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School grounds and physical activity: Associations at secondary schools, and over the transition from primary to secondary schools

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ABSTRACT

This paper aims to further understanding of the physical environments of secondary schools and their associations with young peoples' physical activity. Accelerometer-derived physical activity measurements from 299 participants in the SPEEDY study (Norfolk, UK) were obtained from baseline measurements (age 9–10 y) and +4y follow-up. These were linked to objective measures of primary and secondary school environments as measured by the SPEEDY grounds audit tool. We saw considerable differences in the nature of school grounds between primary and secondary schools. Cross-sectional associations were seen between active travel provision scores and commuting time moderate-to-vigorous physical activity (MVPA) for 13–14 year old boys and adolescents living further from school. However, few associations were seen between changes in school grounds scores and changes in school-based MVPA.

1. Background

Schools are important settings for the promotion of children's physical activity. Through commuting, break times, and physical education lessons they provide regular opportunities for children to be active (Ridgers et al., 2006). Past work has found that children can acquire up to 40% of their daily moderate-to-vigorous physical activity (MVPA) during school break times (Ridgers et al., 2006), and between 25% and 40% during travel to and from school (van Sluijs et al., 2009). Previous work has highlighted how alterations and additions to the physical school environment can increase children's activity levels (Harrison and Jones, 2012), and that the supportiveness of primary school physical activity environments is positively related to children's school-time activity levels (Jones et al., 2010).

Children's physical activity is known to decline as they age, and the transition to adolescence (Dumith et al., 2011), coinciding with the move from primary to secondary education, is seen as key point at which to intervene (Cale and Harris, 2006). MVPA has been shown to decline more strongly over these ages at school lunch times, during which school grounds are key locations for physical activity, than at other periods of the school day (Brooke et al., in press). There is some evidence that changes in the environmental supportiveness of schools between primary and secondary settings are associated with changes in physical activity. De Meester et al. (2014) found that young people's weekday step counts increased if the quantity of schoolyard facilities and equipment was higher at secondary schools than primary schools. Despite this, much work on activity promotion through the design of school grounds has focused on primary schools. A recent review of the role of school playgrounds in children's physical activity included 33 papers, of which only two were set in secondary schools (Broekhuizen et al., 2014). These cross-sectional analyses found associations between increases in the number of facilities in the school grounds and increased self-reported physical activity during recess (Haug et al., 2010, 2008). Broekhuizen et al. (2014) concluded that further work is needed to explore if and how secondary school grounds can be adapted to promote physical activity in older children and adolescents.

The assessment of school grounds may be conducted via questionnaire surveys of staff or students, as used by De Meester et al. (2014), or objectively through the use of systematic observational audits. The audit approach requires the development of an audit tool through which standardized measurements of characteristics such as the presence of individual items of equipment, the standards of maintenance of facilities, and the more subjective feel of an area, may be taken across different settings (Brownson et al., 2009). Such an audit tool was developed to

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assess the suitability of school grounds for physical activity as part of the Sport Physical Activity and Eating Behaviour, Environmental Determinants in Young People (SPEEDY) study (Jones et al., 2010). The validity and reliability of the SPEEDY school audit tool was tested in primary schools, and showed that the supportiveness of primary school grounds was related to children's school-time MVPA (Jones et al., 2010). The SPEEDY audit tool has since been adapted to assess the supportiveness of primary school environments for physical activity around the world (Katzmarzyk et al., 2013).

Given the need to understand how secondary school grounds can support young people's physical activity, this study has three aims; (1) to assess if and how the supportiveness of school environments for physical activity change between primary and secondary schools, (2) to assess the cross-sectional association between the secondary school environment as assessed by the SPEEDY school audit tool and young people's school-based MVPA, and finally (3) to assess the association between change in children's school based MVPA and change in school physical activity environment supportiveness across the transition from primary to secondary school. These aims will be met through analyses of data collected as part of the SPEEDY study in Norfolk, UK.

2. Methods

2.1. Recruitment and data collection

The SPEEDY study (Sport, Physical activity and Eating behaviour: Environmental Determinants in Young people) is a population based longitudinal cohort study designed to investigate factors associated with diet and physical activity behaviour of children across the county of Norfolk, UK. The study's methods are described in detail elsewhere (van Sluijs et al., 2008; Corder et al., 2014) and so are only briefly recounted here.

In 2007, schools across Norfolk with at least 12 Year 5 pupils (age 9/10 years) were sampled according to stratification by urban/rural status (Bibby and Shepherd, 2004). Ninety two schools took part in the main study, and 2064 children were recruited. Baseline data collection was performed during the school summer term (April–July; 'SPEEDY 1'). Teams of trained Research Assistants performed measurements at participating schools according to standard operating procedures. Participant height and weight were recorded using a Leicester height measure and non-segmental Tanita scales (type TBF-300A). Body mass index (BMI) was calculated from height and weight measurements and weight status (overweight or obese vs healthy weight) was determined based on international age and sex-specific cut points (Cole et al., 2000). Participants were fitted with an accelerometer (Actigraph GT1M) and were given a pack to take home including a questionnaire for their parents or carers to complete. To provide a measure of household socio-economic status, the parent questionnaire asked at what age the person completing the questionnaire (the mother on 84% of occasions) left full-time education.

Participants were invited to undertake further physical activity measurements in the school summer terms at +1year (2008), and again at +4years (2011) when aged 13/14 y and in Year 9, the third year of secondary education. At age 13–14 years the full suite of study measures (physical activity, diet, anthropometry and questionnaires) were repeated. For these analyses physical activity measurements from baseline and second (+4years) follow-up ('SPEEDY 3') were used, as these allow measurement of changes in behaviour between primary and secondary schools.

2.2. Physical activity measurement

The Actigraph GT1M accelerometers were set to record at 5 s epochs. Participants were asked to wear the devices on their right hip for seven days, removing them overnight and for aquatic activities. For consistency, and to limit any potential reactivity effect (Dössegger et al., 2014), the first partial day of data collection was removed from all files, and 10 min of continuous zero counts were classified as 'non-wear time' based on standard protocols (Eiberg et al., 2005; Mattocks et al., 2008; Riddoch et al., 2004). 'Wear time' was derived by subtracting minutes of 'non-wear time' from the total minutes in a given period. As physical activity outcomes were to be derived for two school-specific time periods, the commuting period (8–9 am and 3–4 pm), and the lunchtime period (12 noon to 2 pm), days for which fewer than 60 min of wear time were recorded within each of these two periods (across the two one-hour periods for commuting time) were excluded. Weekend days and school holidays were also excluded. Participants were included in the analysis if they provided at least one day of measurement on both measurement occasions, but were excluded if their baseline measurements were part of the pilot phase that was undertaken in February 2007. These criteria were implemented in order to maximize the numbers included in these analysis, and are in line with previous work with this sample (Corder et al., 2014; van Sluijs et al., 2008).

For each valid measurement day, time spent in MVPA (>2000 cpm) was extracted for the commuting period (8–9 am and 3–4 pm), and the lunchtime period (12 noon to 2 pm). MVPA during these times was averaged across all valid days at each measurement occasion for each participant. The threshold of 2000 cpm is equivalent to walking at 4 km/h (Ekelund et al., 2003) and has been used to define MVPA previously in this study (Corder et al., 2010; van Sluijs et al., 2008) and others (Riddoch et al., 2004). The outcome was average minutes of MVPA over each time period, and average wear time within the period was included as a covariate in all models. Change in average MVPA between the two time points was calculated by subtracting baseline average from follow-up average so that negative values indicate a decline in average time spent in MVPA.

2.3. School environment measurement

As part of the first phase of the SPEEDY study, we developed and tested an audit tool to objectively assess the opportunities for physical activity within primary school environments (Jones et al., 2010). The 44 item tool was used at the 92 primary schools recruited at baseline. Scores from the tool covering six domains of facility provision were examined against objectively measured time spent in MVPA among 1868 9–10 year old pupils attending the schools. The tool was found to have acceptable reliability and good construct validity, differentiating the physical activity levels of children attending the highest and lowest scoring schools (Jones et al., 2010).

For the +4year follow-up measurements at secondary schools, the SPEEDY school grounds audit was adapted very slightly from the original audit whereby three facilities that were commonly recorded as 'other' facilities in the original audit ('formal garden/quiet space', 'outdoor teaching space' and 'vegetable/fruit garden') were added as named items. No items were removed from the audit. Audit scores were calculated for SPEEDY 3 schools using the same methodology as for SPEEDY 1 (Jones et al., 2010). Briefly, these scores were derived by summing the values of individual items across six domains; 'walking provision', 'cycling provision', 'sports and play provision', 'other facility provision', 'design of the school grounds' and 'aesthetics'. A seventh score was also created assessing overall school physical activity suitability by summing all