






STUDY PROTOCOL

REVISED Feasibility of an intervention for increasing moderate-to-vigorous intensity physical activity (MVPA) in primary school physical education: a study protocol [version 2; peer review: 1 approved]

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Abstract

Background: Most primary school Physical Education (PE) has relatively little health-enhancing moderate-to-vigorous physical activity (MVPA). - A promising theory and evidence-based intervention, the 'SHARP Principles' model, has been effective in making PE lessons more active in one area of England. This protocol paper explains the rationale for use of the SHARP intervention, and the methods used to examine the feasibility and acceptability of a version of SHARP translated for use in Scotland (SHARP Scotland).

Methods: The feasibility of SHARP Scotland will be evaluated by key areas of focus for feasibility studies: Acceptability, Implementation, Integration, Limited Efficacy Testing. A combination of process measures, including observations, session delivery records, accelerometry-data collection, questionnaires, and semi-structured qualitative focus groups with teachers and pupils will be used. The feasibility and suitability of the SHARP Scotland intervention for a future Randomised Control Trial (RCT) will be assessed. The study will involve children from 8-11 years old (Primary 4 to 6) in two schools, one large urban school, and one smaller school; four classes will be randomly assigned to the intervention group (will be taught by class teachers with SHARP approach training), and four classes randomly assigned to the usual-care (standard curriculum) control group (taught by class teachers without SHARP training). Within the 8-week intervention, MVPA in the intervention group will be targeted by encouraging class teachers to deliver their PE classes in more active ways, following SHARP Principles. A maximum of 64 PE lessons

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1

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view

1. Freya MacMillan , Western Sydney University, Campbelltown, Australia

Any reports and responses or comments on the article can be found at the end of the article.

delivered in a SHARP way will be conducted to assess the effectiveness of the intervention.

Discussion: The outcome of this study will be an assessment of whether applying the SHARP intervention is feasible in Scottish schools. Identification of any modifications to the intervention or evaluation which are required will provide insight for a fully powered effectiveness trial in the future, if appropriate.

Keywords

Moderate-to-vigorous physical activity, Intervention, Primary school, Children, Physical education, Health, Accelerometry-measured, Feasibility.



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REVISED Amendments from Version 1

We add the URI address for one of our co-authors John J Reilly

In response to the reviewer's comments, we made the following changes.

1. We concisely mentioned in the abstract too that the teachers delivering the intervention (taught by class teachers with SHARP approach training) are not the same teachers taking the control classes (taught by class teachers without SHARP training).
2. We deleted the term 'non-health' and replaced the word with 'other'.
3. We updated the reference with the current WHO recommendation i.e., an average of at least 60 minutes of MVPA per day. Relevant change has also been made on reference list no.5.
4. The word 'accelerometry' has been replaced by 'accelerometers' in the 2nd sentence of the 'limited efficacy testing' section.

Any further responses from the reviewers can be found at the end of the article

List of abbreviations

MRC: Medical Research Council

MVPA: Moderate-to-vigorous physical activity

PA: Physical activity

PE: Physical education

RCT: Randomised Control Trial

SHARP: Stretching whilst moving, High repetition of skills, Accessibility, Reducing sitting and standing, and Promotion of physical activity

UK: United Kingdom

USA: United States of America

WHO: World Health Organisation

Introduction

Moderate-to-vigorous intensity physical activity (MVPA) is very important to the health and well-being of children as it provides both immediate and long-term health and other benefits (such as academic performance).¹⁻⁴ Despite these positive impacts, it is estimated that approximately only 20% of children and adolescents globally meet the WHO recommendation of an average of at least 60 minutes of MVPA per day.^{5,6} As a result, children's current and future health is at risk.⁶ As there is good evidence that physical activity generally declines by age 6-7 years in the UK and globally,⁷ future interventions to promote MVPA should start before adolescence.⁸

There is high potential for school time to help pupils meet the WHO MVPA recommendation.⁹ Schools are an important setting for promoting children's daily physical activity (PA) as pupils from all socio-economic and cultural backgrounds spend around half of their days per year at school.¹⁰ Schools can therefore play a vital role in keeping young people active through all activity opportunities,¹¹ such as morning and lunch breaks, recess, active travel, afterschool activities, play and sports,¹² but most importantly in physical education (PE) lessons.

The United States Centers for Disease Control and Prevention (CDC, USA)¹³ recommends that MVPA levels during primary school PE lessons should reach 50% of lesson time. The UK Association for Physical Education (AfPE, UK)¹⁴ recommends that children be actively moving for 50-80% of the available PE learning time. In its health position paper, AfPE also outlines that active learning time is about developing children's physical skills by providing them with the opportunity to practise those skills during lessons in a fun and purposeful learning environment, as PE involves 'learning to move' and 'moving to learn',¹⁴ so PE lessons can enhance MVPA beyond just class time. Nevertheless, most primary school PE lessons globally do not meet recommendations for the MVPA content of class time,¹⁵ so there is a need to find more effective and sustainable good practices to increase children's MVPA levels during school time and in PE lessons.¹⁶

In Scotland, there is a great public health need for population-wide interventions to increase Scottish children's physical activity as few children reach the recommended minimum of 60 minutes of MVPA per day.^{5,17} Scotland faces a crisis arising from unhealthy lifestyles which begin in early childhood: poor diet and low physical activity or exercise create a massive burden of later heart disease and stroke, diabetes, obesity, and cancers.¹⁸ Hence the Scottish Government is keen to improve children's health and wellbeing as guidelines stated in the national "Curriculum for Excellence"¹⁹ that "*Learning in health and wellbeing ensures that children and young people develop the knowledge and understanding, skills, capabilities, and attributes which they need for mental, emotional, social and physical wellbeing now and in the future*".

To find interventions that could increase the MVPA content of school PE, a systematic review was undertaken by the author in 2019.²⁰ A literature search of global evidence (within the past decade) on effective interventions to increase MVPA during PE classes in children (8 to 11 years) was conducted. The systematic review identified five eligible intervention studies.^{21–25}

Specific rationale for the choice of the SHARP intervention for translation to Scotland

One study from our recent systematic review²⁰ was identified as the most promising for translation to Scotland among the five eligible studies, the ‘SHARP Principles’ model (SHARP), an intervention developed in one part of England.²¹ This intervention, with a few modifications, now forms the basis of the present feasibility study. The SHARP intervention was chosen for future intervention development and evaluation, starting with the proposed feasibility study, as it:

1. had clear evidence of efficacy in increasing MVPA content of PE in children in our target age range. Indeed, there was evidence that the SHARP lessons had a much higher MVPA content than standard (control) PE lessons in the original evaluation studies. SHARP had been tested twice across multiple schools in the West Midlands, England it increased children’s MVPA during PE lessons by 30% and 27% respectively.^{21,26}
2. had a theoretical basis - the intervention was grounded in a combination of theoretical frameworks namely the Self-Determination Theory (SDT),²⁷ the Socio-Ecological Model,²⁸ and key components (e.g., barrier identification, action planning, and providing instruction) from Behaviour Change Taxonomy.²⁹ In the original development of SHARP, SDT was applied to connect the roles of the Head Teachers, PE subject leader, and the individual teachers. The components of SDT were implemented through a supportive autonomous role (autonomy) along with developing teachers’ social networks (relatedness) and knowledge (competency). Implementation of the SHARP Principles in Scotland is underpinned through the original SHARP Principles model. It is intended that when the intervention is translated to Scotland teachers have relatedness through the shared aims of PE within the school and their connection with each other as professional practitioners working towards this shared aim, along with the support of their PE subject leader and school leadership team. Moreover, since SHARP is applied to teachers’ existing planning, it ensures that they can retain autonomy, so it is also faithful to SDT.
3. could be applied at little cost, as it could be potentially applied to any PE lessons with no additional equipment or other resources.
4. appeared applicable for the Scottish context, in part due to the close cultural and social contexts between England and Scotland. SHARP involves teaching existing PE lessons but in a more physically active way and does not require curriculum changes or extensive re-learning by teachers.
5. had readily accessible online resources available. The SHARP teaching resource cards and videos were available online for teachers’ use.³⁰ The SHARP Principles can be learned by both generalist class teachers and specialist teachers of primary PE in a workshop with the support of these materials.

Table 1. Key areas of focus to be addressed and method to assess that area.³¹

Areas of focus	The feasibility study asks	Method to assess/evaluate
Acceptability	of the intervention	assessed by qualitative methods
Implementation	of the intervention - can it be implemented as planned/what refinements are needed? What adaptations to the intervention might be needed?	assessed by a combination of quantitative evaluation of the number of SHARP sessions delivered and qualitative work
Integration	of the intervention into the new setting - can teachers integrate it into their routine teaching practice?	assessed by qualitative methods
Limited efficacy testing	is there any preliminary evidence of efficacy?	quantitative evaluation (MVPA content of PE lessons by collecting accelerometers data between intervention vs control classes) - the SHARP lessons had higher MVPA content in two previous evaluations in England. Increased children’s MVPA during PE lessons by 30% and 27% respectively. ^{21,26}

The present study aims to describe how we will test the feasibility of the SHARP intervention in Scotland. We propose this study as the foundation of future research which tests whether the SHARP-Scotland intervention works or not, and how it might be implemented across various parts of Scotland to increase MVPA during PE (two lessons of PE per week are timetabled in Scottish primary schools), and in turn increase overall MVPA. Hence, to assess the issue of ‘can the SHARP Scotland intervention work?’, the current study is planned to assess some key areas of focus for feasibility studies as proposed by Bowen *et al.*,³¹ particularly Acceptability, Implementation, Integration, and Limited Efficacy Testing (Table 1).

Methods

The study sample, recruitment, randomization, and consent

Children from 8-11 years old (Primary 4 to 6) will be involved from two local authority primary schools in the Glasgow area, characterised for socio-economic status using the Scottish Index of Multiple Deprivation (SIMD).³² All class teachers from 18 classes will be invited to take part and we intend to recruit a total of eight classes/class teachers which will then be randomly allocated to four intervention classes and four control classes (standard curriculum, offered the SHARP intervention training after the eight-week intervention, i.e., a wait-list control) by a member of staff from the Mathematics and Statistics Department in our university who is not connected to the study. A total maximum of around 240 children will be involved in this study (the typical class size in Scottish primary schools is 30 pupils).

We have not yet registered this trial because the local authority will only give agreement in principle until the schools are operating normally post-COVID. We also cannot apply for ethics approval until schools are operating normally post-COVID. When schools will be operating normally is unclear, and the restrictions which might apply to PE classes, or to our research (e.g., access to schools) are unknown at present. Once confirmed, this study will seek ethical approval from the University of Strathclyde’s School of Psychological Sciences and Health Ethics Committee. Any amendment to the study protocol will be submitted for ethical approval before implementation. Consent will be obtained from all participating children via parental consent forms. All pupils attending the relevant PE classes will be considered as suitable for inclusion, with no exclusions, though if children have health reasons which might impair their ability to take part in PE this will be noted. Teachers will be required to provide informed written consent. Verbal assent will be sought from children before enrolment in the study, and their parents will be required to provide informed written consent.

Teacher training in the SHARP intervention

The intervention will be delivered by generalist class teachers and the SHARP Principles (more active approach) will be adopted when they are teaching PE lessons. Teachers of intervention classes will be trained in the SHARP approach (via a workshop) before intervention commencement. They will then be asked to apply the principles in their PE lessons over one school term (eight weeks). The workshop will be delivered by the originator of the SHARP (EP) and the PE specialist (CS) involved in translating SHARP Scotland. Existing SHARP resources and training materials are available online³⁰ and will be used by the teachers involved. Group planning sessions (30 minutes), as required will be used to help teachers deliver the intervention and intended also to motivate teachers to use the SHARP Principles in their planning and teaching. Training content will be flexible and would depend on what is needed to modify the SHARP Principles according to the curriculum and environment of Scotland. To provide additional motivation for teachers to take part, the training will count towards continuous professional development hours.

(A summary of the intervention description (trial process) is outlined in Figure 1).

To apply the SHARP teaching principles in the intervention

The SHARP intervention is based on five teaching principles named ‘SHARP Principles’ (Stretching whilst moving, High repetition of skills, Accessibility, Reducing sitting and standing, and Promotion of physical activity^{21,26}). SHARP Principles are designed specifically to help teachers deliver their existing PE classes but to do so in ways that involve more children in the class moving for much more of the class time, to increase MVPA during the lesson. The authors of the present study consist of the original developers of the SHARP intervention in England, a PE specialist teacher from Scotland, and the researchers responsible for evaluation. We consider that SHARP can be adapted to the Scottish context relatively easily, in part because it does not seek to change what is taught in the class but focuses on how it is taught (in a more active way).

In brief, the SHARP Principles are as follows³⁰:

Stretching whilst moving - During the warm-up section of a SHARP PE lesson, activities are to include dynamic movements (such as movements that engage the lower and upper body), and stretches (e.g., side shuffles, jump and twist, high knees, and skipping).

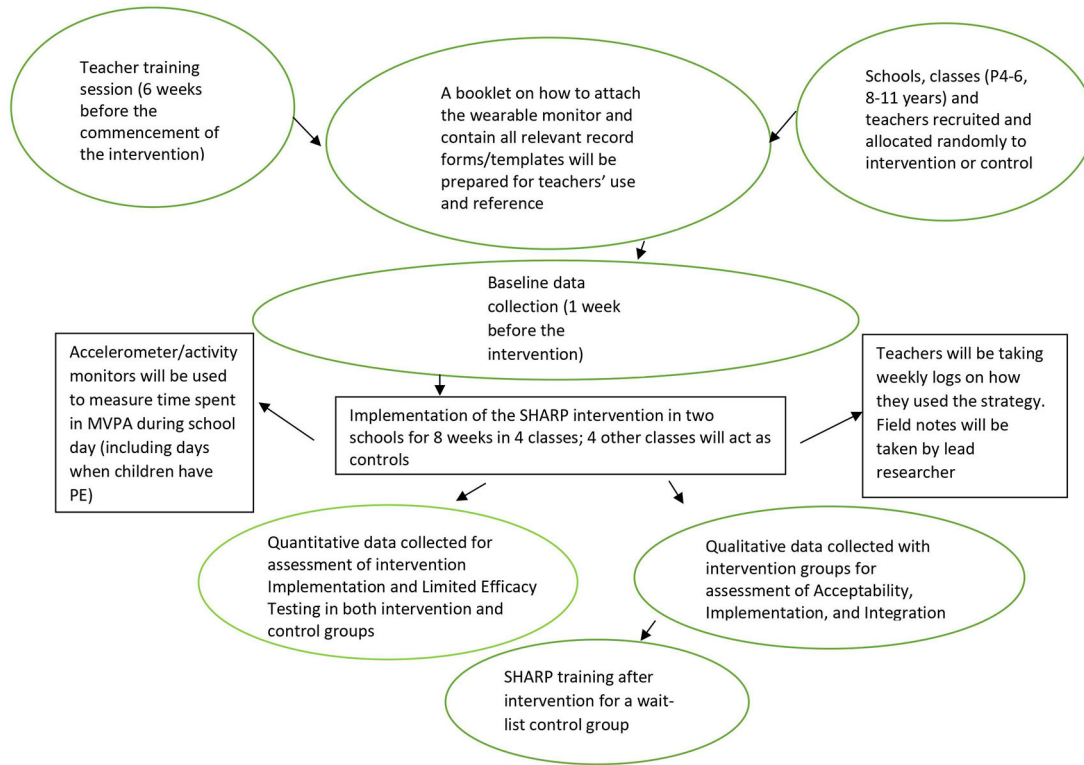


Figure 1. Intervention description.

High repetition of motor skills - SHARP increases active learning time by reducing queueing. SHARP can also increase the amount of existing equipment used in each class or increase the number of learning stations.

Accessibility through differentiation - SHARP focuses on setting tasks appropriate to children’s physical, cognitive and social development, which will enable them to engage in more active learning time. Teachers can use the ‘STEP framework’ (space, task, equipment, and people) for more effective differentiation of activities in class.^{21,26}

Reducing sitting and standing - SHARP increases teachers’ awareness of the amount of time children are sitting and standing during the lesson with knowledge transfer, teacher feedback, and improved organisation of equipment. In a SHARP lesson, teachers should engage children in activity as soon as possible at the start of a lesson, they should not stop the whole class from moving while instructions are being given, they should encourage children to stay active (e.g., by continuing to practice skills) while receiving instructions, and they should organize equipment to minimize queueing.

Promoting in-class physical activity - This principle is based on teachers’ encouragement of greater children’s in-class physical activity through positive praise such as ‘Great teamwork, keep moving and looking for space’.

Assessment of feasibility

The Bowen *et al.* Framework³¹ (Acceptability, Implementation, Integration, Limited Efficacy Testing) will be used to assess the feasibility of the SHARP intervention and evaluation in Scotland (Table 1).

Acceptability

Acceptability assessment is an attempt to answer the question framed by Bowen *et al.* but applied to the present study of ‘Can SHARP work in Scotland?’³¹ Qualitative methods will be used to assess the willingness of school staff to deliver the programme, (e.g., willingness to be allocated randomly to intervention or control groups, willingness to deliver lessons using the SHARP Principles), and willingness of children to participate. Acceptability of the methods used for measuring the intervention effect in a future evaluation (e.g., whether children find using the accelerometer acceptable) will also be assessed. All qualitative data will be collected via questionnaires and semi-structured focus groups with teachers and pupils on completion of the intervention.

Implementation

Implementation is an assessment of the extent to which the intervention was delivered as planned³¹ - can it be implemented as planned/what refinements are needed? The process evaluation will be supported by the Medical Research Council (MRC) guidance on process evaluation of complex interventions.³³ Quantitative methods will be used to assess recruitment and participant attrition rates (class level and individual level), and intervention fidelity. The researcher's observations of the delivery, relevant documentation, and records (such as teachers' logs - teachers will be asked to log each PE lesson delivered and whether they used SHARP Principles and which ones, using a checklist) will enable the researcher to reflect on the appropriate use of and application of behaviour change tools utilised. Qualitative semi-structured focus groups with the class teachers will be used to identify any refinements to the delivery of the SHARP Scotland intervention which might be required from teachers' perspective.

Integration of the SHARP intervention in the Scottish context (SHARP Scotland)

Integration, as defined by Bowen *et al.*³¹ and applied to the present study, is an assessment of the extent to which changes to the school were necessary to integrate SHARP PE lessons (e.g., any changes to timetabling, equipment, unintended teacher impacts such as increased workload). This type of assessment, as framed by Bowen *et al.*,³¹ is necessary to assess whether the intervention is feasible beyond the counting of the number of sessions delivered. The integration will be assessed by qualitative methods. Semi-structured focus groups with class teachers will be used to identify the changes to the school which was necessary and to identify any unintended consequences if integrating SHARP lessons.

To some extent, the issue of integration of SHARP Principles into the Scottish primary school system has been addressed by co-production work³⁴ involving the study authors (researchers, original SHARP development team in England, plus primary school PE specialist from Scotland) before the feasibility study. The main outcome of this co-production was a modified version of the original SHARP Principles intervention ('SHARP Scotland'). [Table 2](#) outlines the differences between the original SHARP intervention and the translated version of the SHARP Scotland intervention which will be tested for feasibility.

Limited efficacy testing

Bowen *et al.*³¹ recommend limited efficacy testing in feasibility studies. Only preliminary evidence of efficacy will be obtained in the present study, and the extent to which the primary outcome of a future evaluation (MVPA content of PE lessons in both the intervention and control groups using accelerometer) can be measured feasibly will be assessed by quantitative methods. We will measure MVPA during PE lessons and the whole school day in all children with hip-worn Actigraphs. Children will be asked to wear the Actigraph during school time for five days from the beginning to the end of the intervention.



Whole-school day MVPA data will be collected to provide useful contextual information on the amount of MVPA being accumulated during the school day, and because in previous studies we have found that it is more practical to collect accelerometry data during specific periods of the school day (e.g., PE class, recess) if children simply put the Actigraph on at the start of the school day and return it to class teachers at the end of the school day. The feasibility of accelerometry will be assessed as the number of school days with at least 75% of wear time as a percentage of the total number of school days in which children were asked to wear the accelerometers. The teachers in the classes will be shown how to help children put the monitors on/check that they are being worn and worn properly and asked to ensure that the monitors will be put on the consenting participants at the start of the school day and remove just before school finishing. This process of accelerometry data collection also minimizes disruption and delay to PE classes (by avoiding the need to distribute accelerometers during the PE class). Teachers will also be asked to record children's PE classes (PE date, day start time, and finish time) in a class diary.

Analyses of between-group differences in the MVPA content of PE (the percentage of time in PE class spent in MVPA), will be preliminary, as the feasibility study is not powered to test for intervention effects. As this is a feasibility study, one of the main objectives is to collect appropriate data to inform a power calculation for a future Randomised Control Trial (RCT). Therefore, no sample size calculation was undertaken for this feasibility study, but the samples will be sufficient to measure important feasibility parameters, notably accelerometer loss, accelerometer data loss, and our ability to identify and extract accelerometer data from PE classes. The analyses will inform a future full-scale trial if feasibility is high.

Dissemination

Findings of the study will be disseminated via publications in peer-reviewed journals, conference presentations, and lay summary reports/presentations which will be given to parents and primary school teachers who participate in the study.

Table 2. The differences between the original SHARP intervention and the translated version of SHARP Scotland intervention.

Original SHARP Principles Model Duration – 1 school year Population: Primary school children (year 3 and 4 (aged 7 to 9 years)/year 1 to year 6 (aged 5 to 11)) ^{21,26}		Adapted “SHARP Scotland” Intervention: Duration – 8 weeks (1 school term in Scotland) Population: Primary school children (P4 to P6, aged 8 to 11 years)	
Components	Details		Details
Teacher training	<ul style="list-style-type: none"> Support by head teachers at the organisational/policy levels, PE coordinators, and other staff members in the use of the SHARP Principles during PE lessons Joint planning sessions (30 minutes) 		<ul style="list-style-type: none"> Four teachers provided with a “3-hour workshop”. Aimed to get teachers on board, motivate them with initiate peer group support among trained teachers, and empower them with the knowledge and skills to deliver the SHARP. Arranged with ongoing support plus online communication to provide instant feedback if required. Group planning sessions (30 minutes).
Provision of materials and equipment	<ul style="list-style-type: none"> Pedagogical guidelines for teachers to consider during the planning and delivery stage of their PE lessons Provide the SHARP Principles instruction and resources cards 		<ul style="list-style-type: none"> Pedagogical dialogue on what and how to modify the SHARP Principles Model according to the curriculum and environment of Scotland. Provide the SHARP Principles instruction and resources cards and an overview video resource & SHARP PE lessons – for example, video resource. Online communication to provide instant feedback if required.
Teaching content	<ul style="list-style-type: none"> A minimum of two different activity areas of the primary PE National Curriculum (e.g., dance, gymnastics, games, athletics, and adventure activities), joint planning Content aligned with the National Curriculum for England. 		<ul style="list-style-type: none"> Co-production approach to the translation of SHARP to Scotland (input of PE coordinator and relevant class teachers will be needed via online if necessary) has already taken place. Minimal modifications made to original SHARP intervention content and training materials as it was felt that SHARP Principles can be applied to existing PE lessons. Teachers will be using their normal PE curriculum but delivering the lesson in a SHARP (more active) way Contents align with the Curriculum for Excellence in Scotland as based on existing PE classes. A feasibility study
Nature of intervention	<ul style="list-style-type: none"> A quasi-experimental, non-equivalent group design intervention 		
Theoretical constructs of the SHARP Principles model are not affected by curriculum activity type or teaching style.	<ul style="list-style-type: none"> Self Determination Theory Behaviour Change Taxonomy Social-Ecological Components (Specifically directed at teachers) 		<ul style="list-style-type: none"> Self Determination Theory – (Teachers’ competence relatedness and autonomy) Behaviour Change Taxonomy Social-Ecological Components (Teachers’ individual level, interpersonal level, organisational level)
Measurement tools	<ul style="list-style-type: none"> SOFIT, (pre-and post-direct observation, training provided to observers) Semi-structured teachers interview during the post-intervention 		<ul style="list-style-type: none"> Accelerometer/activity monitor used during PE lessons and whole school day Quantitative evaluation of SHARP PE lesson delivery Semi-structured teachers/pupils focus groups
Others			<ul style="list-style-type: none"> Pre-school visit/observation. Talk to school health staff, if appropriate. City Council meeting.

Data management

Paper-format documents (e.g., field notes) will be kept locked in filing cabinets. All electronic data will be stored in the University of Strathclyde's centralised secure data storage system. Only the immediate research team will have access to raw data and will be kept for five years before being destroyed. Participants' information will also be given codes and will not be referred to by name in published documents. Only the researchers will have access to the codes and their relating participant names. Consent forms will be stored separately from participant data. Teachers' and pupils' questionnaires will be kept by the researchers after completion. After the transcription, data from interviews will be deleted immediately from voice recorders, with pseudonyms used in all reports in place of participants' names. All data collection and storage procedures will be general data protection regulation compliant.

Safety procedures

Every primary school has its health and safety policies, which the SHARP Scotland feasibility study will not breach. In the event of an accident occurring as a direct consequence of participation in the study (no high-risk activities were identified by risk assessment during ethics application) primary school teachers will report this to the research team and appropriate measures will be taken according to existing policies. The researchers will adhere to any Covid-19 safety requirements in place at the time of the study.

Data analysis

A descriptive analysis will summarise the findings of the feasibility and acceptability parameters of interest such as the proportion of children measured at baseline and follow-up to calculate recruitment and attrition rates. Accelerometer data (primary outcome MVPA during PE lessons) will be used to estimate differences in the MVPA content of school PE between intervention and control groups and it is useful for planning future trials. Qualitative interviews/focus groups will be audio-recorded, transcribed verbatim, and thematically analysed. Due to the small sample size, anticipate these analyses will be exploratory and will be used to inform a future trial rather than to draw definitive conclusions regarding the effectiveness of the intervention.

Study status

Teacher training in the intervention is currently scheduled for summer 2022 (at the end of the 2021-2022 school year in Scotland) and the feasibility study itself is intended to begin later in 2022, ideally towards the start of the school year in 2022-2023 (August-October, 2022), but with the precise timing depending on how the COVID-19 pandemic is affecting schools in Scotland at the time.

Discussion

While concerns about insufficient MVPA in childhood have focused on the impact on their physical and mental health, low MVPA also impairs cognitive function and academic attainment in children.^{1,35} Only a small proportion of Scottish children are achieving the recommended minimum of 60 minutes of MVPA daily^{36,37} and so a simple school-based intervention could provide an effective measure in childhood for increasing MVPA. Therefore, it is hoped that the outcome of this study will be a demonstration that applying the SHARP Principles intervention is feasible in Scottish schools. An intervention that is translated so that it fits the Scottish context well could produce much more active PE lessons and consequently help large numbers of children achieve the MVPA recommendations.

This paper describes the protocol for the SHARP Scotland intervention feasibility study. As noted above, the original SHARP Principles intervention studies^{21,26} were successful in improving MVPA significantly in school PE lessons in the Midlands of England. Adapting successful interventions for use in other settings should be more efficient than developing entirely new interventions. Using existing interventions means that intervention evaluation does not need to start at the beginning of the process described by the UK MRC.³³ To translate an existing intervention from one setting to the other, context-specific modifications might need to be made to ensure the intervention can function as intended while still meeting its desired aims. The study outlined in this protocol aims to test whether the SHARP Scotland intervention is both feasible and acceptable in the Scottish primary schools while it follows along with the intervention development and evaluation pathway described by the UK MRC Framework.³³

Strengths and limitations of this study

There are some strengths to this study. First, it is a translation of a previously successful intervention (SHARP Principles Model) to be used in another setting (SHARP Scotland) and the feasibility testing is a low-cost, culturally relevant school-based intervention with great public health potential.^{21,26} Furthermore, both quantitative (accelerometry data; process evaluation logs; recruitment data) and qualitative (interviews/focus groups) approaches are utilised to test feasibility in the present study, so the data are complementary and can be triangulated. Lastly, information on the feasibility of the SHARP intervention and SHARP evaluation in Scotland will be useful to provide insight for a fully powered effectiveness trial in the future.

However, there are also limitations to the study. Firstly, in this study, we are only dealing with one part of the school day, PE lessons. However, PE lessons are an important part of school day MVPA since they can both increase MVPA directly (MVPA during PE time, 2 lessons per week in Scotland), and indirectly (e.g., by enhancing motor competence, physical fitness, and/or physical literacy). The MVPA accumulated in the whole school day is crucial, but it is the result of a complex system made up of many other elements e.g., influences on what children do during recess, lunchtime, and whether they have active breaks at other times. A whole school day MVPA intervention will probably be required to achieve desired population levels of MVPA but is beyond the scope of the present study. This study will be focused on one element of the whole-school complex system, but future studies will have to build on it and address the other parts of the school system. The present study is restricted to the issue of enhancing existing PE lessons through teaching strategies designed to increase physical activity above routine practice.³⁸ Secondly, as a small-scale pilot and feasibility study, the generalisability of this study may be limited due to its short duration and small sample size. However, the feasibility study is required to develop and evaluate the intervention on a larger scale in the future - it is a foundation for future evaluation research. Thirdly, since the feasibility study may be carried out during the COVID-19 pandemic in 2022, an unstable education environment might cause research delays and modifications may be required to the proposed intervention or feasibility evaluation.

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Freya MacMillan 

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This paper reports on the protocol for a PE based intervention that will be feasibility tested in Scotland. The intervention being tested is novel as it has been adapted to the Scottish setting from an evidence-based approach previously used in England. This is an important study to show that the intervention can be tailored to other countries - important for translational capacity of the SHARP intervention. The design is rigorous and considers implementation measures to guide feasibility as well as indicators of initial efficacy (which the authors correctly state is not a powered analysis). Overall this is a very well written paper that includes the necessary details to replicate the study.

I have some minor suggestions to improve this paper:

- The abstract describes the study as a RCT (randomised control trial). The methods section describes the RCT as being of wait list design. Please add 'wait list' to the abstract so it is consistent. It would be good to concisely mention in the abstract too that the teachers delivering the intervention are not the same teachers taking the control classes (there is a worry over potential contamination if they were - eg once trained up in SHARP, how easy would it be to revert back to a usual care style).
- Non-health benefits is a clunky term. Instead can you provide an example of the types of benefits outside of health (eg additional benefits such as academic performance).
- Why the 'previous' WHO recommendation and not the 'current?'
- 2nd sentence of the 'limited efficacy testing' section should read 'accelerometry' or 'accelerometers'.

Is the rationale for, and objectives of, the study clearly described?

Yes

Is the study design appropriate for the research question?

Yes

Are sufficient details of the methods provided to allow replication by others?

Yes

Are the datasets clearly presented in a useable and accessible format?

Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Lifestyle behaviour intervention development, implementation and evaluation

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

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