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The effects of schools and school-environment interventions on health: evidence mapping and syntheses

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The effects of schools and school-environment interventions on health: evidence mapping and syntheses

Aims/Objectives

Aim

To synthesise the evidence base relating to the effects of school-environment (SE) interventions and of school-level influences on the health and well-being of students, staff, parents and the local community, and to make recommendations for the implementation of SE interventions, and the development and testing of new interventions.

Research questions

Our overall aim will be addressed via producing and combining five evidence syntheses addressing the following research questions:

RQ1: What theories and conceptual frameworks are most commonly used to inform SE interventions and/or explain school-level influences on health? What testable hypotheses do these suggest regarding the effects on health?
RQ2: What are the effects of SE interventions on health and health inequalities? What are their direct and indirect costs?
RQ3: How feasible and acceptable are SE interventions? How does context affect this?
RQ4: What are the effects of other school-level factors on health?
RQ5: Through what processes might these school-level influences on health occur?

Objectives

In order to answer these research questions we will achieve the following objectives:

Stage 1: Mapping phase
• Finalise search and data extraction methods, and inclusion criteria for each of our syntheses.
• Undertake searches.
• Retrieve and identify pertinent studies.
• Extract data and produce map of evidence relating to our research questions.
• Complete preliminary synthesis of evidence addressing RQ1.
• Hold two stakeholder meetings in order to consult on our map and RQ1-synthesis and finalise stage-2 hypotheses and priorities.

Stage 2: Individual syntheses
• Apply additional inclusion criteria in order to identify high-quality studies.
• Undertake further data extraction/review of these studies.
• Undertake syntheses for RQs2-5 and refine the synthesis addressing RQ1.

Stage 3 Overall conclusions

• Develop overall conclusions from our five syntheses as well as that of the Bristol/Cardiff review of HPS interventions and draft a report of this.
• Hold two stakeholder meetings in order to assess the usefulness of our draft report.
• Produce a final report to NIHR and at least two journal articles and begin dissemination of these.

Background

Young people's health and the limitations of traditional health education

UK young people have among the worst health in Europe and there are marked inequalities in health across the social scale, with considerable implications for later health problems and economic costs (1-2). A great deal of effort has been put into the development of health education programmes delivered through the school curriculum. Such interventions aim to improve knowledge, develop skills and modify peer norms, and are now well-established in schools, addressing health behaviours such as smoking, drinking, drug use, sexual behaviour, physical activity and diet, However, numerous systematic reviews and rigorous evaluations of such interventions show mixed and frequently disappointing results (3-9).

School environment interventions

Curriculum-based health education is only one potential school-based strategy. Another, complementary, approach is to change the school environment to promote health and wellbeing. The physical, social and cultural environment in which staff and students spend a high proportion of every weekday may have a profound influence on their emotional and mental health, and their opportunities to choose healthy lifestyles. Rather than treating schools merely as sites for health education, school environment' (SE) interventions (defined in section 6 below) treat schools as settings which can influence health. SE interventions can include actions aiming to address health directly, for example: modifying school policies on smoking (10) etc; improving catering (11); or encouraging staff and students to walk or cycle to school (12). Other actions aim to promote health via addressing issues, such as disengagement and lack of social support, which are established risk factors for multiple adverse outcomes (13-14). The latter include: increasing student participation in decision-making; providing staff with training on how to re-engage disaffected students; and encouraging students to take on new responsibilities such as becoming peer mediators(15). These interventions take a 'socio-ecological' (16) or 'structural' (17) approach to promoting health, whereby health is understood to be influenced not only by individual characteristics and behaviours, but also the wider social, cultural and economic context.

One key influence on the development of SE interventions has been the World Health Organisation's (WHO) framework for 'Health Promoting Schools' (HPS) (18). This requires that schools simultaneously address the domains of 'ethos' (i.e. school values and priorities) (19), family/community involvement and curriculum. The HPS framework has received support from international networks, such as the European Network of HPS (20), and has informed some interventions that have been rigorously evaluated but many that have not (21). Additionally, a large number of trials have been conducted on interventions which aim

to modify the school environment to promote health but which are not explicitly informed by the HPS framework. These frequently report greater effectiveness in reducing risk behaviours than traditional health education (22-29).

Existing reviews

However, evidence concerning the effects of SE interventions has not been comprehensively synthesised and several reviews that have examined SE interventions are now quite old. A decade-old systematic review, focused on the small sub-set of SE interventions explicitly following the HPS framework, and requiring action on all the domains listed above, and identified only 12 studies, four of which were randomized trials (none from the UK). This concluded HPS interventions are promising, especially for promoting healthy eating, reducing bullying and improving mental and social wellbeing (21).

Other systematic reviews have focused on SE interventions that aim to reduce violence and drug use (not explicitly informed by the HPS framework), and report their effectiveness (27-30). Three systematic reviews, focused respectively on young people's mental health, physical activity and healthy eating, examined SE alongside other forms of health promotion. These concluded that SE interventions are promising (9, 11-12). However, other than those on violence and drug use, these reviews are now quite old, and no evidence syntheses have been done on the effects of SE interventions in important areas such as sexual health, alcohol and smoking. In addition, none has examined SE intervention effects on school staff, parents or the local community, synthesised evidence on sub-group effects in order to explore potential impacts on health inequalities, or examined the costs (and where available, cost-effectiveness) of SE interventions.

Another gap is that except for some consideration within the reviews focused on healthy eating and physical activity (11-12, 31), there has been no synthesis of evidence on intervention process. Process evaluations examine the planning, delivery and receipt of SE interventions, and are useful for informing decisions about the wider implementation of interventions (32-33). They draw on qualitative and sometimes quantitative research to examine interventions' feasibility, acceptability (to providers, participants and other stakeholders) and how various contextual factors appear to promote or hinder implementation. Process evaluations can be useful in considering an SE intervention's potential transferability to other settings (34).

A further gap in the synthesis of evidence is the effects of the normal school environment (i.e. in the absence of a specific SE intervention) on health. This is important because to date SE intervention studies appear to have addressed only some aspects of the school environment and neglected others, such as school leadership and approaches to learning. Educational research suggests that a number of school-level factors improve educational outcomes: high expectations; an emphasis on basic skills; a safe environment; monitoring of student progress; good communication; parental involvement; and student involvement in decisions (35-37). Examining the impacts of such factors on health outcomes is now a growing field of public-health research (19) which merits synthesis. Although such studies provide less certain causal inference than experimental studies, those aiming to minimize

confounding, reverse causality and other sources of bias could be used to identify promising areas for future intervention and evaluation. A few reviews of such non-evaluation studies have been conducted but these either focused only on certain outcomes or were not undertaken systematically. Systematic reviews of school-level influences on drug use (30) and smoking (38) have concluded there is, respectively, emerging and good evidence that factors such as teacher-student relationships and teaching styles may be important influences on health. One non-systematic review of multi-level studies examined a range of health outcomes and, despite missing several important studies, suggested that strong leadership and high expectations appear to influence various health outcomes (39).

Qualitative research has also been used to explore how staff and students perceive their school environment, and the processes which they see as influencing their health (40). This evidence would also be useful in informing future SE interventions but remains unsynthesized. A final gap is that, other than the reviews focused on healthy eating and physical activity (11-12, 31), none of the above reviews have examined what theories and conceptual frameworks (41) are used to underpin SE interventions or explain school-level influences on health. Without knowledge of these, it is difficult to determine whether empirical studies confirm or deny that SE interventions and school-level influences occur as expected and indeed none of the above reviews has attempted to test this.

Need

SE interventions appear to have the potential to improve young people's health and wellbeing. The studies cited above suggest they may be more effective than traditional health education. Furthermore, they have the potential to reach very large numbers of individuals at a critical point in the development of health-related behaviours with major consequences for later health and illness (42). However, in the absence of a fully synthesised evidence base bringing together all the forms of evidence discussed above, it is not clear: what existing theories and conceptual frameworks might predict about the effects of SE interventions and school-level influences on health; what effects SE interventions are actually reported to have and at what cost; how feasible and acceptable are such interventions; and what other aspects of the school environment might be addressed in order to promote health. Our study comprises five individual syntheses to address these gaps.

We will work in close collaboration with colleagues in the Universities of Bristol and Cardiff who, under the auspices of the DECIPHer, a UKCRC Public Health Research Centre of Excellence (http://www.decipher.uk.net/), are undertaking a Cochrane review updating the decade-old review of interventions following the HPS framework, which require simultaneous action in the domains of ethos, family/community involvement and curriculum (21) - protocol available on request. They will focus on HPS interventions while we focus on the broader set of SE interventions, (as well as the other forms of evidence described above).

Study population

Our study will focus on the students, staff, parents and/or the local community of schools reported on in the types of study listed above. By school, we mean educational institutions catering for students age 4-18 (including sixth-form and other colleges for those age 16-18). If any studies follow students' outcomes from before age 18 to after age 18, we will include these.

Planned intervention

At the mapping stage, we will examine SE interventions, which we define as interventions aiming to aiming to promote health/wellbeing or prevent disease by modifying the school physical, social or cultural environment via actions focused on school policies and practices relating to education, pastoral care, sport, extra-curricular activities, catering, travel to and from school and other aspects of school life which go beyond merely the provision of health education or checks. Thus we exclude interventions that solely consist of: education, information or counselling focused only on health; school nursing, clinics or health checks; provision of health-related goods such as medicines, contraception or micronutrient supplements or other interventions which solely target young people on the basis of health-related need.

At the in-depth review stage we will determine which sub-set of these interventions to focus on, informed by which are most pertinent to testing the hypotheses to be derived from our review of theoretical literature (see below), which are of most interest to stakeholders and which have been least subject to existing reviews.

Proposed outcome measures

Our syntheses of evidence relating to RQs 2 and 4 above will focus on health in a broad sense in terms of the following types of outcome (overall and by population sub-group) (43): physical and emotional/mental health and wellbeing end-points; intermediate health measures (for example, health behaviours, body mass index, teenage pregnancy); and health promotion outcomes (for example knowledge and attitudes relating to health). Our focus on intermediate health measures recognises that health behaviours initiated in childhood and adolescence may exert significant effects on health end-points later in the life-course (1). Our focus on population sub-group effects reflects the importance of identifying and addressing health inequalities for NIHR and the Department of Health (DH) (44). We will also seek data on economic outcomes, including costs of providing the intervention and costs to individuals.

Methods

Overview

The review will follow existing general criteria for the good conduct and reporting of systematic reviews (e.g. the Centre for Reviews and Dissemination guidelines; Quality of

Reporting of Metaanalyses guidelines). The review will be carried out in three stages: 1) a descriptive map of the available research evidence (which will involve exhaustive searching, application of inclusion and exclusion criteria, detailed coding), plus a preliminary synthesis of the theories and conceptual frameworks used to inform SE interventions or explain school-level influences on health; 2) a series of in-depth syntheses in which the available research will be quality assessed, relevant findings extracted, and statistical and narrative/qualitative methods applied to synthesise findings; and 3) a final stage drawing conclusions from our five individual reviews, as well as that produced by the Bristol/Cardiff review of HPS interventions, and developing recommendations for research, policy and practice. We will use EPPI-Reviewer to support the management and analyses of the studies found and the data extracted. EPPI-Reviewer is a web-based systematic review program that supports the review process from the downloading of bibliographic citations, application of inclusion and exclusion criteria, recording and storing free text, categorical and numerical data, and conducting statistical and qualitative synthesis. This specialist programme also incorporates functions for comparing the independent assessments of studies from two or more reviewers. EPPI-Reviewer therefore helps to assure quality in a review and facilitates transparency and auditability (45).

Stage 1: identifying and describing studies

Inclusion and exclusion criteria

In stage 1 we will include research literature that addresses each of our research questions as follows:

(RQ1) literature describing/explaining the theories and conceptual frameworks that are used to inform SE interventions or explain school-level influences on health;

(RQ2) evaluation studies reporting on SE intervention effects on health, as well as cost, economic and econometric studies examining the costs of SE interventions (studies evaluating interventions explicitly guided by the WHO HPS framework that we identify will be passed onto our Bristol/Cardiff colleagues and our Bristol/Cardiff colleagues will similarly pass on studies not explicitly guided by the WHO HPS framework to us);

(RQ3) process evaluations of SE interventions;

(RQ4) multi-level or ecological (school) studies examining school-level influences on health; and

(RQ5) qualitative studies exploring the processes by which school-level factors might influence health.

Exclusion criteria

Exclude 1 (general topic)

- Not about health/wellbeing or disease (including studies solely focused on outcomes concerned only with education).

Exclude 2 (setting / population)

- Not about the students or staff of schools (i.e. serving those age 4-18).

Exclude 3 (type of report)

- Not reporting primary research, a review of research or a theory

Exclude 4 (specific focus)

Exclude 4a (for intervention primary studies)

- About an intervention that is neither mainly delivered on the school site nor concerned with travel to and from schools (extra-curricular interventions would be included unless excluded based on any of the criteria below).
- Neither about an intervention aiming to promote health/wellbeing or prevent disease nor reporting on the health/wellbeing outcomes of an intervention.
- About an intervention only involving: health education, information or counselling (regardless of who delivers this); school nursing, clinics or health checks; and/or health-related goods (medication, contraception, micronutrients etc), but interventions concerning school catering, sport or active transport would be included.
- About an intervention targeted only to some students on the basis of health-related needs (but interventions targeted on the basis of educational or social but not health needs would be included).

Exclude 4b (for non-intervention (primary) studies)

- Not a study of the effects of the school environment/school-level factors on health/wellbeing.

Exclude 4c (for reviews and theoretical research)

- Not a review or theoretical paper with a focus on the school environment, interventions addressing this or school-level effects

Exclude 5 (study type)

Exclude 5a (for intervention (primary) studies)

- Not an empirical outcome evaluation or process evaluation

Exclude 5b (for non-intervention (primary) studies)

- Not empirically examining school-environment influences on health/wellbeing
- If the study is a quantitative study it will be excluded if it is:

  - not reporting on school-level variables (but multi-level analyses including school-level analyses would be included).
  - only reporting on school-level measures of student social (e.g. SES) or demographic (e.g. ethnicity) characteristics or students' social networks (but studies examining student-staff relationships would be included).

- only reporting on school-level measures of health education (regardless of who delivers this), school-based clinical health services or interventions targeted on the basis of health-related needs.

Exclude 5c (for reviews or theoretical research)

- Not a systematic review with a focus on school environment interventions, interventions to address this or school-level effects AND does not propose an abstracted, generalizable way in which features of schools are causally related to student/staff health.

Search strategy

Initial analysis of the type of studies sought by this review revealed that they were described in very wide-ranging terms. They were not reliably indexed in databases with controlled vocabularies. For this reason, a very sensitive search was undertaken using a large number of natural language phrases (appendix 1). This was carried out in two phases, after trial searches produced over 14,000 hits in Medline alone. The first "core" phase used key terms and phrases for interventions/school level effects, with broader terms in the second "non-core" phase. Some additional intervention terms were added to the key terms as a third phase. The intention was to sift the first set very carefully while the second set would be sifted more quickly. A total of 82,279 references were retrieved before de-duplication.

Despite the sensitivity of the search and the scale of the results, some studies will be not have been picked up in the search. It was agreed to undertake a particularly intensive process of reference-checking of relevant papers, not only those references cited in the papers, but also looking for those papers which cite our target papers (using Citation Indexing in Web of Knowledge) and the *Related Citations* facility in Medline.

The search strategy consisted of four sets of terms:
1. Setting - school terms
2. Population - child terms
3. Intervention/effect (key and noncore)
4. Outcomes - broad range of health outcomes.

Some key phrases, e.g. "health promoting school*" were also searched without any further restrictions.

The following databases were searched between 30 July and 23 September 2010, with no limits on language or date:

Australian Educational Index
British Educational Index
CAB Health [part of CAB Abstracts]
The Campbell (C2) Library
CINAHL
Cochrane Controlled Trials Database

Embase
ERIC
HMIC (Health Management Information Consortium)
IBSS
Medline
PsycInfo
Social Policy and practice (includes Child Data & Social Care Online)
Social Science Citation Index (Web of Knowledge)
Sociological Abstracts

Dissertation Abstracts/Index to Theses

Econlit and PAIS were also investigated but trial searches produced no new material.

The process of carrying out the searches proved to be particularly slow and complex, partly due the number of free text terms, and the number of hits, but another factor has been the seven different database hosts, an unusually high number: CSA, Datastar, DIALOG, EBSCO, Ovid, Web of Knowledge, Wiley. Each host has different searching conventions, which has led to a need to modify the search more than would normally be required. Downloading from some hosts was also very slow, as only a small number of records could be marked and downloaded at a time.

Application of inclusion criteria

Search results were downloaded into EPPI-Reviewer 4 for screening. An inclusion criteria worksheet was prepared, and each reference screened. This sifting was done in three phases, a first one to remove any clearly irrelevant studies, a second one to identify studies that are pertinent or where it is not possible to determine pertinence based on title and abstract alone, and a third one to determine the pertinence of studies for which a full report is necessary. Three reviewers undertook these sifts, initially double-sifting and comparing answers in initial batches of at least three sets of 50 studies to ensure consistency and more if required until the disparities were negligible, after which sifting was done individually.

A total of 63,650 references were imported into Eppi-Reviewer 4. A search of duplicates identified 19,125 references. This left 44,525 references. Of these 44,525 references, 35,188 were excluded (based on the exclusion criteria). Thus, from the 63,650 references, 54,313 were discarded, leaving 9337.

Descriptive coding and mapping

Studies will be descriptively coded based on title and abstract where possible and based on the full report where necessary. Included studies will be described by applying a standardized classification system for health promotion and public-health research (46). This system will be supplemented by additional codes developed for this review to cover SE intervention characteristics (components, duration, frequency, delivery, providers, fidelity) and school-level factors examined. We will also develop a taxonomy of the various sub-

types of SE intervention informed by existing educational and health promotion literature. New codes will be developed informed by this taxonomy and piloted on a sample of studies before being applied. For an initial sample, two reviewers will code independently, compare notes and reach consensus drawing on a third reviewer where necessary. Guidance for reviewers will be refined to remove any ambiguities that arise. Subsequent coding will be done by one reviewer checked by another. We will thus develop a map of existing evidence addressing our research questions. The methodological quality, results and conclusions of studies will be examined in more detail in stage 2 (see below).

Preliminary synthesis of RQ1 studies

Alongside the descriptive mapping of all included studies, we will review the literature we find that addresses RQ1. Some of this will derive from stand-alone publications focused on the theoretical basis of SE interventions and school health effects while some will consistent of theoretical sections within reports of empirical research.

The RQ1 synthesis will aim to develop hypotheses which will then be tested in our synthesis relating to RQ2-5. The review of theoretical literature will use thematic synthesis methods (47) to categorise and describe the theories and conceptual frameworks used to inform SE interventions and explain school-level influences on health, in terms of constructs/factors, causal pathways and assumptions. This synthesis will refer to our taxonomy of SE intervention sub-types, setting out their various objectives, approaches, and actions. Because the RQ1 synthesis is distinctive in aiming to build not test hypotheses it will involve some subjective judgements for example about which theories have most explanatory scope. However, any such judgements will be transparently reported.

At this stage, we will engage with stakeholders in two ways: a workshop involving professionals and parent-governors; and a meeting involving young people. Each of these will review our initial map of evidence and preliminary synthesis relating to RQ1 in order to provide comments on the plausibility and importance of the theories and conceptual frameworks described. We will use these to inform our setting of hypotheses to be examined in stage 2. Additionally, if we identify a body of evidence of a size incommensurate with the planned scale of this evidence synthesis, we will also consult with these groups to determine which interventions, outcomes and analyses etc. to prioritise in our stage 2 syntheses. These groups will meet again in stage 3 (see below).

Stage 2: In-depth syntheses addressing each research question

Inclusion and exclusion criteria and quality assessment

The final scope of the in-depth syntheses will be informed by our descriptive map, our preliminary synthesis addressing RQ1, and our consultation with stakeholders. We will restrict the in-depth syntheses to the best available evidence. Inclusion criteria relating to methodological quality will vary according to the research question being addressed. Draft methodological inclusion criteria for stage 2 are as follows:

RQ1: Not applicable: already synthesised in stage 1.

RQ2: Prospective design with comparison groups; pre-determined outcomes; control for clustering; control of confounding; no over-adjustment for potential mediators; and reporting on attrition, overall and by group (we will include in the review studies with >30% overall attrition, or >10% between-group differences in attrition, but may exclude these from meta-analyses) . Our current knowledge of the literature on SE interventions suggests that very few cost studies, let alone economic evaluations or econometric studies, have been undertaken. However, we will seek to identify evidence on intervention costs and indirect resource use contained in any such studies, as well as in outcome evaluations reporting more limited data on resource use and/or costs. Any such studies will be quality-assessed and their evidence weighted (see below).

RQ3. Process evaluations will not be excluded on the basis of quality but will be quality-assessed and their findings weighted (see below).

RQ4: Control for clustering; control of school-compositional confounders; no over-adjustment for potential mediators; and reporting on attrition (again we may exclude studies with > 30% attrition from meta-analyses). If sufficient studies, we will restrict our attention to multi-level, longitudinal studies which can better control for individual-level confounding and for reverse causality.

RQ5: Qualitative studies will also not be excluded on the basis of quality but will be quality-assessed and their findings weighted (see below).

As in stage 1, criteria will be piloted prior to application. To help assure the review's quality at this stage, pairs of reviewers will first work independently and then compare their decisions before reaching consensus for all reports reviewed, involving a third reviewer where necessary.

Data extraction and further quality assessment

We will collect detailed data from, and describe, the included studies addressing RQs2-5 (RQ1 already having been addressed in our preliminary synthesis). For all studies we will extract data on: study research questions/hypotheses; study site and population; sampling; data collection methods; analysis methods; results; and authors' conclusions.

Additional data to be extracted for various study types are listed below.

- Quantitative studies addressing RQs 2 and 4: methods of adjustment for clustering; confounders and methods to control these; attrition rates overall and by study arm (RQ2 only); outcome measures; and effect size estimates (overall and by population sub-group) and measures of confidence/significance.

- Economic studies addressing RQ2: (depending on what studies are found): intervention costs and indirect resource use; basis, assumptions and/or perspective taken regarding cost

estimates; and (if available) economic measures of cost-effectiveness. In addition, we will extract other relevant data on study design and methods as per those listed above for quantitative studies.

- Qualitative studies addressing RQs 3 and 5: the rationale for the sampling method used; the range of stakeholder perspectives explored; and the transparency of reporting methods and data. For process evaluations we will also examine: part of process examined (planning, delivery, receipt); aspect of process examined (feasibility, fidelity/quality, coverage/ accessibility, acceptability, appropriateness/fit with measured/perceived need); and aspect of intervention context examined (e.g. socio-demographic, policy, institutional capacity and collaboration, professional capacity). We have previously developed a tool for examining intervention context (48) which will be considered for use in this review, suitably adapted.

The quality of process evaluations and other qualitative research will be assessed according to a set of recently developed criteria used successfully in an HTA-funded review of school-based interventions (49) and based on extensive developmental work (3, 50-52). Reviewers will assess studies according to: the appropriateness of the sampling strategy to the evaluation aims; the rigour and, where appropriate, flexibility of data collection; the systematic and comprehensive nature of data analysis; whether findings are grounded in/supported by the data; whether the findings are of sufficient depth and breadth; and whether the perspectives of those involving in planning, delivering and receiving the interventions are adequately examined. A final step in the quality assessment of qualitative studies will be to assign studies two types of 'weight of evidence'. Firstly, reviewers will be asked to assign a weight (low, medium or high) to rate the reliability or trustworthiness of the findings (the extent to which the methods employed were rigorous/could minimise bias and error in the findings). Secondly, reviewers will also be asked to assign an additional weight (low, medium, high) to rate the usefulness of the findings for shedding light on factors relating to the research questions. Guidance will be given to reviewers to help them reach an assessment on each criterion and the final weight of evidence. Similarly, assessment and weighting of the methodological quality of any cost, economic evaluations and econometric studies that we find will be informed by application of existing methods and checklists (53-54).

Syntheses addressing each research question

Quantitative research addressing RQs 2 and 4: study findings on effect sizes (overall and by population sub-group) will be synthesised via statistical meta-analysis when studies are sufficiently homogenous in terms of measures and (for RQ2) interventions. Where significant heterogeneity exists, evidence will be subject to narrative synthesis (see section 10 for further details) using similar approaches to those used in previous well-conducted reviews (30, 38). Section 10 below also outlines how these syntheses will examine the effect of SE interventions on inequalities. Where data allow, our meta-analyses will aim to test hypotheses generated from our preliminary synthesis addressing RQ1 (which will have been refined as appropriate in the light of comments from our stakeholder group and/or any new evidence found in stage 2). The use of a priori hypotheses from RQ1 will: give us an empirical justification for hypothesising that a given concept might impact on study findings;

protect us from 'dredging' the data for spurious statistically significant results; and enable us to critique the selection of covariates that are employed in our included studies. Regarding economic evaluations pertinent to RQ2, our synthesis will be guided by what evidence we find. Our team includes a health economist who will examine the evidence and advise on appropriate methods of synthesis. Measures of costs and (if available) indirect resource use and cost-effectiveness will be summarised using tables. If measures of resource use are judged sufficiently homogeneous across studies, and applicable or transferable to the UK context, these will be synthesised using statistical meta-analysis (53). Measures of costs, indirect resource use and cost-effectiveness collected from studies conducted in settings other than the UK and/or in previous years will be adjusted for currency and inflation to the current UK. These data will be used to inform a narrative synthesis of the principal results of economic analyses, a commentary on economic aspects of SE interventions, and the applicability of collected economic evidence to the UK context.

Qualitative studies addressing RQs 3 and 5: Study findings will be synthesised using narrative methods developed in previous work on the synthesis of process evaluations and qualitative research (47, 55-56). Detailed evidence tables will be prepared to describe the methodological quality of each study, details of the intervention or aspect of schools examined, study site/population (where appropriate), and findings. Two reviewers will read and re-read the data contained in the evidence tables, apply codes and memos to capture the content of the data, and then group and organise codes into higher-order themes. These themes will be used to generate an explanatory framework to address RQs 3 and 5.

Stage 3: Overall conclusions

At this stage we will draw on our five individual syntheses in order to address our over-arching aim, and produce a draft report which draws conclusions about: the effectiveness, and direct and indirect costs (and cost-effectiveness if evidence allows) of SE interventions; their feasibility and acceptability, how this is influenced by context, and the implications of this for their potential transferability; what other school-level factors influence health, through what pathways, and have these factors been addressed by interventions to date; and in the light of the evidence we have synthesised, what can we conclude about the validity and usefulness of existing theories and conceptual frameworks used to inform SE intervention and explain school-level influences. We will collaborate with our Bristol/Cardiff colleagues to compare and contrast the reported effects of SE interventions that are informed by the HPS with those that are not. As well as drawing general conclusions about transferability, we will also consider the appropriateness of transferring the various sub-types of SE interventions to the UK, informed by existing guidance about intervention transfer (57-58). We will consider the strengths and weaknesses of our syntheses and develop recommendations for research, policy and practice.

We will then organise a further two stakeholder workshops, one involving our stakeholder group of professionals and parent-governors, and the other involving young people from the YPPHRG, to review our key findings and conclusions. Taking on board the views expressed by stakeholders, we will then finalise our technical report and executive summary, and

begin disseminating the research via other means.

Statistical analysis

In synthesising the evidence regarding RQs 2 and 4 we will undertake statistical meta-analysis when studies are sufficiently homogenous in terms of interventions (RQ2) and measures (RQs 2 and 4). Statistical heterogeneity of effects will be assessed using Chi-square tests and the magnitude of statistical heterogeneity will be assessed using the I2 statistic. We will undertake subgroup analyses and meta-regression (59) and where no significant heterogeneity of effect sizes is found, these will be pooled to calculate a final effect size. Where data allow, our meta-analyses will aim to test hypotheses generated from our preliminary synthesis addressing RQ1 by conducting subgroup analyses and, where possible and appropriate, meta-regression (assuming a random effects model (60)).While these analyses may enable us to hypothesise as to possible causes of differences between studies' findings, some heterogeneity is likely to remain, and any statistical analysis will be accompanied by a narrative synthesis. If the number of outcomes for which meta-analyses is possible exceeds the capacity of this project, we will focus on those outcomes prioritised by our stakeholder meeting. Meta-analysis and subgroup analysis will be conducted using EPPI-Reviewer with Stata 11 being used for any meta-regression. As we anticipate that outcomes will be measured using a range of measurement tools, standardisation of results will be required in the form of standardised mean difference (SMD). We also anticipate that most of the studies addressing RQ2 will have used cluster randomised controlled trials, and most of those addressing RQ4 will have used multi-level or ecological (school) designs. We will draw on methods reported by White and Thomas (61) to calculate effects sizes from such studies. Drawing on the work of Kavanagh et al (62) we will apply an 'equity lens' to the effectiveness analysis (conducting sub-group analyses employing meta-regression to examine any differences in impact according to population) in order to explore the potential impact of SE interventions on health inequalities. We will ensure that comparable approaches to methods of synthesis are taken in this review and in the review of HPS interventions being undertaken by our Bristol/Cardiff collaborators in order that we can compare and contrast our respective findings.

Project Management

The London School of Hygiene and Tropical Medicine (LSHTM) will act as sponsor for this research. In practice this function will be undertaken by Professor Anne Mills, the head of LSHTM's Public Health and Policy department. The full project study team will meet at least three times in person in order to assess progress against milestones and decide actions. An executive group comprising the project co-directors and research fellows will meet fortnightly face to face or by 'phone conferencing. A formal advisory group will not be convened but consultation will be carried out via the stakeholder meetings (see below) which will include researchers as well as other professional stakeholders.

Date	Milestone

Stage 1: Mapping phase	
September 2010.	Finalise search and data extraction methods, and inclusion criteria for each of our syntheses
September 2010	Undertake searches
February 2011	Retrieve and identify pertinent studies
March 2011	Extract data and produce map of evidence relating to our research questions
March 2011	Complete preliminary synthesis of evidence addressing RQ1
April 2011.	Hold two stakeholder meetings in order to consult on our map and RQ1-synthesis and finalise stage-2 hypotheses and priorities
Stage 2: Individual syntheses	
April 2011	Apply additional inclusion criteria in order to identify high-quality studies
May 2011	Undertake further data extraction/review of these studies
August 2011	Undertake syntheses for RQs2-5 and refine the synthesis addressing RQ1
Stage 3 Overall conclusions	
September 2011	Develop overall conclusions from our five syntheses as well as that of the Bristol/Cardiff review of HPS interventions and draft a report of this
September 2011	Hold two stakeholder meetings in order to assess the usefulness of our draft report
December 2011	Produce a final report to NIHR and at least two journal articles and begin dissemination of these

Service users/public involvement

With our Bristol/Cardiff colleagues, we have, under the auspices of the DECIPHer, a UKCRC Public Health Research Centre of Excellence (http://www.decipher.uk.net/), we have consulted with a group of young people to explore their experiences of school and views on how the school environment might influence their health. This has informed our strong focus on mental health and confirmed the importance of examining the effects on health of learning and teaching, staff-student relations and student participation.

We will undertake two further consultation events with young people on the evidence map and on the contents of the draft final report. In addition we will also consult on the same matters with a group of adult stakeholders which will involve representatives of parent governors, government departments and local policy-makers (NHS, local government), researchers, and health and education practitioners. This group will be facilitated by a senior member of the study team.

Discussion

Strengths and limitations of the review

The major strength of this review is its breadth of scope. SE interventions to promote health is a relatively new field and it is unlikely that a review only of intervention studies would identify the diverse ways in which the modifiable aspects of the school environment can be intervened upon to improve health. In reviewing evidence from quantitative studies of the effects on health of the normal (i.e. not intervened on) school environment as well as from qualitative studies of staff and student accounts of how the school environment may influence health, our review will assess areas of promise. While this other evidence cannot provide evidence on health effects of the rigour associated with randomized intervention studies it should nonetheless identify promising avenues to be examined in future intervention studies.

The review is also strong in being user and theory led. We will consult with students, teachers and a variety of practitioner and policy stakeholders in the course of the review. We will review the theoretical and conceptual literature which considers the effects of the school environment on health and use this to develop hypotheses to be tested in our review of empirical literature. Together, our user consultation and theory review will enable us to prioritize which literature to review in-depth in a transparent and rational way. Our aim of testing theory-derived hypotheses within the in-depth review should enable the review to clarify the implications of existing empirical research for theory and in doing so to contribute to the refinement of theory and later generations of theory-based interventions.

Implications for policy and healthcare commissioning

Health promoting schools and other interventions to modify schools' environments to promote health are increasingly popular. This review aims to provide comprehensive evidence of the effectiveness and cost-effectiveness of SE interventions as well as the potential for other modifiable aspects of the school environment can be intervened upon to improve health. This should help those planning, implementing and evaluating such interventions to do so based on the best evidence.

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Appendices

Appendix 1. Search terms

Set 1: Setting
School or schools

Set 2: Population
child* or adolescen* or youth or young people or teen* or student* or pupil* or teacher* or teaching staff or school personnel or school staff or parent*

Set 3A: Key Intervention/ School-level effect - key terms (CORE)
ADJX = within X words of, in both directions. X determined by trial searches.

ethos
school* ADJ5 climate (exc MeSH climate/ or climate change/)
school* ADJ5 environment

school* ADJ5 culture
school* ADJ3 manag*
school* ADJ3 leader*
school* ADJ5 organization or organisation
school* ADJ5 aggregate*
school* ADJ5 governance
education* context*
inter(-)school variation
inter(-)school differen*
inter(-)school inequalit*
school differen* or differen* between school*
school ADJ2 level
school* ADJ3 varia*
school influence*
school* ADJ3 effect or school* ADJ3 effects
restor* justice

Specific intervention types
school* adj3 (breakfast* or lunch* or dinner* or meal*)
breakfast club*
vending
snack* machine* or soft drink* machine*

physical education and training/ MeSH
physical train*
games adj3 school*
sport* adj3 school*

active transport (not cell*)
active commuting to school
walking bus* or walking school bus*
school travel plan*
active commuting to school
walk* ADJ3 school*
cycl* ADJ3 school*

MeSH
Schools/organization and administration
AND Health promotion/

Set 4: Outcome terms

General health/well being terms
Health
Well(-)being or wellbeing
Infection
Disease*

Specific areas
Emotion*
Mental

Psychiatr*
Anxi*
Depress*

Violence
MeSH
Juvenile delinquency/
Violence/*prevention & control
Violen*
Delinquen*
Aggress*
Bully*
Bullies or bullied
Injur*
Accident
Victimi*

Substance abuse
MeSH
Alcohol Drinking/
Marijuana Smoking/
Smoking/
Substance-Related Disorders/*prevention & control
Substance* ADJ2 (use* or abuse* or misuse*)
Smok* or Tobacco or Cigarette*
Drug* ADJ2 (use* or abuse* or misuse*)
Illicit drug* or Illegal drug* or Street drug*
Cannabis or Marijuana
Alcohol
Binge

Obesity issues
Healthy(-)eating
Nutrition
Obesity
Diet
Over(-)weight
Body weight or bodyweight
Body mass or bodymass
Physical exercise
Physical* activi*
Pysical train*

Active Transport
active transport (not cell*)
active commuting to school
walking bus*
school travel plan*
active commuting to school
walk* ADJ3 school*
cycl* ADJ3 school*

Sexual behaviour

MeSH

Acquired Immunodeficiency Syndrome/ epidemiology/*prevention & control
Condoms/utilization
HIV Infections/epidemiology/*prevention & control
Pregnancy in adolescence/
Sexual behavior/
Sexually Transmitted Diseases/epidemiology/*prevention & control

Pregnan*
Sexual
HIV
Chlamydia
Condom [use]
Contracepti*

All excluding MeSh: exp: schools, medical/ or medical school*

***Set 3b: Intervention/ School-level effect (*NON-CORE)**

General free-text

multi(-)intervention
non-curric*
socio(-)ecological*
ecological or ecology
socio(-)environment
classroom management
value(-)added
engag* or disengag*
student-led
pupil-led
pastoral (not agric* or farm*)

school ADJ3 achievement*
school* ADJ3 attainment*
school* ADJ3 exam*
school* ADJ3 (test or tests or testing or tested)
school* ADJ3 qualif*
school* ADJ3 quality
school* ADJ3 inspect*
school* ADJX influence
school* ADJ5 (policy or policies)
school* ADJ3 rules
school* ADJ5 context*
school* ADJX opport*
school* ADJ3 practices
school* ADJ5 collective
school* ADJ3 communit*

school* ADJ5 structur*
school* ADJ3 relation*
school* ADJ5 communicat*
school* ADJ5 aggregate*
school* ADJ5 security
school* ADJ5 safe*
school* ADJX expectation*
between ADJ2 schools
school* adj2 exclusion*
school inclusion

education* ADJ3 achievement
education* ADJ3 attainment
education* ADJ3 examin*
education* ADJ3 (test* or tests or testing)
education* ADJ3 qualif*
education* ADJ3 quality
education* ADJ3 engag*
education* ADJ3 (policy or policies)
education* ADJ3 opportun*
education* ADJ3 practices
education* ADJ3 culture
education* ADJ3 manag*
education* ADJ3 leader*
education* ADJ3 communicat*
education* ADJ3 safe*
education* ADJ3 expecation*

teaching ADJ3 practices
teaching ADJ3 standard*
teaching ADJ3 style*
teaching ADJ3 method*
teaching ADJ3 differen*
teaching ADJ3 varia*

aggregate* adj1 (data or reports or information)

school* size
school restructur*
comprehensive school reform

vending
School meal*

SET 5 Simple phrases - searched alone

health(-)promoting school*
healthy(-)school or healthy schools
comprehensive school* health program*
co(-)ordinated school* health program*

SET 6 Simple phrases combined with SET 4 outcome terms

school(-)wide
whole(-)school

Search summary

Search One:	Set 1 and Set 2 and Set 3a and Set 4 (setting/population and key intervention/effects and outcomes)
Search Two:	Set 5 (HPS phrases)
Search Three:	Set 6 and Set 4 (whole school phrases and outcomes)
Search Four:	Set 1 and Set 2 and Set 3b and Set 4 (setting/population and key intervention/effects and outcomes) [Note additional terms were added to Set 3b in the third phase of the search]

This protocol refers to independent research commissioned by the National Institute for Health Research (NIHR). Any views and opinions expressed therein are those of the authors and do not necessarily reflect those of the NHS, the NIHR, the PHR programme or the Department of Health.