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School environments and physical activity: the development and testing of an audit tool

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Abstract

The aim of this study was to develop, test, and employ an audit tool to objectively assess the opportunities for physical activity within school environments. A 44 item tool was developed and tested at 92 primary schools in the county of Norfolk, England, during summer term of 2007. Scores from the tool covering 6 domains of facility provision were examined against objectively measured hourly moderate to vigorous physical activity levels in 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. The characteristics of school grounds may influence pupil's physical activity levels.

Keywords

Physical activity; school environment; children; environmental audit

Introduction

Physical activity in childhood is known to have both short and long term health benefits (Biddle et al., 2004, Andersen et al., 2006, Boreham and Riddoch, 2001), whilst physical inactivity in children has been linked to rises in childhood obesity (Tremblay and Willms, 2003, Wareham et al., 2005). Despite the reported benefits of physical activity, levels in many children are low (Verstraete et al., 2006); Riddoch et al. 2007).

The drivers of physical activity are many and varied (Sallis et al., 2000) but there is increasing recognition of the importance of the physical environment (Jones et al., 2007). In the case of children, the environment of the school may be a particularly significant

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influence on physical activity. Children spend much of their day during the week at school and have many potential opportunities for daily activity there; during break times, the beginning and end of the school day, as well as in physical education lessons (Wechsler et al., 2000, Verstraete et al., 2006, Jago and Baranowski, 2004). However, physical education lessons alone do not generally provide children with enough opportunity to meet recommended levels of physical activity (Biddle et al., 2004, Cardon et al., 2008, Belsky et al., 2003, McKenzie et al., 2000). It is therefore important to explore broader factors that may impact on physical activity at school out of lesson times.

Different components of the school environment have been shown to influence physical activity in children and a recent systematic review has highlighted the potential of interventions which target school environments (van Sluijs et al., 2007). A number of studies have demonstrated that the presence of fixed play equipment encourages physical activity (Farley et al., 2008, Sallis et al., 2001, Moore, 1989), as do coloured playground markings (Ridgers et al., 2007). Furthermore, schools with playing fields have been found to have more active pupils than those without (Haug et al., 2008). A number of studies have shown aesthetically pleasing environments to be associated with higher levels of physical activity in adults (McCormack et al., 2004, Ellaway et al., 2005), and thus there is reason to believe that the same may be so in children.

A number of previous studies have investigated the opportunities for physical activity in school environments. However, the majority have not measured the characteristics of the environment objectively, instead relying on questionnaire surveys of staff (Young et al., 2007) or students (Robertson-Wilson et al., 2007, Haug et al., 2008). In one of the few studies that did include objective measurements, Webber et al., (2007) undertook an environmental audit, but examined schools as workplaces, investigating how the characteristics of school grounds influenced the physical activity of staff, rather than pupils. Sallis et al., (2001) also objectively measured the school environment and its association with pupils' activity. However the study examined just 24 schools and relied on observation to determine levels of physical activity.

Brownson et al. (2009) have recently shown that audit tools are a useful method for measuring the built environment. Although it can be more time consuming than using remote measurements, such as those taken from satellite photographs or computed in Geographical Information Systems (GIS), direct observation in the form of an audit allows data to be collected on features that are commonly not represented in computer databases. These include the presence of individual items of equipment, the standards of maintenance of facilities, and the more subjective feel of an area. Consequently, a number of area audit tools have been used to examine how components of the general environment could influence physical activity. These have been developed to test the effect of features such as neighbourhood walking and cycling environments (Pikora et al., 2002, Hillsdon et al., 2006). However, we are not aware of published studies that have developed and rigorously tested an audit instrument to assess the school environment. The aim of this study was to develop, test, and employ an audit tool to objectively assess the opportunities for physical activity within a sample of 92 primary school environments in the county of Norfolk, England. This study was undertaken as part of the larger SPEEDY (Sport, Physical activity and Eating behaviour: Environmental Determinants in Young people) study (van Sluijs et al., 2008).

Methods

Selection of schools and participants

In total 157 eligible (those with at least 12 Year 5 pupils) schools in Norfolk were approached, from which 101 agreed to participate in the SPEEDY study, and 92 took part. The University of East Anglia local ethics committee approved the study and written consent for participation was obtained from all school head teachers, parents, and children. For a full description of the sample and methods of SPEEDY, see van Sluijs et al., (2008). Schools in rural areas were over-sampled in order to maximise variability of the environments considered; based on the Bibby and Shepherd (2004) urban/rural classification system, 33% of schools were urban, 39% were in town and fringe areas, 24% were situated in villages, and the remaining 4% were located in very small settlements (hamlets). Three schools were independent (privately funded), with the remainder being state financed. From 3619 invitations, a total of 2064 Year 5 children (age 9 – 10 years, equivalent to Fourth Grade or Grade 4 in the USA) attending these schools took part in SPEEDY, with more girls (55.1%) than boys (44.9%) participating.

Design and implementation of the audit tool

The audit tool was created to measure the environmental characteristics of the external grounds of each school. It was partly based upon a tool previously developed to examine the quality of urban green spaces (Hillsdon et al., 2006), and adapted to be appropriate to the school setting. Additional components were added, some taken from an existing preschool playground audit (Cardon et al., 2008). The items were designed to be independent of weather conditions and season at the time of audit. Face validity was tested by circulating a draft of the audit tool to three experts for comment, after which the tool was amended slightly to clarify the definitions of some items. The final version was piloted in two schools.

A comprehensive user manual was developed to ensure consistency between auditors and schools. A full day training session was arranged for each auditor. At the start the background to the study, the reason for the audit, the audit tool and the manual were explained to each auditor. Each auditor then undertook a supervised audit at one of the schools, where the auditor and the supervisor completed an audit and the results were compared to ensure consistency. The final tool comprised 44-items which were used to record details of six components of the school grounds; 'walking provision', 'cycling provision', 'sports and play provision', 'other facility provision', 'design of the school grounds', and 'aesthetics'. Table 1 shows the individual items from the tool that were included in each component, with some items, such as the number of cycle racks, included in more than one component. The tool took on average 30 minutes to complete at each school.

The first four components of the tool focused on facility provision. Facilities were recorded if they were provided in the school grounds or, in the case of infrastructure such as bus stops, street cycle lanes, or pavements, if they were visible from one of the entrances to the school. When the presence or absence of facilities was recorded, note was taken of their quality using a three point scale. Facilities were marked as "good" quality if they were well maintained with no visible damage and clearly fit for purpose. An "adequate" rating was given if features showed some damage but this did not impair use. "Poor" ratings were given to facilities which were damaged to the extent that they were no longer useable or fit for purpose. Where more than one facility of each type was present then an average quality rating was assigned.

The 'design of the school grounds' component recorded those characteristics of the grounds that determined how suitable they were for three types of physical activity: sports, informal

games and general play. Sports were defined as activities which required facilities such as hoops, courts and pitches, while informal games were those that did not require facilities but did need a suitable location such as a hard or soft play area. General play was defined as the unstructured activities that children may typically engage in during break times. For each activity type, a three point scale was used to assess suitability. Grounds were classified as “very” suitable if they were particularly suited to the activity, and “somewhat” if the activity could be undertaken although the conditions were imperfect. The “not at all” rating was given when it would be very difficult to undertake the activity. Whether the school grounds were flat or sloped and if they were split across more than one site was also recorded by this component, as was the presence of dog dirt.

Nine items in the tool were used to define the ‘aesthetics’ component, including the presence or absence of trees, noise and litter. A three point scale was used to assess their abundance. Schools were classified as having “a lot” of each if there were enough to impact on the ‘feel’ of the grounds, while “some” was recorded when the items were present but not enough to impact on the ‘feel’. If no items were present this was recorded as “none”. The maintenance, seclusion and vandalism of the school grounds were measured in terms of agreement with a statement, using a five point Likert scale ranging from ‘strongly agree’ to ‘strongly disagree’.

The audit tool was completed over a six month period from February to July 2007, by a team of five trained auditors. In order to assess inter-rater reliability, repeat full audits were undertaken at 17 schools. Eleven schools were audited by two auditors; four schools were assessed by four auditors and the remaining two schools by all five auditors. Each repeat audit was undertaken independently, and as close in time to the original audit as practically possible.

Audit processing

The coding scheme developed for processing the audit was based on that employed by Hillsdon et al. (2006) from which the audit tool was derived. For the purposes of analysis, composite scores were derived by summing the values of individual items. For items where the presence or absence of an object was being measured, a binary 1/0 weighting was allocated whereby ‘1’ was used to signify presence, except where the variable was deemed to discourage activity (dog dirt, noise, litter, graffiti) in which case reverse coding was applied. For some items, such as the presence of trees for sitting under, a general quantity was recorded (‘none’, ‘some’, ‘a lot’) which was weighted ‘0’, ‘1’, ‘2’ respectively, with reverse coding again being applied in the case of likely activity detractors (e.g. litter). Where a count of the number of facilities was recorded, weightings were assigned relative to the mean number of facilities across the whole population of schools: if no items were recorded the weighting was zero, if the number of facilities counted was between one and the mean number of that facility plus one standard deviation the item was given a weighting of one, whilst if the number of facilities was greater a score of two was given. This method was employed as it was found to be effective in preventing large numbers of particular items, such as benches in the playground, from dominating scores. In order to measure suitability (e.g. for sport) a three point scale was used with ‘very’ being coded ‘2’ and ‘somewhat’ coded ‘1’ and ‘not at all’ zero. General views on the grounds were captured using a 5 point Likert scale indicating agreement with a statement, ranging from ‘5’ for ‘strongly agree’ to ‘1’ for ‘strongly disagree’. The specific coding adopted for each item is listed in Table 1. Each component was computed based on a sum of all the relevant individual weightings.

A ‘school physical activity suitability’ component was created which was the sum of all the items included in the ‘walking provision’, ‘cycling provision’, ‘sports and play provision’ and ‘design of the school grounds’ components. Thus it encompassed the items felt to most

directly impact on physical activity. To avoid replication, items which occurred in more than one component were only included once.

Physical activity measurement

Teams of two or more research assistants visited the schools during the Summer term of 2007 for data collection (van Sluijs et al., 2008). Children were handed an ActiGraph activity monitor (Actigraph LCC, USA) and instructed to wear it continuously for one week, except whilst sleeping and undertaking aquatic activities. Children were asked to record when and why they had removed the monitor. Activity data were stored at 5-second intervals. Upon collection, data were downloaded onto a computer and stored for batch analyses using a bespoke programme called Mahuffe (<http://www.mrc-epid.cam.ac.uk/Research/PA/Downloads.html>). The first day of data collection was disregarded and 10 minutes of continuous zero counts were classified as 'non worn time'. For the purpose of the present analyses, hourly data on time spent in moderate to vigorous intensity physical activity (MVPA) was derived using a threshold of 2000 cpm and above (Troost et al., 1998). The average number of minutes per day of MVPA undertaken by each child during lunchtime and the period of commuting to and from school was used as the physical activity measure in this study. Lunchtime was defined as the time between 12noon and 2pm on weekdays, while the commuting to and from school period was taken as 8am to 9am and 3pm to 4pm on weekdays. Only children who provided at least three full weekdays of valid data (at least 500 minutes of accelerometer data) were included in the analysis.

Reliability and validity testing

Inter-rater reliability of the audit tool was determined by the calculation of kappa statistics. Where there were more than two ordered responses, a quadratic weighted kappa was calculated (Sim and Wright, 2005, Roberts and Richmond, 1997). The level of agreement was categorised as poor (<0.00), slight (0.00-0.20), fair (0.21-0.40), moderate (0.41-0.60), substantial (0.61-0.80) or almost perfect (0.81-1) based on Landis and Koch (1977). As kappa is affected by the frequency of responses, being low when some responses are limited or binary (Chinn and Burney, 1987, Steinijans et al., 1997), percentage agreements were also calculated, which indicated the percentage of occasions that pairs of raters agreed on scores. Agreement above 66% was classed as fair or better, based on Portney and Watkins (2000). The STATA SE 8 (StataCorp LP, USA) package was used to calculate the inter-rater reliability statistics.

In order to measure construct validity of the audit component scores as a predictor of MVPA in the children, scores were divided into quintiles and independent samples T-tests were used to compare the MVPA levels of children in schools in the lowest quintiles with those in the highest using the SPSS 16.0 (SPSS Inc., USA) package. So that the outcomes studied were specific to the appropriate exposures, commuting time MVPA was tested with scores from the 'walking provision' and 'cycling provision' components, and scores from the 'sports and play provision', 'other facility provision', 'design of the school grounds' and 'aesthetics' components tested with lunchtime MVPA. The 'school physical activity suitability' component was tested with both combined.

Results

Tool reliability

Table 2 shows the inter-rater reliability measures for the tool. Six of the seven components had a mean percentage agreement of 90% or above, with just walking provision being lower at 76%, but still indicating better than fair agreement. The kappa scores were more varied, ranging from -0.67 to 1. Four of the components had an average kappa score above 0.41,

indicating moderate or greater agreement. The 'other facility provision' component showed fair agreement based on the kappa scores, while the 'design of school grounds' and 'aesthetics' components showed slight agreement, although the latter two components also had mean percentage agreements above 98%. In total 23 individual items had less than moderate kappa scores and less than fair percentage agreement between at least one pair of raters. These items are listed in Table 2.

Characteristics of the schools

Almost half of the schools audited were in completely urban areas, with just 16% recorded as having open fields, commons or parks around them. The remaining 33% were surrounded by a mix of residential buildings, business or retail buildings and open fields, commons or parks. The provision of facilities for private motor vehicles was high; only two schools did not have anywhere for parents to either stop or park their cars to drop their children off. All but five schools had pavements on at least some of the streets on which their entrances were situated. Marked pedestrian crossings were found near just four schools, but 25% had some kind of traffic calming to slow vehicles. Cycle parking provision was generally good with only 15% of schools having none.

The prevalence and quality of facilities for physical activity that were recorded in school playgrounds are listed in Table 3. A diverse range of facilities that the children could use for physical activity were noted, with almost all schools having at least some playground markings and painted courts. Three-quarters of schools had marked pitches and athletics tracks, while almost half had some form of playground equipment. In general, quality was good with average scores being 'adequate' or 'good'. School grounds included a substantial presence of vegetation, with 83% having planted beds and 87% having trees for the children to sit under. A wildlife garden was present in the grounds of 51% of schools, while 71% had some place for the children to garden in. As with physical activity facilities, general facilities were fit for purpose, with average quality scores being 'adequate' or 'good'. Maintenance standards were high; just 15% of schools had litter in the grounds, and there was no evidence of graffiti or vandalism at any school. Dog dirt was evident in just one school. In terms of school surroundings, 50% of the audits recorded some surrounding noise, although 76% of schools were also shielded from their neighbouring environment by hedges, trees or fences.

Tool validity: associations with physical activity

Altogether, 1868 children provided valid physical activity data. Across the 92 schools the mean time spent in MVPA during the school commuting period (8am to 9am and 3pm to 4pm) was 15.29 minutes per day (SE 0.16). Boys were more active than girls in this period, with a mean MVPA of 16.46 minutes per day (SE 0.25) versus 14.36 minutes per day (SE 0.21) for girls ($p < 0.001$). During the lunchtime period (12pm to 2pm) the mean time in MVPA was 14.60 minutes per day (SE 0.14), with boys again being significantly more active (17.84 minutes per day (SE 0.21) versus 12.00 minutes per day (SE 0.13), $p < 0.001$).

Scores for certain components of the audit tool were associated with physical activity levels of the children (Table 4). For the components measuring walking and cycling provision, the schools which fell into the highest quintile of each set of scores (those with the best provision) had the most active children, and a significantly higher mean MVPA during the commuting period than the schools with the lowest level of provision. The association was similar for boys and girls. The component measuring the sports and play provision of the schools was also associated with lunchtime MVPA and, although after stratification this was only statistically significant for boys, the effect size in girls was similar. Girls attending schools in the lowest quintile of the 'design of the school grounds' component had a

significantly lower mean lunchtime MVPA time than those in the highest. For boys the difference was in the opposite direction to that expected, although it was not statistically significant. For the 'school physical activity suitability' component, the lowest quintile of schools had the lowest mean time spent in MVPA during the commuting and lunchtime periods combined for both boys and girls. However these were not significantly different from those in the highest quintile.

Discussion

To our knowledge this is the first study to develop and test a tool for auditing the supportiveness of school surroundings for physical activity amongst children. The tool was straightforward to complete, with the audits taking less than 30mins on average to carry out (data not shown). The audit tool had reasonable inter-rater reliability, with similar scores to those of others (e.g. Pikora et al., 2002), and construct validity. It was possible to differentiate the physical activity levels of children at different schools using component scores from the tool. Many of the schools had features that are generally considered to encourage physical activity. All of the school grounds were reported as being suitable for formal and informal play and the majority were shown to be well maintained and have a naturalistic feel, which may also encourage children to make use of them (McCormack et al., 2004, Ellaway et al., 2005). Nevertheless, despite the generally good standards recorded, the audit tool was able to discriminate MVPA levels in the children attending the schools falling in the highest and lowest quintiles for some of the components. The different results for boys and girls serves to emphasise that factors promoting physical activity may differ by gender.

A number of individual items in the tool showed some differences between the five auditors; however no one auditor was consistently an outlier. Where differences were present, they may reflect an element of subjectivity associated with some of the classifications (such as the measures of suitability). Pikora et al. (2002) also found the lowest agreement for measures which were the most subjective, a finding that emphasises the need for a clear instruction manual for auditors. Future updates to the definitions provided in our manual may go some way to reducing this subjectivity. We also recorded poorer levels of agreement of the level of provision of some features such as wall games, playground equipment and pitches. This may reflect the fact that it was sometimes difficult to determine the number of individual items due, for example, to the overlapping nature of markings or the close proximity of units of playground equipment.

There was little variability in some of the items recorded by the tool, suggesting that they could possibly be omitted in future audits. In particular we found only one school with dog dirt and none with graffiti. Standards of maintenance of facilities were almost always good, suggesting that they also may not need to be assessed, although these features may exhibit greater variability in other settings, for example in inner-city locations.

Our study has a number of strengths and weaknesses. The sample of schools and children is large, and the environments in which the schools were situated were varied. The audit tool was specifically developed to be used in the school environment. It was rigorously designed and tested and has been shown to have a good level of specificity against which physical activity behaviours can be compared. Further refinement of the simple weighting of scores may enhance the validity of the tool. A further strength of the study is the availability of objectively measured physical activity data for almost 2000 children attending the schools.

Limitations include the fact that measurement was undertaken during the summer, it may be that associations between school characteristics and children's MVPA differ by season. For

example, the lighter evenings during summertime present children with additional opportunities to be active outside school, and this may lessen the importance of the facilities provided at school. The audit tool was only able to record the presence of fixed or permanent outdoor facilities, so the presence of sports equipment such as storable goals or footballs was not recorded. Furthermore, the presence of equipment did not necessarily mean it was always available for the pupils to use. The cross sectional nature of the data we collected limits our ability to determine causality and determine the direction of association. We cannot exclude the possibility that schools with more active children provide more facilities for activity, rather than the presence of facilities encouraging children to be active. However, evidence from recent controlled interventions (e.g Loucaides et al., 2009) suggests that modifying the environment of the school playground is associated with increases in physical activity participation amongst pupils. Furthermore, the associations we detected were specific to the times of day we studied; whilst we also tested the relationship between travel time MVPA and the non-walking and cycling components of the school grounds, we found no associations (results not presented). Similarly lunchtime MVPA was not associated with walking or cycling facility provision. It is hence reassuring that the associations detected matched the times of day during which the facilities concerned would be expected to be used.

Due to resource constraints we were only able to undertake repeat audits in 17 schools. Whilst it would have been desirable to undertake repeats at a larger sample of schools, we note that our reliability testing generally showed good agreement, and a larger sample may not have provided a different conclusion. The calculation of kappa statistics to measure reliability was problematic due to the many binary measurements of the tool (Chinn and Burney, 1987, Steijnijans et al., 1997). In order to overcome this, percentage agreements were also calculated, and were generally high. The majority of schools studied were found to have good facility provision, and thus the ability of the tool to discriminate between the most and least supportive schools on each component in this study may be less than if the sample was more varied. Although we measured quality of facilities as well as levels of provision we found very few cases of poor quality and hence did not include quality considerations in our component scores. As the schools had prior awareness of the audit, it is possible that some work had been undertaken to improve the grounds prior to the day of each audit, although we have no reason to believe this did occur. We attempted to avoid subjectivity in our computation of weightings for component scores, but inevitably different weightings could have been selected. Although a weighting scheme based simply on the number of facilities recorded appears intuitively attractive, this would place undue weight on features which are often present in large numbers, such as benches or playground markings. Furthermore, although the tool was designed to be transferrable, we have only tested it amongst a sample of primary schools in the county of Norfolk, an area which does not contain any major urban conurbations. Its applicability to other school types, such as secondary schools, or other areas is as yet untested.

We have developed a suitable tool for auditing school environments for physical activity. The tool had acceptable levels of reliability and was found to differentiate schools according to children's MVPA. Further work is needed to quantify its association with children's physical activity amongst other potential influences and in more varied settings.

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Table 1

Components of the school audit tool

Component	Items	Measure(s)	Response options for measure 1	Response options for measure 2
Cycling provision^a	Cycle lanes	1. Visible from school entrance	Yes/No	n.a.
	Pavements	1. Visible from school entrance	Yes/No	n.a.
	Marked pedestrian crossings	1. Visible from school entrance	Yes/No	n.a.
	Traffic calming	1. Visible from school entrance	Yes/No	n.a.
	School warning signs for road users	1. Visible from school entrance	Yes/No	n.a.
	Road safety signs	1. Visible from school entrance	Yes/No	n.a.
	Route signs for cyclists	1. Visible from school entrance	Yes/No	n.a.
	Cycle parking	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor
Walking provision^a	Pavements	1. Visible from school entrance	Yes/No	n.a.
	Marked pedestrian crossings	1. Visible from school entrance	Yes/No	n.a.
	Traffic calming	1. Visible from school entrance	Yes/No	n.a.
	School warning signs for road users	1. Visible from school entrance	Yes/No	n.a.
	Road safety signs	1. Visible from school entrance	Yes/No	n.a.
Sports and play facility provision^a	Bright markings on play surfaces	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor
	Playground equipment	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor
	Pitches	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor
	Athletics tracks	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor
	Courts	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor
	Cycle parking	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor
	Assault (obstacle) courses	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor
	Other sport and play facilities	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor
	Hard surface playgrounds	1. Presence	Yes/No	n.a.
Other facility provision	Benches	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor
	Picnic tables	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor
	Drinking fountains	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor
	Wildlife gardens	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor

Component	Items	Measure(s)	Response options for measure 1	Response options for measure 2
Design of school grounds^a	Quadrangles (courtyards)	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor
	Other facilities	1. Quantity provided, 2. Quality of item	Number ^b	Good, adequate, poor
	School grounds on a split site	1. Presence	Yes/No	n.a.
	Sloped school grounds	1. Presence	Yes/No	n.a.
	Suitability for sport	1. Suitability	Very, somewhat, not at all	n.a.
	Suitability for informal games	1. Suitability	Very, somewhat, not at all	n.a.
	Suitability for general play	1. Suitability	Very, somewhat, not at all	n.a.
Aesthetics	Hard surface playgrounds	1. Presence	Yes/No	n.a.
	Presence of dog dirt (faeces)	1. Presence	Yes/No	n.a.
	Planted beds	1. Presence	None, some, a lot	n.a.
	Trees	1. Presence	None, some, a lot	n.a.
	Ambient noise	1. Presence	None, some, a lot	n.a.
	Litter	1. Presence	None, some, a lot	n.a.
	Murals / outdoor art	1. Presence	None, some, a lot	n.a.
	Graffiti	1. Presence	None, some, a lot	n.a.
	Grounds shielded from surrounding area	1. Agreement	Strongly agree, agree, neither, disagree, strongly disagree	n.a.
	Grounds well maintained	1. Agreement	Strongly agree, agree, neither, disagree, strongly disagree	n.a.
	Grounds free from vandalism	1. Agreement	Strongly agree, agree, neither, disagree, strongly disagree	n.a.

n.a. = not applicable.

^a = included in the 'school physical activity suitability' component (repeated measures only included once).

^b = the number of items recorded was grouped into three categories based on the mean and standard deviation. The three categories were: none, between one and the mean plus one standard deviation, and greater than the mean plus one standard deviation.

Table 2

Measures of audit tool inter-rater reliability

Name of component	Number of items in component	Overall component percentage agreement between pairs of auditors		Overall component kappa score for pairs of auditors		Individual items within component with less than moderate kappa (<0.41) and less than fair percentage agreement (<66%)
		Range	Mean	Range	Mean	
Walking provision	5	50.00 - 97.22	76.22	0 – 0.88	0.41	Presence of school warning signs for road users.
Cycling provision	9	87.5 - 98.15	94.99	0 – 0.90	0.57	Presence of school warning signs for road users.
Sports and play facility provision	16	94.44 - 99.18	98.15	0.24 – 0.89	0.72	The number of athletics tracks, wall games, playground equipment, willow tunnels, assault courses, pitches and other play equipment.
Other facility provision	8	84.37 - 97.92	92.71	–0.33 – 0.82	0.36	The number of wildlife gardens, attractive seats, amphitheatres, gardens and quadrants.
Design of the school grounds	6	96.30 –99.38	98.06	–0.22 – 0.56	0.07	Suitability for informal games, play and sport
Aesthetics	9	97.51 - 99.73	98.83	–0.67 – 0.62	0.20	Presence of planted beds, trees, litter and murals. The extent of shielding, maintenance and vandalism.Presence of school warning signs for road users.
School physical activity score	29	97.88 - 99.59	98.88	0 – 0.86	0.48	The number of athletics tracks, wall games, playground equipment, willow tunnels, assault courses, pitches and other play equipment. Suitability for informal games, play and sport

Table 3

Prevalence and quality of physical activity facilities in school grounds

	Mean number	Percentage of schools with none	Mean number excluding schools with none	Modal Quality
<i>Activity facilities</i>				
Courts	3.10	4.3	3.24	adequate
Bright markings on play surfaces	7.21	7.6	7.80	adequate
Cycle parking (number of bike spaces)	20.27	15.2	23.91	good
Pitches	1.64	25	2.19	adequate
Athletics tracks	0.88	26.1	1.19	good
Assault courses	0.76	34.8	1.17	good
Playground equipment	1.26	53.3	2.70	good
Wall games	1.04	75	4.17	good
Willow tunnels	0.23	79.3	1.11	good
Long jumps	0.21	80.4	1.06	adequate
Climbing walls	0.11	90.2	1.11	good
Hoops and nets	0.16	90.2	1.67	adequate
Swimming pools	0.07	93.5	1.00	good
Sand pits	0.08	94.6	1.40	good
Play equipment	0.10	96.7	3.00	adequate

Table 4

Associations between commuting and lunchtime mean daily MVPA and audit tool score quintiles

		Commuting time (8am – 9am & 3pm – 4pm)					
		Overall		Boys		Girls	
		Mean time spent in MVPA (mins) (SE)	p-value	Mean time spent in MVPA (mins) (SE)	p-value	Mean time spent in MVPA (mins) (SE)	p-value
Walking provision	Lowest quintile	14.70 (0.47)	<0.001	15.13 (0.59)	<0.001	14.24 (0.74)	0.004
	Highest quintile	19.29 (0.75)		21.28 (1.21)		17.73 (0.92)	
Cycling provision	Lowest quintile	14.11 (0.42)	<0.001	15.26 (0.60)	<0.001	13.09 (0.57)	<0.001
	Highest quintile	17.57 (0.34)		19.05 (0.56)		16.57 (0.42)	
		Lunchtime (12am – 2pm)					
		Overall		Boys		Girls	
		Mean time spent in MVPA (mins) (SE)	p-value	Mean time spent in MVPA (mins) (SE)	p-value	Mean time spent in MVPA (mins) (SE)	p-value
Sports and play facility provision	Lowest quintile	13.11 (0.39)	0.034	15.38 (0.62)	0.016	10.88 (0.38)	0.110
	Highest quintile	14.15 (0.31)		17.26 (0.46)		11.64 (0.30)	
Other facility provision	Lowest quintile	14.54 (0.27)	0.629	17.40 (0.44)	0.135	12.02 (0.24)	0.926
	Highest quintile	14.72 (0.26)		18.27 (0.38)		11.99 (0.26)	
Design of the school grounds	Lowest quintile	14.01 (0.30)	0.093	17.73 (0.46)	0.439	11.38 (0.28)	0.001
	Highest quintile	14.63 (0.22)		17.27 (0.35)		12.60 (0.23)	
Aesthetics	Lowest quintile	14.47 (0.29)	0.522	18.12 (0.48)	0.305	11.97 (0.26)	0.585
	Highest quintile	14.19 (0.33)		17.35 (0.57)		11.75 (0.31)	
		Commuting time and lunchtime combined					
		Overall		Boys		Girls	
		Mean time spent in MVPA (mins) (SE)	p-value	Mean time spent in MVPA (mins) (SE)	p-value	Mean time spent in MVPA (mins) (SE)	p-value
School physical activity suitability	Lowest quintile	29.32 (0.49)	0.818	32.88 (0.69)	0.265	25.72 (0.63)	0.658
	Highest quintile	29.48 (0.47)		33.99 (0.72)		26.08 (0.52)	

SE = Standard error