

Physical activity and the environment

Evidence Update April 2014

A summary of selected new evidence relevant to NICE public health guidance 8 'Physical activity and the environment' (2008)

Evidence Update 57



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Introduction

Evidence Updates are intended to increase awareness of new evidence – they do not replace current NICE guidance and do not provide formal practice recommendations.

Evidence Updates reduce the need for individuals, managers and commissioners to search for new evidence. For contextual information, this Evidence Update should be read in conjunction with the relevant public health guidance, available from the [NICE Evidence Services](#) topic page for [physical activity](#).

This Evidence Update provides a summary of selected new evidence published since the literature search was last conducted for the following NICE guidance:

- ¹[Physical activity and the environment](#). NICE public health guidance 8 (2008)

A search was conducted for new evidence from 1 July 2006 to 31 October 2013. A total of 6689 pieces of evidence were initially identified. After removal of duplicates, a series of automated and manual sifts were conducted to produce a list of the most relevant references. The remaining 32 references underwent a rapid critical appraisal process and then were reviewed by an [Evidence Update Advisory Group](#), which advised on the final list of 10 items selected for the Evidence Update. See [Appendix A](#) for details of the evidence search and selection process.

Evidence selected for inclusion in this Evidence Update may highlight a potential impact on guidance: that is, a high-quality study, systematic review or meta-analysis with results that suggest a change in practice. Evidence that has no impact on guidance may be a key read, or may substantially strengthen the evidence base underpinning a recommendation in the NICE guidance.

The Evidence Update gives a preliminary assessment of changes in the evidence base and a final decision on whether the guidance should be updated will be made by NICE according to its published processes and methods.

This Evidence Update was developed to help inform the review proposal on whether or not to update NICE public health guidance 8 ([NICE PH8](#)). For further information about the review decision see the [NICE PH8](#) webpage. The process of updating NICE guidance is separate from both the process of an Evidence Update and the review proposal.

See the NICE public health process guide for further information about [updating public health guidelines](#).

Other relevant NICE guidance

The focus of the Evidence Update is on the guidance stated above. However, overlap with other NICE guidance has been outlined as part of the Evidence Update process. Where relevant, this Evidence Update therefore makes reference to the following guidance:

- ²  [Walking and cycling](#). NICE public health guidance 41 (2012)
- ¹[Promoting physical activity for children and young people](#). NICE public health guidance 17 (2009)

¹ Guidance published prior to NICE accreditation

² [NICE-accredited guidance](#)

NICE Pathways

NICE pathways bring together all related NICE guidance and associated products in a set of interactive topic-based diagrams. The following NICE Pathways cover advice and recommendations related to this Evidence Update:

- [Physical activity](#). NICE Pathway
- [Walking and cycling](#). NICE Pathway

Feedback

If you would like to comment on this Evidence Update, please email contactus@evidence.nhs.uk

Key points

The following table summarises the key points for this Evidence Update and indicates whether the new evidence may have a potential impact on [NICE PH8](#). Please see the full commentaries for details of the evidence informing these key points.

The section headings used in the table below are taken from [NICE PH8](#).

Evidence Updates do not replace current NICE guidance and do not provide formal practice recommendations.

Key point	Potential impact on guidance	
	Yes	No
Strategies, policies and plans <ul style="list-style-type: none"> Implementing community design policies, aimed at creating 'liveable' developments that promote physical activity, results in environments more supportive of walking. Additionally, the degree of compliance with these policies (not just the intention to create liveable developments) appears to be associated with increased levels of walking for transport purposes – although walking for recreation does not appear to increase. 	✓*	
Public open spaces <ul style="list-style-type: none"> Improving the features and amenities of a community park may lead to increased use and physical activity. Upgrading and maintaining community playgrounds could increase levels of physical activity among local school children, but the effect may be restricted to those with a lower BMI. 	✓*	✓
Schools <ul style="list-style-type: none"> Upgrading, renovating and maintaining school playgrounds appear to increase levels of physical activity. Providing equipment and playground markings may help to encourage physical activity, but on their own may not bring about long-term changes in children's activity levels. A greater number and variety of play facilities (such as a mixture of play equipment, different play zones, and shaded areas) and environmental features (such as landscaping and vegetation) may further contribute to raising levels of playground use and physical activity. 	✓*	

* Evidence Updates are intended to increase awareness of new evidence and do not change the recommended practice as set out in current guidance. Decisions on how the new evidence may impact guidance will not be possible until the guidance is reviewed by NICE following its published processes and methods. For further details of this evidence in the context of current guidance, please see the full commentary.

1 Commentary on new evidence

These commentaries focus on the 'key references' identified through the search process and prioritised by the EUAG for inclusion in the Evidence Update, which are shown in bold text. Supporting references provide context or additional information to the commentary. Section headings are taken from [NICE PH8](#).

Strategies, policies and plans

Community design policy

NICE public health guidance 8 ([NICE PH8](#)) recommends:

- Ensuring planning applications for new developments always prioritise the need for people (including those whose mobility is impaired) to be physically active as a routine part of their daily life.
- Ensuring local facilities and services are easily accessible on foot, by bicycle and by other modes of transport involving physical activity.
- Assessing in advance what impact (both intended and unintended) the proposals are likely to have on physical activity levels. (For example, will local services be accessible on foot, by bicycle or by people whose mobility is impaired?)

In addition, 'Walking and cycling' ([NICE PH41](#)) recommends:

- Ensuring local, high-level strategic policies and plans support and encourage both walking and cycling. Relevant policies and plans include those on:
 - housing
 - land use, planning and development control.

The Residential Environments project (RESIDE) is a longitudinal natural experiment in Western Australia to assess the impact of a state government community design policy to encourage physical activity ('Liveable Neighbourhoods'). It included 1813 people building homes in 73 new housing developments of 3 different types (liveable developments, conventional developments, or hybrid developments).

Liveable Neighbourhoods guidelines cover 4 design elements:

- community design (such as mixed-use planning and different sized lots)
- movement network (such as interconnected street networks, access to public transport, and traffic calming)
- public parkland (such as the balance between parks and larger playing fields)
- lot layout (such as increased densities around public transportation and activity centres).

Two studies recently assessed data arising from the RESIDE project.

A study by [Christian et al. \(2013\)](#) examined whether people who moved to housing developments designed according to Liveable Neighbourhoods guidelines did more walking after relocation than people who moved to other development types. The study included a subset of 1047 people from RESIDE moving to one of the 3 development types (liveable, n=299; conventional, n=528; hybrid, n=220). Participants completed 3 questionnaires: before moving, and then 12 and 36 months after moving. Time spent walking was self-reported using the Neighbourhood Physical Activity Questionnaire, and perceptions of the environment were gauged using the Neighbourhood Environment and Walking Scale. Researchers additionally made objective measures of the built environment using a geographic information system. Analysis of walking time was based on a linear model adjusted for several factors including

age, gender, education, marital status, children at home, baseline walking level, and self-selection factors for choice of new neighbourhood.

At 36 months, there were no significant differences in mean total time spent walking per week between those who moved to liveable developments (121 minutes/week) and those who moved to a conventional development (112 minutes/week, $p=0.449$). The mean time spent walking per week significantly increased by 18 minutes from baseline to 36 months across all participants ($p\leq 0.001$). This was driven mainly by an increase in walking among those moving to liveable developments (+27 minutes/week, $p\leq 0.001$); the change in time spent walking among those moving to conventional developments was not significant.

Some significant differences between development types were noted based on objective measures of the environment. People moving to liveable developments had: greater access to a range of services, a range of convenience goods, different types of public open space, and public transport stops; better street connectivity; higher residential density; and greater land use mix than those who moved to conventional developments (all $p<0.001$). Based on the perceptions questionnaire, those moving to liveable developments had better infrastructure and safety for walking, footpaths present on both sides of the road, improved access to mixed-use services and to transport, retail and recreation destinations (all $p<0.001$), and improved neighbourhood aesthetics ($p=0.008$).

A second study also using data from RESIDE by [Hooper et al. \(2014\)](#) assessed compliance with and implementation of the Liveable Neighbourhoods guideline and the impact on walking behaviours. Participants ($n=594$) who had lived in their current location for at least 2 years were selected from 36 housing developments (19 liveable, 17 conventional). From the Liveable Neighbourhoods guidelines, 43 policy requirements were selected for analysis that were relevant to walking behaviour, the implementation of which could be objectively measured using geographic information systems. Walking behaviours were self-reported using the Neighbourhood Physical Activity Questionnaire. Logistic regression was used to assess the likelihood of walking (for transport or recreation) associated with policy compliance. Adjustments were made for demographic variables, stage of construction, size of development, and self-selection (that is, preferences for particular features of liveable developments).

Based on objective geographic assessment, overall compliance with the Liveable Neighbourhoods guidelines ranged from 30–55% (average 47%) in liveable developments and 27–53% (average 45%) in conventional developments. The only significant difference in compliance between the 2 development types was for lot layout (58% in liveable versus 44% in conventional developments, p value not stated).

Likelihood of any walking for transport purposes increased with compliance with the following design elements of the guidelines:

- Overall policy (OR=1.53, 95% CI 1.13 to 2.08, $p=0.007$).
- Community design (OR=1.27, 95% CI 1.13 to 1.42, $p<0.001$).
- Movement network (OR=2.49, 95% CI 1.38 to 4.50, $p=0.003$).
- Lot layout (OR=1.26, 95% CI 1.06 to 1.50, $p=0.010$).

No significant differences were observed with any recreational walking outcomes.

Limitations common to both studies included that:

- The Australian setting (particularly in terms of car use, distances people travel, and climate) and the nature of the studies (new homebuyers moving into, or those living in, urban fringe greenfield developments) may not be fully generalisable to the UK. However, the principles of the Liveable Neighbourhoods guidelines are similar to those set out in [UK local government policy](#) relating to 'eco-towns'.

- Measures of walking time relied solely on self-reporting, which may introduce bias.
- The studies did not randomise participants (although this would be difficult for evaluation of built environment interventions).
- Longer term follow-up may be needed to allow enough time for all features of Liveable Neighbourhoods to be implemented (for example, it was noted that not all developments were fully complete).

The evidence from these studies suggests that implementing community design policies, aimed at creating 'liveable' developments that promote physical activity, results in environments more supportive of walking. Additionally, the degree of compliance with these policies (not just the intention to create liveable developments) appears to be associated with increased levels of walking for transport purposes – although walking for recreation does not appear to increase. These data are largely consistent with recommendations in [NICE PH8](#) and [NICE PH41](#) to ensure policy and planning applications for new developments prioritise the need for people to be physically active as a routine part of their daily life. However, the evidence also identifies the importance of assessing compliance with and implementation of community design policies, which is not explicitly discussed in current guidance. These data may therefore have a potential impact on the guidance. The details of any impact are outside the scope of the Evidence Update. Decisions on how the new evidence may impact guidance will not be possible until the guidance is reviewed by NICE following its published processes and methods.

Additionally, this evidence addresses some of the questions posed in the [NICE research recommendation](#) (particularly in examining the impact of changes to the physical environment brought about by urban planning initiatives), but further research to identify more specific aspects of policy that influence physical activity would still be useful. It should also be noted that the evidence from the RESIDE studies is based on 3 years of follow-up. Further work examining new planning policies may benefit from a longer follow-up to allow time for the features and facilities of new neighbourhoods to fully develop. Researchers may also find the methodology employed in Hooper et al. 2014 to measure compliance with planning policy useful in informing future work.

Key references

Christian H, Knuiman M, Bull F et al. (2013) [A new urban planning code's impact on walking: the residential environments project](#). *American Journal of Public Health* 103: 1219–28

Hooper P, Giles-Corti B, Knuiman M (2014) [Evaluating the implementation and active living impacts of a state government planning policy designed to create walkable neighborhoods in Perth, Western Australia](#). *American Journal of Health Promotion* 28 (supplement 3): S5–S18

Supporting reference

Department for Communities and Local Government (2009) [Planning Policy Statement: eco-towns - A supplement to Planning Policy Statement 1](#)

Transport

No new key evidence for this section was selected for inclusion in this Evidence Update.

Public open spaces

[NICE PH8](#) recommends:

- Ensuring public open spaces and public paths are maintained to a high standard. They should be safe, attractive and welcoming to everyone.

Improving community parks

A before-and-after natural experiment in Australia by [Veitch et al. \(2012\)](#) looked at whether improvements to a community park increased attendance and physical activity at the park. The refurbished park (area=25,500 m²) was initially an open space with few amenities. Refurbishments included a leash-free dog area, playground, walking track, barbecue area, landscaping, and fences to prevent access by motor vehicles. Another park (area=10,000 m²) in the same neighbourhood with similar baseline features was selected as a control. A modified version of the observational tool SOPARC (System for Observing Play and Recreation in Communities) was used to characterise park users, and to classify their activity (sedentary, walking, or vigorous). Scans were performed of the whole park every 15 minutes during 3 periods (morning, midday, and afternoon) lasting 1.5 hours each. Data collection was performed on 5 weekdays and 4 weekend days over a 4-week period. Measurements were taken at baseline, then following the refurbishment, and finally at 12 months. Two-way analyses of variance (ANOVA) were used to examine the effect of the park refurbishment over time on numbers of people using the park, and the nature of their activity.

In the refurbished park, significant increases were seen in:

- Total number of park users (baseline n=235, 12 months n=985, p<0.0005).
- Number of people walking (baseline n=155, 12 months n=369, p<0.0005).
- Number of people being vigorously active (baseline n=38, 12 months n=257, p=0.008).

At the control park, number of users decreased over the same period (baseline n=83, 12 months n=51), and no differences in walking or vigorous activity were seen. The decline in numbers at the control park was not sufficient to account for the increased numbers in the refurbished park.

Limitations of the evidence included that:

- The study examined only 1 intervention and 1 control park, which may limit transferability of results.
- Whether the increase in use of the refurbished park was because of more frequent visits by existing users, or whether new users were visiting the park after refurbishment, could not be established.
- The control park was more than 50% smaller than the refurbished park, which may have influenced results (although the authors stated that adjustment for park size did not alter findings).
- Observers recorded activity and usage data for the whole park and were therefore unable to attribute effects to any particular aspect of the park refurbishment.

The evidence suggests that improving the features and amenities of a community park may lead to increased use and physical activity. These data strengthen the recommendations in [NICE PH8](#) to ensure that public open spaces and paths are maintained to a high standard, and should be safe, attractive and welcoming to everyone.

Key reference

[Veitch J, Ball K, Crawford D et al. \(2012\) *Park improvements and park activity: a natural experiment*. American Journal of Preventive Medicine 42: 616–19](#)

Upgrading community playgrounds

A before-and-after natural experiment in New Zealand by [Quigg et al. \(2012\)](#) assessed the effect of upgrading community playgrounds on the physical activity of 184 local elementary school children aged 5–10 years (mean age ~8 years). In the intervention community, playground upgrades were conceived and managed by the local authority with no influence from the research team. Upgrades included installation of new play equipment, seating, safety surfacing, and waste facilities, and removal or modification of existing equipment. Another

community, physically separated from the intervention community, was selected as a control based on its similarity according to several criteria (including socioeconomic indicators, number and size of schools in the area, and state of existing playgrounds). Four schools in each of the intervention and control communities participated in the study. Two public playgrounds were selected for upgrading from the six playgrounds in the intervention community.

Accelerometry data were recorded at baseline (before the upgrades) and after 1 year. Accelerometers were worn for 8 days, enabling up to 6 days of data to be analysed. Height and weight were measured by research assistants and converted to BMI z-scores (standardised for age and sex). The primary outcome measure was mean total daily physical activity based on total daily accelerometer counts. The effect of the playground upgrades was assessed using a linear mixed model (controlling for confounders such as age, mode of travel to school, sex and ethnicity).

From the adjusted model, playground upgrades were associated with significant changes in mean total daily physical activity depending on BMI z-score ($p=0.006$). Compared with the control community, in the community where playgrounds were upgraded, higher levels of activity were seen among children with BMI z-scores less than 0.4, but lower levels of activity for children with BMI z-scores greater than 0.4. There was no evidence of an effect of the playground upgrades for BMI z-scores typical of children in the study (around 0.7).

Limitations of the evidence included that:

- As a natural experiment, participants were not randomised to intervention or control groups, and differences between communities or participants may have affected results.
- The length of time accelerometers were worn for during baseline and post-intervention measurement periods was not reported and could have influenced amount of activity recorded.
- Study compliance was rewarded with swimming and play equipment, which may have encouraged greater participation among the more active children and families.
- The small numbers of participants meant few subgroup analyses could be done.

The evidence suggests that upgrading and maintaining community playgrounds could increase levels of physical activity among local school children, but the effect may be restricted to those with a lower BMI. [NICE PH8](#) currently recommends that public open spaces in general should be maintained to a high standard, but does not specifically discuss maintenance of public playgrounds (or school playgrounds that are open to the public). These data may therefore have a potential impact on the guidance. The details of any impact are outside the scope of the Evidence Update. Decisions on how the new evidence may impact guidance will not be possible until the guidance is reviewed by NICE following its published processes and methods.

More work may also be needed to examine reasons behind the differential effects of playground upgrades on children with lower and higher BMIs.

Key reference

Quigg R, Reeder AI, Gray A et al. (2012) [The effectiveness of a community playground intervention](#). *Journal of Urban Health* 89: 171–84 [[NIH Public Access author manuscript – full text](#)]

Buildings

No new key evidence for this section was selected for inclusion in this Evidence Update.

[Schools](#)

School playgrounds

[NICE PH8](#) recommends:

- Ensuring school playgrounds are designed to encourage varied, physically active play.
- Primary schools should create areas (for instance, by using different colours) to promote individual and group physical activities such as hopscotch and other games.

In addition, 'Promoting physical activity for children and young people' ([NICE PH17](#)) recommends:

- Ensuring the spaces and facilities used for physical activity meet recommended safety standards for design, installation and maintenance. For example, outdoor play areas should have areas of shade and shelter.
- Providing children with access to environments that stimulate their need to explore and which safely challenge them. (Examples include adventure playgrounds, parks, woodland, common land or fun trails.) Also providing them with the necessary equipment.
- Keeping children motivated to be physically active by updating and varying the way physical activities are delivered (including the resources and environments used).

Six studies recently examined school playground interventions aimed at increasing levels of physical activity.

A quasi-experimental study in the USA by [Brink et al. \(2010\)](#) examined the effect of schoolyard renovation on physical activity among children. The study included 6 elementary schools with yards that had been renovated as part of the Learning Landscapes program (3 yards were established for >2 years, and 3 were built within the past year), and 3 control schools (n=1185 students in total). The Learning Landscapes program was a public-private partnership to upgrade neglected schoolyards. Common elements included age-appropriate play equipment, hard surfaces for ball games, a playing field, a central space with shade, and landscaped areas. Parents, children, community members and school staff helped with design, fundraising and construction. The validated direct observation tool SOPLAY (System for Observing Play and Leisure Activity in Youth) was used to measure physical activity before, during, and after school hours. Each school was observed for 4 days during each period of data collection, and to ensure objectivity, observers were not part of the research team. Physical activity (validated by heart rate and accelerometry data) was categorised as sedentary or active.

The percentage of all students observed who were classified as active was similar across all types of schoolyard: established renovations (66.1%), recent renovations (65.4%), and control schoolyards (64.5%). A significantly increased activity level in renovated versus control schoolyards was observed among boys ($p<0.005$ for established renovations, $p<0.002$ for recent renovations); however for girls, there appeared to be significantly more active girls in control schoolyards than recently renovated yards ($p<0.002$). The mean number of total active observations was greater in schoolyards with both established (3.60) and recent renovations (3.42) versus control schoolyards (2.70, $p<0.001$). This difference was significant for both boys and girls.

Differences were also seen in activity levels across different areas of the playground. In renovated yards, the percentage of students classified as active was greater than in control yards for hard surface unstructured areas (such as social gathering areas: 58.7% versus 52.2%, $p<0.003$) and soft surface structured areas (such as play equipment with fall zones: 71.2% versus 67.9% $p<0.003$). But no significant difference in activity levels was seen between renovated and control schoolyards in hard surface structured areas (such as those with basketball markings).

Limitations of the evidence included that:

- The timing and funding of new Learning Landscapes schoolyards meant that a randomised study was not possible.
- The renovated schoolyards varied in size and in the number and types of play features installed.
- Only 1 observational measure was used, and individual movements of children were not tracked.
- Only 9 schoolyards (of varying size and features) were included, and demographics were not controlled for.

A cluster randomised control trial in Belgium by [Cardon et al. \(2009\)](#) investigated the effect of providing play equipment and playground markings on physical activity level in 40 public preschools (n=583 children, mean age=5.3 years). Schools were randomised to: provision of play equipment (10 schools); applying painted markings to the playground (10 schools); play equipment plus painted markings (10 schools); or control (10 schools). Physical activity levels during the post-lunch break were assessed (in a random selection of 12 to 20 children per school) by accelerometer at baseline and at 4 to 6 weeks after the intervention. Activity levels were classified as sedentary, light, moderate, or vigorous.

At baseline, across all children, percentage of break time spent in each activity bracket was:

- moderate to vigorous activity: 11.2% (average=4.7 minutes)
- light activity: 25.6% (average=10.7 minutes)
- sedentary activity: 61.3% (average=25.7 minutes).

After 4 to 6 weeks, none of the interventions had led to a significant change in average activity level, or percentage engagement in any particular activity level.

Limitations of the evidence included that:

- The study was among young children and may not be generalisable to older primary school children.
- All children, not just those who were randomly selected to provide accelerometer measurements, had access to the play equipment and markings – and providing enough equipment for every child was not feasible.
- Physical activity levels were only measured during 1 school break. The overall physical activity of children, including their activity levels out of school, was not taken into account by the study.

A study in the USA by [Colabianchi et al. \(2011\)](#) assessed whether specific features of school playgrounds affected use of and physical activity levels on the playground outside of school hours. Using the Environmental Assessment of Public Recreation Spaces tool, information was collected on the attributes of 20 playgrounds (10 of which were renovated). A validated tool (SOPLAY) was then used to observe adults and children attending each schoolyard and their physical activity levels. Data were recorded in 10 sessions of 90 minutes each. The effect of playground attributes was measured by clustered multivariable negative binomial regressions for use of the schoolyard, and by linear regressions for the proportion active on the playground. In analysing effects of individual playground attributes, other significant playground, school and neighbourhood attributes were also controlled for.

Across all playgrounds, the mean number of unique types of play equipment (scored out of 10) was 5.2, and the mean number of total play features was 30.4. At each data collection period, a mean of 2.5 persons were observed (0.4 adults, 0.9 girls, 1.2 boys) with 52% of those observed being moderately or vigorously active.

At renovated schoolyards, the total number of people using the yard (regardless of activity level) was significantly associated with:

- The total number of play features:
 - adults: incident rate ratio [IRR]=1.07 (95% CI 1.06 to 1.07, $p<0.05$)
 - girls: IRR=1.07 (95% CI 1.06 to 1.08, $p<0.05$)
 - boys: non-significant.
- Coverage or shade for resting features:
 - adults: IRR=1.44 (95% CI 1.29 to 1.61, $p<0.05$)
 - boys: IRR=2.03 (95% CI 1.40 to 2.92, $p<0.05$)
 - girls: non-significant.

At unrenovated schoolyards, number of play features and provision of shade did not appear to affect use. However, overall safety at these yards was significantly associated with greater use in boys (IRR=2.77, 95% CI 1.05 to 7.32, $p<0.05$).

For the proportion of people observed as being moderately to vigorously active on the playground, no attribute had a significant effect on this variable.

Limitations of the evidence included that:

- The small sample size may have resulted in limited power to detect differences (for example, in the analyses of physical activity levels).
- The SOPLAY tool was designed to collect data in children and young people, but in this study was also used to assess adults.

A cross-sectional before-and-after study in the USA by [Nicaise et al. \(2012\)](#) investigated the effect on physical activity among preschool children (mean age=4.4 years) of renovating the outdoor space of a university campus children's centre. The study examined 2 independent cross-sectional samples at baseline (n=50) and post-intervention (n=57) – a small significant difference between the samples was noted for age but for no other variables. Renovations were based on 'urban naturalism' (that is, using natural elements of the environment, such as topographical contours, as major design features). Additionally, playground elements were reconfigured to encourage more active forms of play that sustain higher levels of moderate to vigorous activity. For example, a cycle path was lengthened and reshaped, a grassy hill was created, and 2 permanent play structures were removed to create more open space.

Physical activity was measured during break time by direct observation with the OSRAC-P tool (Observational System for Recording Activity in Children-Preschool Version) and by accelerometer. Activity was categorised as sedentary, light, and moderate to vigorous. Separate analyses of covariance (ANCOVA) were conducted for both the observational and accelerometer measures of physical activity, controlling for gender, age, and BMI.

Based on the observational tool, significant differences from baseline were seen in the percentages of observation intervals spent sedentary (–26.5%, $p<0.001$), in light activity (+11.6%, $p<0.001$), and in moderate to vigorous activity (+14.9%, $p<0.001$). Higher levels of moderate to vigorous activity were associated with the specific environmental changes (new cycle path: OR=2.18, $p<0.001$; new grassy hill: OR=3.27, $p<0.001$; more open space: OR=7.62, $p<0.001$). Accelerometer data, however, did not show any significant difference from baseline in amount of time spent in any category of physical activity.

Limitations of the evidence included that:

- Data were gathered from a single site, and the prevalence of overweight/obesity in the sample was 10% less than national rates, which may reduce generalisability of results.
- The absence of a control site meant that effects of the intervention could not definitely be inferred.
- The authors noted that accelerometry may not detect all increases in energy expenditure (such as ascending an incline, upper body movement, or cycling). Because some of the

playground alterations involved this type of activity, not all physical activity may have been captured.

A longitudinal cross-sectional study in Denmark by [Nielsen et al. \(2012\)](#) investigated the association between physical activity and the number of permanent facilities in the playgrounds of 18 schools. Accelerometer data were gathered from children in preschool (n=594, mean age=6.3 years) and then 3 years later when they were in third grade (n=518, mean age=9.5 years). Accelerometry (measured as mean counts per valid minute of recording) was recorded from 7am to 11pm for 4 days, including 1 to 2 weekend days, and was analysed separately for time spent in and out of school. Regression analyses were adjusted for season, sex, and socioeconomic status (and in grade 3 children, whether physical education classes were held during measurement periods).

For every 10 additional permanent play facilities, average accelerometer counts increased among both preschool and third grade children:

- Preschool: 14% increase (p<0.001) in school time and 6.9% increase (p<0.001) overall.
- Third grade: 26% increase (p<0.001) in school time and 9.4% increase (p<0.001) overall.

School playground area did not affect activity levels independently of the number of facilities.

Limitations of the evidence included that:

- The period in which accelerometry data were gathered may not fully represent habitual levels of physical activity.
- The study was cross-sectional; longitudinal, randomised intervention studies would be needed to firmly test for causal effects.
- The study considered only the number of playground facilities, rather than type or variety.

A study in the UK by [Ridgers et al. \(2010\)](#) examined the effect of providing playground markings and equipment on physical activity among 470 children (mean age=8 years) from 26 schools. Playgrounds at 15 schools were renovated, with 11 schools acting as socioeconomic matched controls. Renovation comprised provision of coloured floor markings and physical structures, to increase physical activity levels but also to tackle social exclusion and bullying. Playgrounds were divided into colour-coded zones (for sports, multiactivity and skills, and quiet play) to encourage a variety of activities, especially among children who are intimidated or excluded. In addition, physical structures such as goal posts, basketball hoops, and seating were provided. Sports equipment such as balls and skipping ropes were available at all schools during breaks. Physical activity was measured at morning and lunch breaks via heart rate and accelerometry at baseline, and again at 6 and 12 months post-intervention. All children wore a heart rate monitor, but only 300 wore an accelerometer. Monitoring took place on 1 school day when children could access the playground (data from wet days were discarded and re-recorded on another day). A multilevel analysis on 3 levels (time, pupil, and school) was used to determine the effects of the intervention on physical activity levels.

After 12 months, based on accelerometry data recorded during lunch break, children at intervention schools engaged in significantly more vigorous physical activity than children at control schools (+1.4%, 95% CI +0.1 to +2.7%, p<0.05). No other significant effects of the intervention based on other measurements at other break times were observed. Additionally, the greatest impact on physical activity levels was seen at 6 months, and then declined between 6 and 12 months. For example, time spent in vigorous activity declined significantly between 6 and 12 months according to heart rate data (-3.0%, 95% CI -4.8 to -1.2%, p<0.001).

Limitations of the evidence included that:

- Some data were missing at 6 months (mainly because of monitoring problems and absence from school) and at 12 months (mostly from children having left the participating

schools, or removal of schools from the analysis for making changes independently of the study). Multilevel modelling was used to account for these missing data.

- Only heart rate and accelerometry data were collected; direct observation may have provided additional useful information about effects of the intervention on physical activity.

Conclusions on school playgrounds

The evidence from these 6 studies suggests that upgrading, renovating and maintaining school playgrounds appear to increase levels of physical activity. Providing equipment and playground markings may help to encourage physical activity, but on their own may not bring about long-term changes in children's activity levels. A greater number and variety of play facilities (such as a mixture of play equipment, different play zones, and shaded areas) and environmental features (such as landscaping and vegetation) may further contribute to raising levels of playground use and physical activity.

This evidence is partially consistent with recommendations in [NICE PH8](#) and [NICE PH17](#) (for example, encouraging varied play, using different colours to create specific areas, providing areas of shade and shelter, providing environments that stimulate and challenge, and varying the way physical activities are delivered). However, more details of specific types of playground intervention (such as the amount and type of equipment, and topographical changes to the environment) would be beneficial. In particular, diagrams and photographs may be of use to those designing, planning or refurbishing school playgrounds. This evidence may therefore have a potential impact on the guidance. The details of any impact are outside the scope of the Evidence Update. Decisions on how the new evidence may impact guidance will not be possible until the guidance is reviewed by NICE following its published processes and methods.

Further research is also needed to determine the features and amenities of playgrounds that are most associated with increased levels of physical activity. Ideally, this should comprise randomised studies in heterogeneous populations, including cost-effectiveness analyses.

Key references

Brink LA, Nigg CR, Lampe SM et al. (2010) [Influence of schoolyard renovations on children's physical activity: the Learning Landscapes program](#). *American Journal of Public Health* 100: 1672–8 [[NIH Public Access author manuscript – full text](#)]

Cardon G, Labarque V, Smits D et al. (2009) [Promoting physical activity at the pre-school playground: the effects of providing markings and play equipment](#). *Preventive Medicine* 48: 335–40

Colabianchi N, Maslow AL, Swayampakala K (2011) [Features and amenities of school playgrounds: a direct observation study of utilization and physical activity levels outside of school time](#). *International Journal of Behavioral Nutrition and Physical Activity* 8: 32

Nicaise V, Kahan D, Reuben K et al. (2012) [Evaluation of a redesigned outdoor space on preschool children's physical activity during recess](#). *Pediatric Exercise Science* 24: 507–18

Nielsen G, Bugge A, Hermansen B et al. (2012) [School playground facilities as a determinant of children's daily activity: a cross-sectional study of Danish primary school children](#). *Journal of Physical Activity & Health* 9: 104–14

Ridgers ND, Fairclough SJ, Stratton G (2010) [Twelve-month effects of a playground intervention on children's morning and lunchtime recess physical activity levels](#). *Journal of Physical Activity & Health* 7: 167–75

2 New evidence uncertainties

No new evidence uncertainties were identified during the Evidence Update process, however current uncertainties for physical activity can be found in the [UK Database of Uncertainties about the Effects of Treatments](#) (DUETs) and in the [NICE research recommendations database](#).

UK DUETs was established to publish uncertainties about the effects of treatments that cannot currently be answered by referring to reliable up-to-date systematic reviews of existing research evidence.

Appendix A: Methodology

Scope

The scope of this Evidence Update is taken from the scope of the reference guidance:

- [Physical activity and the environment](#). NICE public health guidance 8 (2008)

It was decided that the scope of the Evidence Update would not include evidence relating to recommendation 6 (concerning action to be taken in public buildings, specifically staircases) because it was felt that evidence would be unlikely to change recommendations in this area.

Searches

Because the database searches performed for the original guidance identified a limited quantity of high quality evidence, it was decided that replicating the original searches was not a viable option for the Evidence Update. The main search approach for this Evidence Update was therefore a call for evidence to the Evidence Update Advisory Group with a deadline of 31 October 2013. This list of evidence was then assessed and prioritised by the Chair for discussion by the rest of the Evidence Update Advisory Group.

Supplementary to the call for evidence, a highly specific electronic search of the literature was performed to identify studies and reviews relevant to the scope. Searches were conducted of the following databases, covering the dates 1 July 2006 (the end of the search period of NICE public health guidance 8) to 2 October 2013:

- ASSIA (Applied Social Sciences Index and Abstracts)
- CSA Sociological Abstracts
- DoPHER (Database of Promoting Health Effectiveness Reviews)
- MEDLINE (Medical Literature Analysis and Retrieval System Online)
- MEDLINE In-Process
- NHS EED (Economic Evaluation Database)
- PubMed
- Trials Register of Promoting Health Interventions (TRoPHI)
- Web of Science

A citation search was also run in Web of Science on articles that were included in the original guidance.

Table 1 provides details of the MEDLINE search strategy used (based on the search strategy for the reference guidance), which was adapted to search the other databases listed above.

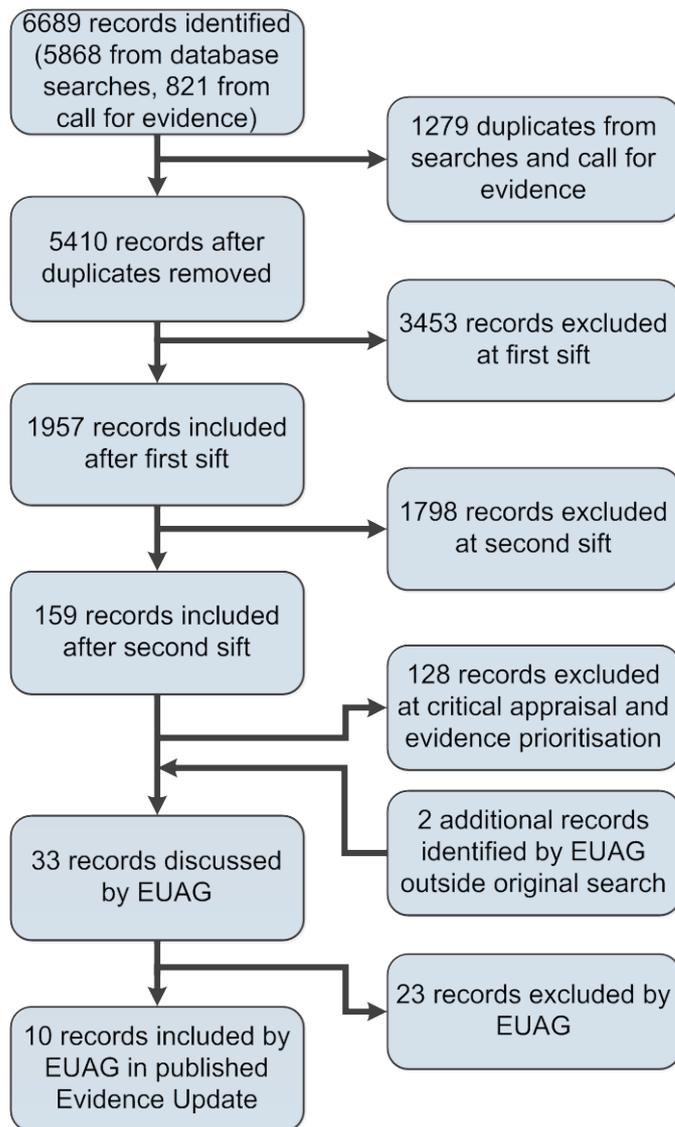
Additionally, 1 study (Hooper et al. 2014) was identified outside of the literature search. Figure 1 provides details of the evidence selection process. The list of evidence excluded after review by the Chair of the EUAG, and the full search strategies, are available on request from contactus@evidence.nhs.uk

See the [NICE Evidence Services](#) website for more information about [how NICE Evidence Updates are developed](#).

Table 1 MEDLINE search strategy (adapted for individual databases)

1	(sport\$3 or exertion\$1 or walk\$3 or bicycl\$3 or bike\$1 or biking or cyclist\$ or (exercis\$3 adj5 aerobic\$1) or rollerblading or rollerskating or skat\$ or athletics or baseball or basketball or boxing or football\$ or soccer or golf\$ or gymnastics or aerobics or recreation or playground\$ or "martial arts" or hockey or racquet\$ or swim\$ or volleyball or runn\$ or jog\$ or yoga or pilates or weightlifting or wrestling or tennis or gardening or recreation\$1 or dancing).ti,ab.	14	8 or 9 or 10 or 11 or 12 or 13
2	exp Physical Exertion/ or Exercise/ or Physical Fitness/ or exp "Physical Education and Training"/ or exp Dancing/ or exp Sports/ or exp Yoga/ or Exercise Therapy/ or exp Fitness Centers/ or Recreation/ or "Play and Playthings"/ or Gardening/	15	exp Behavior/ or Motivation/ or Health Knowledge, Attitudes, Practice/
3	(physical adj5 (fit\$4 or train\$3 or activ\$3 or endur\$4)).ti,ab.	16	((lifestyle or "life style" or brief) adj2 (change\$ or changing or modification\$ or modify or modifying or therapy or therapies or program\$ or intervention\$)).ti,ab.
4	(exercis\$3 adj5 (fit\$4 or train\$3 or activ\$3 or endur\$4)).ti,ab.	17	((promot\$ or uptak\$ or encourag\$ or increas\$ or start\$ or adher\$) adj5 gym\$).ti,ab.
5	(leisure adj5 (centre\$1 or center\$1 or facilit\$)).ti,ab.	18	((promot\$ or uptak\$ or encourag\$ or increas\$ or start\$ or adher\$) adj5 physical activit\$).ti,ab.
6	(fitness adj5 (centre\$1 or center\$1 or facilit\$)).ti,ab.	19	((promot\$ or uptak\$ or encourag\$ or increas\$ or start\$ or adher\$) adj5 (circuits or aqua\$)).ti,ab.
7	1 or 2 or 3 or 4 or 5 or 6	20	((promot\$ or uptak\$ or encourag\$ or increas\$ or start\$ or adher\$) adj5 exercis\$).ti,ab.
8	environment design/st	21	((promot\$ or uptak\$ or encourag\$ or increas\$ or start\$ or adher\$) adj5 (keep fit or fitness class\$ or yoga\$)).ti,ab.
9	environment design/	22	((decreas\$ or reduc\$ or discourag\$) adj5 (sedentary or deskbound)).ti,ab.
10	transportation/	23	(facilitate\$ or uptake or "take up" or increase\$ or impact\$ or effect\$ or improve\$ or enhance\$ or encourage\$ or support\$ or promot\$ or optimiz\$ or optimis\$ or adher\$ or access\$ or motivate\$ or satisfaction or compliance or comply or complie\$ or availabl\$ or provision or incentive\$ or start or attend or utilis\$ or utiliz\$).ti,ab.
11	environment/ or natural environment.ti,ab.	24	15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23
12	"facility design and construction"/ or building design.ti,ab.	25	7 and 14 and 24
13	built environment.ti,ab.		

Figure 1 Flow chart of the evidence selection process



EUAG – Evidence Update Advisory Group

Appendix B: The Evidence Update Advisory Group and Evidence Update project team

Evidence Update Advisory Group

The Evidence Update Advisory Group is a group of topic experts and community members who review the prioritised evidence obtained from the literature search and provide the commentary for the Evidence Update.

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