, children with lower socio-economic status (SES) are more likely to be granted greater independence than those with high SES owing to differences in parenting styles and social norms. It is reasonable to assume that children who live within close proximity to friends and family are more likely to play outdoors independently, as they are likely to have friends or young family members to play with (Sallis and Glanz, 2006). An alternative explanation is that these children live in areas where there are higher levels of social cohesion and thus parents feel their children are “safe” playing out unsupervised.

Of interest, we found evidence that having an elevated presence of externalising problems, in addition to fewer internalising problems, appeared to be associated with greater independent outdoor play. Whilst we cannot be clear on the precise nature of the externalising problems, this construct included items on hyperactivity and conduct problems. In the wider literature, it is established that higher levels of physical activity can decrease the odds of developing depression in children (Korczak et al., 2017), which might be attributed to decreases in inflammation (Schuch et al., 2016) or increasing brain derived neurotrophic factor (Kerling et al., 2017). Outdoor play may be a particularly important strategy to help children with hyperactivity to engage in physical activity and meeting the recommended guidelines. A recent meta-analysis of dropout from physical activity interventions, found that sport and play interventions have lower dropout rate than structured aerobic exercise (Vancampfort et al., 2016). Thus, taken together, outdoor play may be a useful means by which children with externalising problems can participate in physical activity, gain the health benefits and may potentially offer a protective effect for such problems in children generally when considered in relation to the wider literature.

Interestingly, lower levels of pro-social behaviour were associated with higher levels of independent outdoor play. It is likely that those children with higher levels of pro-social behaviour may be spending most of their concessionary time in pro-social behaviours such as helping others or volunteering whereas those with low levels spend most their concessionary time out playing unsupervised.

The present paper found that children whose parents reported that they had higher levels of independent outdoor play had high levels of objectively measured physical activity, a total of 330 additional steps per day but just 2 additional minutes of MVPA per day, and lower levels of sedentary behaviour, nearly 5 min less time spent sedentary per day. This higher level of physical activity and lower level of sedentary behaviour supports previous literature that has shown time spent outdoors to be associated with higher levels of activity (see for example review by Gray et al., 2015). Moreover, our findings support work that shows that children's independent outdoor play is likely to be more active than that of supervised outdoor play (play with a parent/ guardian; Page et al., 2009).

5. Strengths and limitations

Strengths of the present study are the large and representative sample, and the use of objective measures of physical activity. A modest difference in MVPA between levels of independent outdoor play in the present study is likely a reflection of the nature of outdoor play. Outdoor play is likely to involve movements such as jumping and climbing, activities that are of moderate intensity, but owing to limitations of the Actigraph accelerometer to detect ambulatory activity it is likely that such behaviours would had been recorded as light activities/step counts. Moreover, accelerometers only provided data during a single week, which may not be a true reflection of regular behaviour patterns. Some of the correlates identified are potentially modifiable. However, without being able to identify the causal direction we cannot be sure how to intervene. More research to identify causal direction is needed.

6. Conclusions and implications

Data from the present study suggest that outdoor independent play contributes to higher levels of activity and less sedentary time. Younger children, those of a higher SES, those isolated in location from family friends and family, and those with high levels of prosocial behaviour are at risk of lower levels of independent outdoor play. Future interventions to promote independent outdoor play should target such populations.

Conflicts of interest

The authors report no potential conflicts of interest.

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References

Allen, M.S., Vella, S.A., 2015. Are the correlates of sport participation similar to screen time? Prev. Med. Rep. 2 (11), 114–117.
Cleland, V., Crawford, D., Baur, L., Hume, C., Timperio, A., Salmon, J., 2008. A prospective examination of children's time spent outdoors, objectively measured physical activity and overweight. Int. J. Obes. 32, 1685–1693.
Colabianchi, N., Kinsella, A., Coulton, C., Moore, S., 2009. Utilization and physical activity levels at renovated and unrenovated school playgrounds. Prev. Med. 48 (2), 140–143.
Cooper, A., Page, A., Wheeler, B., Hilsdon, M., Griew, P., Jago, R., 2010. Patterns of GPS measured time outdoors after school and objective physical activity in English children: the PEACH project. Int. J. Nutr. Phys. Act. 7.
Craig, R., Mindell, J., Hirani, V., 2009. Health Survey for England 2008. Physical Activity and Fitness. Summary of Key Findings.
Farley, T., Meriwether, R., Baker, T., Watkins, L., Johnson, C., Webber, L., 2007. Safe play spaces to promote physical activity in inner-city children: results from a pilot study of environmental intervention. Am. J. Public Health 97 (9), 1625–1631.
Fyhri, A., Hjorthol, R., 2009. Children's independent mobility to school, friends and leisure activities. J. Transp. Geogr. 17 (5), 377–384.
Goodman, R., Ford, T., Simmons, H., et al., 2000. Using the Strengths and Difficulties Questionnaire (SDQ) to screen for child psychiatric disorders in a community sample. Br. J. Psychiatry 1776, 534–539.
Gray, C., Gibbons, R., Larouche, R., et al., 2015. What is the relationship between outdoor time and physical activity, sedentary behaviour, and physical fitness in children? A systematic review. Int. J. Environ. Res. Public Health 12 (6), 6455–6474.
Griffiths, L., Cortina-Borja, M., Sera, F., et al., 2013. How active are our children? Findings from the Millennium Cohort Study. BMJ Open 3 (8).
Hofferth, S., Sandberg, J., 2000. Changes in American children's Time, 1981–1997. Centre for Ethnography of Everyday Life.
Janssen, I., Leblanc, A.G., 2010. Systematice review of the health benefits of physical activity and fitness in school-aged children and youth. Int. J. Behav. Nutr. Phys. Act. 7 (40).
Kerling, A., Kuck, M., Tegtbur, U., et al., 2017. Exercise increases serum brain-derived neurotrophic factor in patients with major depressive disorder. J. Affect. Disord. 215, 152–155.
Korczak, D., Madigan, S., Colasanto, M., 2017. Children's physical activity and depression: a meta-analysis. Paediatrics. http://dx.doi.org/10.1542/peds.2016-2266.
Page, A., Cooper, A., Griew, P., Davis, L., Hilsdon, M., 2009. Independent mobility in relation to weekday and weekend physical activity in children aged 10–11 years: the PEACH project. Int. J. Behav. Nutr. Phys. Act. 6 (2).
Panter, J., Jones, A., van Sluijs, E., 2008. Environmental determinants of active travel in

youth: a review and framework for future research. Int. J. Behav. Nutr. Phys. Act. 5 (34).
Phoenix, A., Husain, F., 2007. Parenting and Ethnicity. Joseph Rowntree Foundation.
Pulsford, R.M., Cortina-Borja, M., Rich, C., et al., 2011. Actigraph accelerometer defined boundaries for sedentary behaviour and physical activity intensities in 7 year old children. Plos One 68.
Sallis, J.F., Glanz, K., 2006. The role of built environments in physical activity, eating, and obesity in childhood. Futur. Child. 16 (1), 89–108.
Sallis, J.F., Prochaska, J.J., Taylor, W.C., 2000. A review of correlates of physical activity of children and adolescents. Med. Sci. Sports Exerc. 35 (5), 963–975.
Scholes, S., 2016. Health Survey for England 2015 Physical Activity in Children.
Schuch, F., Deslandes, A., Stubbs, B., Gosmann, N., Silva, C., Fleck, M., 2016. Neurobiological effects of exercise on major depressive disorder: a systematic review. Neurosci. Biobehav. Rev. 61, 1–11.
Smith, L., Aggio, D., Hamer, M., 2017. Longitudinal patterns in objective physical activity and sedentary time in a multi-ethnic sample of children from the UK. Paediatric Obes.. http://dx.doi.org/10.1111/ijpo.12222. (Epub ahead of print).
Stanley, R., Ridley, K., Dollman, J., 2012. Correlates of children's time-specific physical activity: a review of the literature. Int. J. Behav. Nutr. Phys. Act. 9 (50).
Tava'e, N., Witten, K., Asiasiga, L., Sweetsur, P., Lin, E., 2010. The influence of ethnicity on children's independent mobility. J. Sci. Med. Sport 15 (s1), s210.
Vancampfort, D., Firth, J., Schuch, F., et al., 2016. Dropout from physical activity interventions in children and adolescents with attention deficit hyperactivity disorder: a systematic review and meta-analysis. Ment. Health and Phys. Act. 11, 46–52.