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Collaborating With Schools for Public Health Research in England: Lessons Learned for Successful Partnerships

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Abstract

Carrying out health research with schools can be both challenging and highly rewarding. Here we describe lessons learned from a research partnership lasting over 5 years, initially with 84 primary schools in London and Luton, and extended to 35 secondary schools, during our children health cohort study. This period included school closures and societal disruption during the COVID-19 pandemic, creating additional challenges to ongoing school participation. Our study involved annual health assessment visits to schools to test over 3000 participants and parental self-report questionnaires, to assess the potential benefits of air quality improvements arising from London Ultra Low Emission Zone (introduced in April 2019) on children's lung development and health. Measures included height, weight, pre- and post- bronchodilator spirometry, physical activity monitoring, cognitive assessment, epigenetic markers of disease risk, SARS-CoV-2 IgE and IgM antibody testing, and heavy metals testing. The average annual participant attrition for our study was 11.6%. The acceptable threshold outlined in the initial protocol was 20%. All schools continued to participate in the study for 5 years. Central to the study success have been: shared agreement on the importance of the research topic; early preparatory work with stakeholders, a parallel engaging and innovative air pollution learning and outreach programme, incentivising school/teacher co-operation and parental questionnaire completion to boost response rates and mitigate non-response bias; and continuity of contact with the accessible and flexible research team. These successes form a template for other health research studies planning long-term engagement with schools.

Keywords

health assessment, air quality improvement, longitudinal study, school engagement, attrition, recruitment, retention

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Introduction

Meaningful engagement and involvement with participants in public health focused research is widely recognised as being necessary to ensure that research remains relevant, useful and trusted by individuals and communities.[1] Schools are popular settings for conducting health research involving young people, providing both practical and contextual benefit for health investigators. Working with children in schools is socially significant because findings can have both immediate and long-term benefits in the lives of developing children[2] and local communities.[3,4]

Schools provide large and often diverse groups of children and young people, conveniently stratified by age, who can be easily approached when successful and trusting relationships have been developed between schools and researchers.[5] Schools are a safe place for children, where the majority of parents have trust in the organisation and governance. However, trust between community and researchers cannot always be assumed as "one of the major challenges in conducting health research is the understandable lack of trust that often exists between community members and researchers, based on the long history of research that has had no direct benefit. . .and no feedback of the results to the participants involved."[6]

Furthermore, due to the large number of studies and projects competing for time on a school's busy schedule, and schools' overriding priority being the education of their students, many researchers have found it difficult to encourage schools to participate in research projects.[7] Problems are often related to building relationships and communicating, including ensuring that school partners in research feel heard and valued, managing expectations about project progress, and maintaining continuous participation over time, within the highly dynamic school environment.[8]

It is therefore important for research teams to build positive and effective relationships with school staff and parents to conduct successful research.[5,9] Research considerations need to be combined with a careful examination of the needs of each individual school in order to build a successful recruitment and retention strategy.[7] Furthermore, conducting health research with children in schools can be challenging due to: gaining access from gatekeepers, logistics and planning of successful field days, co-operation of school staff, parental consent and maintaining contact and positive relationships, particularly over extended periods.[10,11] Ongoing engagement is vital for success where studies use designs that require repeated measurements over time, particularly cohort studies.

We describe our approach and insights from our research - a 5-year parallel natural experiment cohort study (initially 4 years but extended by 1 year due the COVID-19 pandemic), working with primary and secondary schools in London and Luton from 2018 to 2023 to test if the introduction of the Ultra Low Emission Zone (ULEZ) in London would produce improved lung growth in children. Substudies addressed secondary hypotheses on impacts of the ULEZ on physical exercise, obesity and travel behaviours, and cognitive function development. The study is described in detail elsewhere.[12]

By adopting a school-centred research approach, our research team were able to initially partner with 84 primary schools across the 2 study sites and through these partnerships acquired individual parental consent for participation of 3414 children from school years 2, 3, and 4 (aged 6-9 years) to take part in the study. With a 1-year extension to the data collection period to compensate for school closures during the COVID pandemic, we extended recruitment to 35 secondary schools to which the older children among our cohort transitioned. Our partnerships allowed us to schedule and carry out over 500 visits to schools to collect annual health data from participating children, including: height and weight measurements, spirometry assessments, physical activity and travel behaviours, and in subsets of children: measurements of cognitive function and mental health, capillary blood sampling for COVID antibodies and heavy metals, and saliva sampling for DNA and epigenetic analyses.

School closures and social distancing restrictions during the COVID-19 pandemic, and especially the 3 national lockdowns that took place between March 2020 and March 2021, presented particular challenges in terms of continuing engagement and retention of schools and undertaking data collection. Carrying out research activities in the form in which they were originally planned became impossible, hence the investigators had to find alternative ways in which to continue engaging children, teachers and parents, to continue data collection, and to prevent schools from dropping out.

The aim of this article is to share the experiences and lessons learnt from conducting public health research with children in school settings from our research study before, during and after the COVID-19 pandemic. Our reflections might be beneficial for teams conducting school-based research with children and young people, and for researchers who are exploring paths to broadening research impacts and enhancing outreach to diverse communities. Building and maintaining positive, flexible and effective relationships with school staff and parents, even during challenging times, is vital.[9]

Methodology

Research Planning

Researchers naturally think their research topic is sufficient of itself to lead to a school's participation, but our experience shows that schools had a range of different considerations as seen in Figure 1.

Failure to address these fundamental questions, risks recruitment failure at the outset.

In order to mitigate such risk, our team invested time in preparatory work with head teachers, teachers, parents, and children attending schools in the study target area in central London and Luton. We used an informal approach, obtaining permission from head teachers to speak to parents at the school gates of schools eligible for the study, as they collected their children from school. Recent research provided evidence that air pollution levels in Luton was associated with stunted lung growth in primary school children.[13]. We discussed with teachers the optimal means of giving parents information and securing written informed consent (see

Figure 1. School considerations.

Attachment 1) for participation – in this case by sending information sheets and consent forms home in the children's school bags. Every consent form covered all aspects of the study and was signed by the parent and the child.

By involving them in the research planning phase, where the research topics and agendas are set, research questions and aims are agreed, and study design and materials are designed, our research study team were able to facilitate their needs.[14] The stakeholders reflected on their own experiences with air pollution and brought innovative ideas and logistical support to our research study.

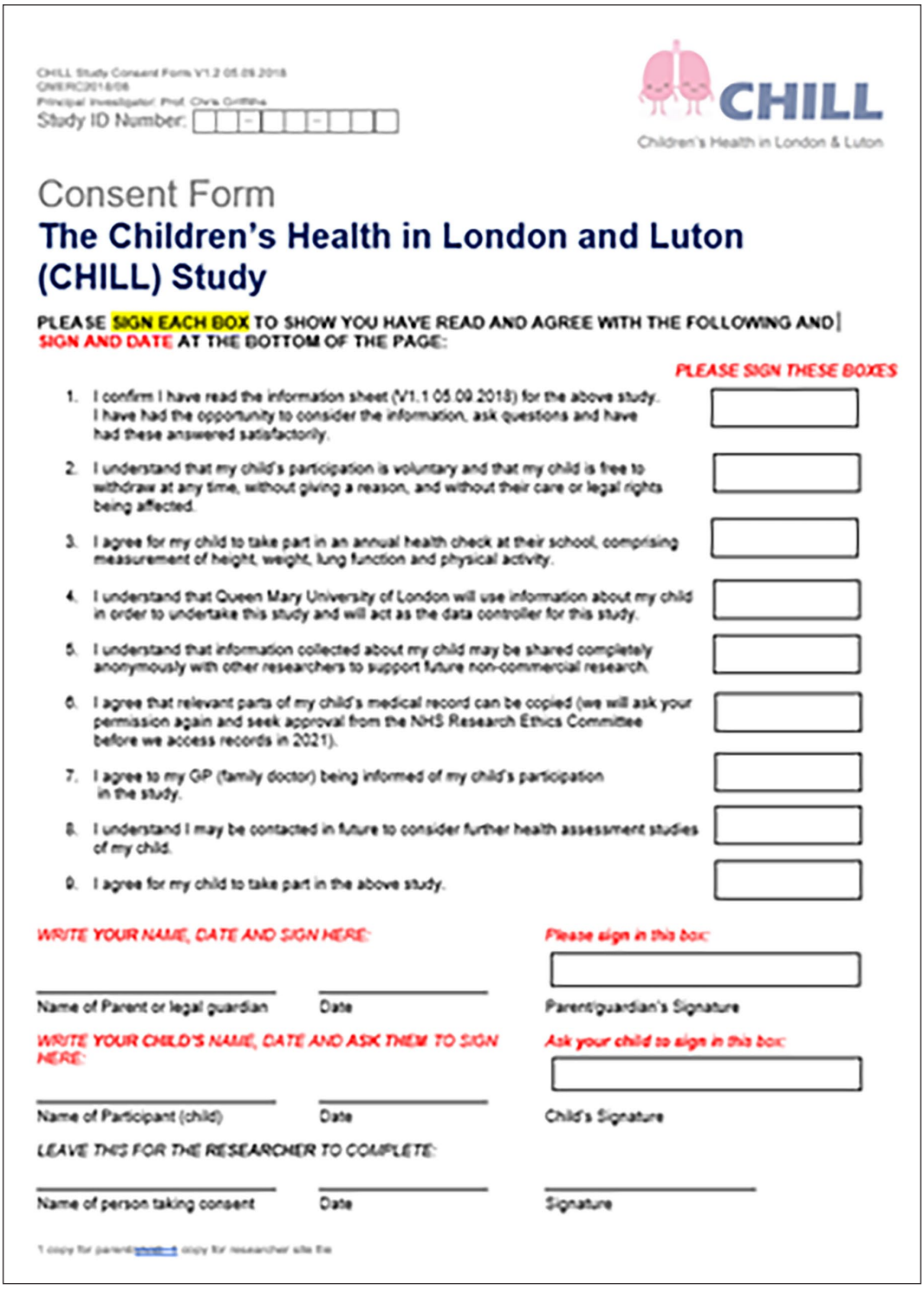
Recruitment of Schools and Children

Considerable data on schools is publicly available on the websites of local authorities and individual schools themselves, enabling researchers to build a picture of the likely numbers of schools and children eligible for a research study.

The 2 pools of schools eligible for recruitment to the study were clearly defined by the study eligibility criteria, in this case state primary schools situated or with catchment areas within the central area of the ULEZ in London (intervention cohort), or within the Borough of Luton (comparison cohort). Schools meeting these criteria were contacted and invited to participate, and meetings arranged with head teachers or their delegates to discuss the study and answer any questions.[12]

Appendix 1 provides an example of our study school Participants Information Sheet.

The results of this school-centred approach enabled us to recruit 84 primary schools and 35 secondary schools' representative of the range of socioeconomic and ethnic profiles of school-aged children across London and Luton.



CHILL Study Consent Form V1.2 05.09.2018
GWERC2018/08
Principal Investigator: Prof. Chris Griffiths
Study ID Number: [ ][ ]-[ ][ ][ ]-[ ][ ][ ]

CHILL
Children's Health in London & Luton

Consent Form

The Children's Health in London and Luton (CHILL) Study

PLEASE SIGN EACH BOX TO SHOW YOU HAVE READ AND AGREE WITH THE FOLLOWING AND SIGN AND DATE AT THE BOTTOM OF THE PAGE:

PLEASE SIGN THESE BOXES

1. I confirm I have read the information sheet (V1.1 05 09 2018) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. [ ]
2. I understand that my child's participation is voluntary and that my child is free to withdraw at any time, without giving a reason, and without their care or legal rights being affected. [ ]
3. I agree for my child to take part in an annual health check at their school, comprising measurement of height, weight, lung function and physical activity. [ ]
4. I understand that Queen Mary University of London will use information about my child in order to undertake this study and will act as the data controller for this study. [ ]
5. I understand that information collected about my child may be shared completely anonymously with other researchers to support future non-commercial research. [ ]
6. I agree that relevant parts of my child's medical record can be copied (we will ask your permission again and seek approval from the NHS Research Ethics Committee before we access records in 2021). [ ]
7. I agree to my GP (family doctor) being informed of my child's participation in the study. [ ]
8. I understand I may be contacted in future to consider further health assessment studies of my child. [ ]
9. I agree for my child to take part in the above study. [ ]

WRITE YOUR NAME, DATE AND SIGN HERE:

Please sign in this box: [ ]

Name of Parent or legal guardian _____ Date _____ Parent/guardian's Signature

WRITE YOUR CHILD'S NAME, DATE AND ASK THEM TO SIGN HERE:

Ask your child to sign in this box: [ ]

Name of Participant (child) _____ Date _____ Child's Signature

LEAVE THIS FOR THE RESEARCHER TO COMPLETE:

Name of person taking consent _____ Date _____ Signature _____

1 copy for parent/[redacted] copy for researcher site file

Attachment 1. Consent form.

Recruitment of the school was the first stage in a partnership, the second stage was recruiting children as participants for the research. Parental consent was sought for each child to participate.

In addition to parent information sheet (Appendix 2) and children information sheet (Appendix 3), the team worked with a professional video company to provide a short engaging YouTube video, involving child actors role-playing the elements of the research. A video was easily accessed via links embedded in emails or QR code scanning and easily watched by parents and children together on mobile phones.

Some of the most useful and practical approaches were found to be school assemblies, playground visits at home time, classroom visits, using the schools' communication systems and social media.

Figure 2 illustrates the approaches that worked for our team during the recruitment process.

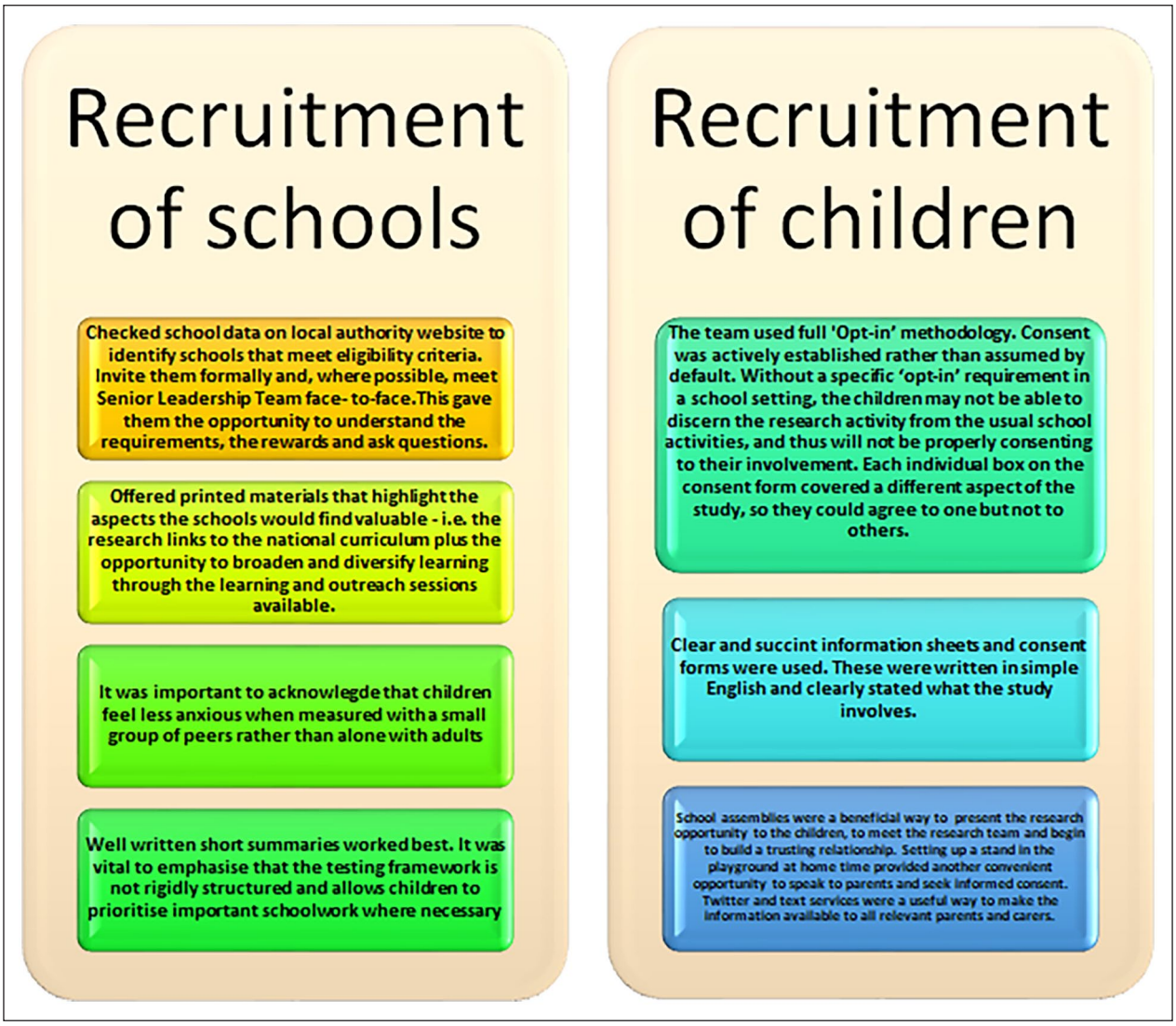


Figure 2. Approaches in Recruitment.

Importance of Public Engagement in Recruitment and Retention

Recruitment of schools and children can also be enhanced through the use of public engagement.[11] Using local and national media or local radio to increase publicity and the profile of the research can play a vital role in accessing a broader range of families within the local area; this could also include those families who speak English as an additional language, thus increasing interest and subsequently participation in the research Schools and their communities often work very closely together in various aspects of school life - from knowledge and teaching to parental support and empowerment. Therefore, discussions between these communities plays a role in promoting the study and enabling the study to be recognised.

The team organised a high-profile launch for the study and worked closely with contacts in the Public Health units of local authorities to arrange simultaneous school visits. The mayors of London and Luton were present at the launching of the project. These provided ready images and copy for local print, regional and national TV, and social media, leading to widespread dissemination of the study, further promoting the study to other schools in the study areas.

Ethical and Safe School Visits

Prior to data collection visits, the team ensures an ethical and safe environment for the researchers and the schools involved. Proof of enhanced Disclosure and Barring Service (DBS) checks (as required by the Office for Standards in Education, Children's Services and Skills (OFSTED) for all study team members visiting schools is a prerequisite for school participation. DBS certificates and work photo IDs were presented upon entry.

Incentives and Science Outreach

Partnering with schools for research is not only beneficial for the research team, but also for the children involved and their schools. Offering incentives for the school plays an important role in collaboration. Based on feedback from participating schools, the incentives were used to purchase

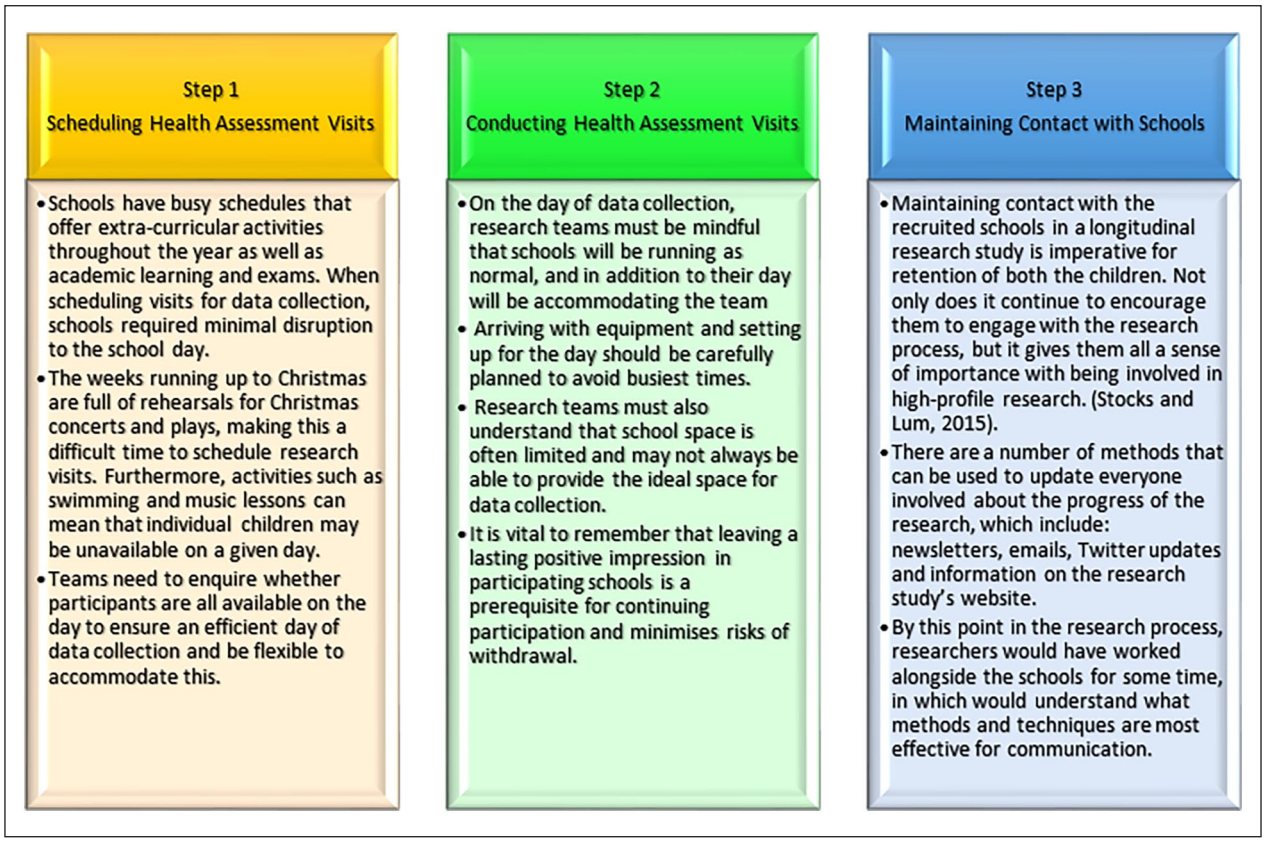


Figure 3. Data collection in 3 steps.

sports equipment, build outdoor learning spaces and fund extra-curricular activities.

Giving the children who participated a small stationery item such as a pen, badge or certificate as a "thank you" is very well-received (Appendix 4), making the children feel valued as part of the research and encourages them to participate again in the future. Parents were also incentivised to return their questionnaires annually. They got a £5 supermarket voucher for returning the health questionnaires.

Offering science educational workshops is a useful way to reach children within the school beyond those consenting to the study. Engaging children in disadvantaged areas in science, especially those under-represented in science, technology and Medicine (STEM) professions including women and those from minoritised ethnic groups is especially important. Children readily understand that their environment is polluted and under threat. Engaging them in interactive informative play readily allows them to understand and begin to articulate views and advocate on this topic.

The team partnered with an award-winning public engagement science group to develop and deliver interactive learning and outreach sessions over the course of the study. These were delivered by a Learning and Outreach Officers. They were STEM subject university graduates who were responsible for the delivery of our interactive learning experiences and building community partnerships. They co-ordinated outreach activities that align with educational standards.

The outreach activities were supported by additional leveraged funding. Topics reflected the additional substudy elements during the course of the study are outlined in Appendix 5.

These outreach sessions were highly attractive to schools and had an important additional effect: retaining schools and children in the study. Comments were almost invariably positive, including for example, from a teacher: "I've never seen my children so engaged in a topic."

Our learning and outreach extended to the wider community and beyond, for example we delivered sessions at local festivals, national initiatives (MRC event, New Scientist LIVE), and leading science bodies.

The School Visits

Figure 3 illustrates the data collection in 3 simple steps:

- Step 1. Scheduling Health Assessment Visits
- Step 2. Conducting Health Assessment Visits
- Step 3. Maintaining Contact with Schools

Sustaining Relationships With Schools and Parents During COVID-19 Pandemic

The COVID-19 pandemic brought unprecedented challenges for society and families. Sudden changes in resources, daily routines and relationships as a result of restrictions on physical interaction resulted in major impacts on families with children. In the absence of school, childcare, extra-curricular activities and family gatherings, children's social and support networks were severely disrupted. This was particularly evident in families with low levels of social support.[15]

The pandemic presented very specific challenges for our research study. Spirometry (blowing into a machine to measure lung function) is a procedure that can generate an aerosol, presenting a potential cross-infection risk. The team had the double challenge of finding a way of visiting schools in a way that was safe for schools and the study team, but also carrying out spirometry safely.

We identified and worked with 4 "pathfinding" schools who helped us to remain in touch with our participants and research partners. Parents, school staff and children were invited to online meetings that helped the team to identify concerns and priorities by listening to honest, helpful and practical suggestions. They were given the opportunity to raise concerns and voice their questions as active contributors to our revised research strategies. These contacts helped to expand the dialogue and acknowledge lived experience. As research on covid transmission dynamics and risk developed, we found ways of minimising risk by carrying out spirometry assessments outdoors under gazebos, and later, in well-ventilated large rooms, using CO2 monitors to give a proxy of fresh air exchange. These approaches were formally co-designed and risk-assessed with stakeholders and respiratory health experts from European Respiratory Society and Public Health England. The team also created interactive science workshop activities that could be accessed by our study participants in their own time. Questionnaires were sent to participants who we could not visit and without a deadline for completion, thus giving families room and time to adjust to their new routines and roles during lockdown.

Retention

Various cohort retention and implementation strategies were adopted. Participating schools were given an annual incentive of £250 for each stage of data collection. Staff members with responsibility for participant contact were provided intensive training and support on study protocols, including retention techniques. In recruiting research staff for our study team applicants were screened for experience, communication skills, cultural-competence, and specialised knowledge of the population (ie, in Luton where a large part of the cohort was of Asian/Asian British origin, researchers with similar ethnic backgrounds were employed. A number of different contact details for participants were recorded and these updated at every participant contact.

20 secondary schools in London with small numbers (<5 children per school) of our cohort participants were identified; The team did not have the resources to visit these schools to carry out health assessments. To retain and gather data on these participants, we ran a health assessment event in central London on 2 consecutive study years (Y4 and Y5). These combined health assessments with science engagement sessions. Centralised testing flyers were sent to participants (Appendix 6). These proved popular and successful and were attended by over 70 children.

Cohort retention issues were discussed through meetings involving research assistants, project managers and principal investigators. During these meetings, the study team examined the latest recruitment and retention rates and discussed strategies and ideas for participants who were difficult to contact.

Table 1 illustrates the challenges encountered by the research team and the measures taken to resolve them.

Discussion

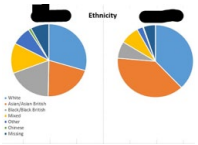
Recruiting and retaining participants in health research is often challenging, especially in ethnically and culturally diverse populations living in disadvantaged communities. These communities face unique challenges, adversities and inequalities.[16] We presented practical solutions that have helped to recruit and retain schools and participants over a 5-year period, as an exemplar for future longitudinal studies in school-aged children.

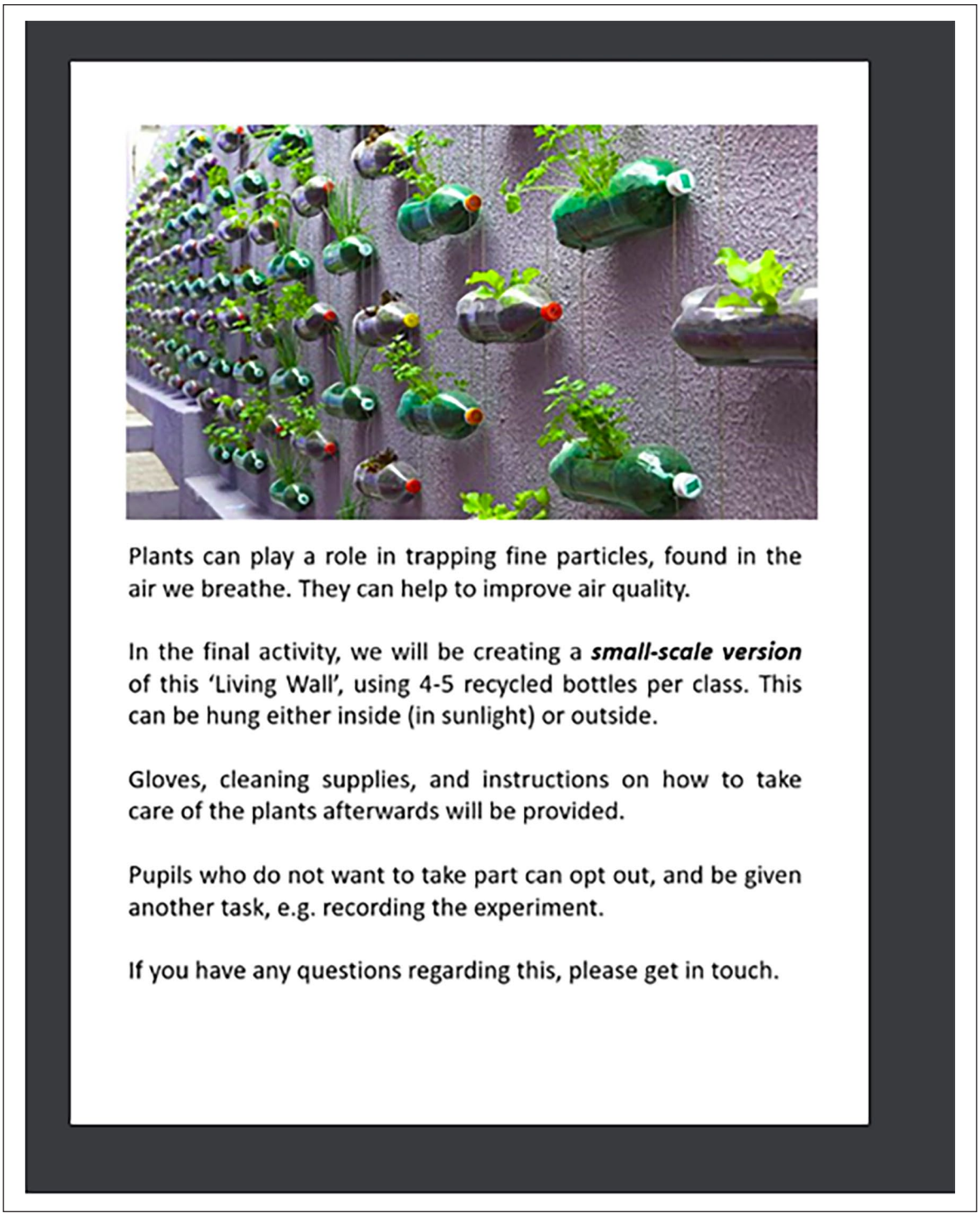
Engaging everyone involved in the research (school staff, parents, children, local council members etc.) at the earliest possible opportunity, helped the research team to make informed decisions about the research process and make some practical changes. Benefits included getting input on research activities, developing culturally sensitive approaches and enhancing the recruitment and retention of research participants.[17] Stakeholder engagement is a powerful vehicle for effectuating changes that can improve health.[18]. Engaging community health stakeholders in the research process is often the missing link to improving the quality and outcomes of health promotion activities, disease prevention initiatives, and research studies.[19]

Maintaining stakeholder engagement for the full duration of the study is a long-term process that requires time and effort from all sides. It builds trust, values all stakeholders' contributions, and generates a collaborative framework.[20]

Children and young people are viewed as active contributors in the project, rather than objects of research.[21] Adopting involvement strategies such as learning and outreach sessions, that play to children's competencies and strengths is vital. Engagement of children and young people requires the use of creative, participatory methods, tools and involvement techniques to reveal children's abilities. Participating children learned about lung function by exploring lung props, making slime, building green walls with plants, drawing with charcoal and performing breathing exercises with straws and feathers. Attachment 2 is an excerpt of our workshop brochures. Research is often planned and described in emotionally "neutral" terms, although participatory research necessarily relies on building relationships and engaging emotionally in a research process with others.[22] Embedding the enjoyment of interactive learning about the main topic of the study within the participatory research process, was an essential part of the project. Learning and outreach sessions for the children on the study health assessment days were a major component of our recruitment and retention strategy, reinforcing the positive relationships between researchers, children, and the schools. Although many funders do not see this as a fundamental part of research which often

Table 1. Research tasks and challenges, measures and outcomes.

Research tasks and challenges	Measures taken	Outcomes
Preparatory work with stakeholders across both sites	• In London, the team visited schools, talked to school staff and parents about air pollution and its impact on our health • Sought feedback from environmental campaign groups in London • In Luton, the team liaised with the Public Health, Commissioning & Procurement department at the local council prior to launching the study • Got feedback on how best to run the assessment and input on our protocol across both sites • Piloted parent questionnaires • Had a STUDY launch event with mayors in London and Luton covered by media • In London, the team took part in local public health forums such as Love Luton: Investing in success, investing in health, and "No education without health education" Primary and Secondary School Health & Well-being Conference.	• Parents across both sites were willing to engage in a discussion about air quality but the problem was more highly publicised in London • In Luton, parents lacked specific knowledge about the Ultra Low Emission Zone (ULEZ) implementation in London, but they expressed concerns about traffic volume from the motorway, local traffic restrictions and the installation of electric vehicle rapid charging units and Gas-To-Liquid refuelling infrastructure • Managed to adjust protocol accordingly based on feedback • As a result of media coverage, the study's profile was raised and key opportunities for co-operation with schools in target areas were identified
Initial recruitment of primary schools in target areas	• Approached all schools that meet selection criteria • Engaged Head teachers, organised meetings with Senior Leadership to answer any questions • Offered each school an annual incentive for taking part	• 67% of primary schools approached in London and 69% of schools approached in Luton signed up for the study • The schools that declined to sign up for STUDY or did not respond to our contact attempts did not give children from certain neighbourhoods the opportunity to take part in the study
Participant recruitment in busy schools	• Engaged non-teaching staff • Prepared concise materials in simple English to present at school assemblies and used visuals (pictures and videos whenever possible) • Arranged brief classroom visits to engage children • Spoke to parents in school playground at home time	• Recruited over 3414 children across London and Luton and exceeded our recruitment target of 3120 by over 8%. • Some recruitment strategies worked better in London (i.e. classroom visits because the schools were smaller), whereas others worked better in Luton (i.e. large assemblies in the school hall because schools had 4 or 5 classes per school year)
Engaging parents from diverse populations and with different levels of literacy  Image 1. Ethnicity distribution across London and Luton	• If the child collecting parent spoke limited English, co-operation was sought from other family members • Where possible help from family workers and diversity and inclusion officers was sought as they usually spoke the languages of local parents • In Luton, the team used Urdu and Bengali speaking student helpers from the local university to engage with parents	• Recruited an ethnically diverse cohort. 62.6% of participants in London and 56.9% of participants in Luton were from BAME backgrounds • Different ethnicity distribution across both sites • Using paper parent questionnaires allowed the team to include parents with low digital literacy • Had lower parent questionnaire return rates from people who spoke limited English
Educate, engage and inspire children from disadvantaged backgrounds	• Explained to children how testing equipment works, what the results show and gave them tasks, not instructions • Careful consideration of contexts and use of child-centred research skills and methods • Interactive science outreach sessions covering study topics were made available to all children in the targeted school years • Children incentives were given for taking part – certificates, pens, pencils and badges branded with the research logo (Appendix 4)	• Successful post-bronchodilator spirometry was achieved with 80% of participating children • Due to evolving communication skills and different social and cognitive capacities, some children needed more time to process instructions or were unable to complete the spirometry manoeuvres • Delivered science outreach sessions to over 11 000 children over a 5-y period. • Schools reported increased interest in STEM subjects as a result of the study team interacting with participating children
Resuming data collection visits during and after the pandemic	• In the beginning, outdoor testing was employed • As the restrictions were relaxed, Perspex partitions were used to create a physical barrier between the researcher and the participating child. • Researchers wore suitable PPE (disposable gloves, aprons and FFP2 masks). • Lung function testing was done with bacterial viral filter (over 99.99% effective in preventing bacterial and viral transfer). • Salbutamol (blue inhaler) was administered using disposable spacers (one per child). • All equipment was cleaned according to manufacturer guidelines between each child. • C02 monitors were used	• These multiple adjustments made to the study SOP allowed the team to return to data collection duties soon after the last lockdown • Co-operation from pathfinding schools across both sites helped to put new implementations in practice • Had to account for various forms of restrictions and tiered systems with varied local modifications across London and Luton • Due to regional differences across both sites, there were some schools that remained closed to visitors throughout the school year 2020 to 21 and only let the study team back in from the start of the new school year in September 2021
Recruiting secondary schools after the pandemic to collect data from traced participants	• Performed tracing activities to identify which secondary schools participants have gone to • Engaged Head teachers, organised meetings with Senior Leadership to answer any questions • After tracing, prompts were sent out to recruited schools to identify participants who were not traced yet • In London, children were distributed across a much larger number of secondary schools, therefore a Centralised Testing event was scheduled for Study Years 4 and 5	• About 60% of participants were successfully traced into secondary schools • The participants who were not traced were lost to follow up due to non-contact, incorrect contact details or moving out of study area • Encountered difficulties when trying to engage secondary schools at first, as they were not familiar with the study • Secondary schools were much larger and teachers were not easily contactable • Secondary schools had limited room availability and time constraints, so the researchers had to work flexibly
Mitigating school/participants withdrawal risk and keeping attrition levels low, including during and after the pandemic	• School incentive was conditional and paid in annual instalments after data collection visits. School certificate was also given • Low value (£5 Sainsbury's voucher) was given for parent questionnaire completion • Hosted a study update zoom workshop for children and parents during lockdown • Kept children engaged via webinars and online activities • Record as many contact details as possible to perform tracing activities if necessary	• No school has dropped out of the study across a 5-y period • Adding a fifth year to the study due to the pandemic heightened the participant attrition risk • Despite adding a fifth year and going through a global pandemic, the attrition rates remained lower than the 20% annual attrition expected in the initial protocol • People moved out of central London during and after the pandemic, resulting in some participant loss to follow up • Over time, a drop-off of parent questionnaire return was observed



Attachment 2. "Pollution solution" workshop activity.

results less financial support, it plays a key role in the study experience. Children are inquisitive by nature, therefore introducing research and workshop-based activities into their typical school day is exciting for them and makes full use of their inquisitive nature. Curiosity is a powerful driver of learning.[23] Additionally, in educational settings, curiosity for scientific knowledge is a major motivation for long-term involvement in STEM subjects and predicts academic performance.[24,25] Furthermore, science education policy documents worldwide highlight the importance of scientific literacy and suggest it is essential that pupils develop their understanding about the processes of science and the type of knowledge science produces and have the ability to apply this in everyday contexts.[26]

One of the often-cited criticisms of health research is its lack of pragmatism, frequently addressing questions and outcomes of limited relevance to the end-users. This means a significant proportion of health research is potentially

wasted from the outset, because researchers have not consulted with end users when prioritising an area of research or selecting a specific research question.[27] Building trust between investigators and community members is vital and could enhance protocol development and implementation.[28,29] Engaging the community can improve the quality, validity, and relevance of research findings, and it can empower community members to advocate for programme and policy changes that may be indicated as a result of the research.[17]

Implications for Practice

The lessons learned from our research team during the 5-year study period appear to have enabled us to maintain 84 primary schools' interests, expand successfully into 35 secondary schools and keep all schools on board for the whole study, including during the pandemic. The team's tailored approach, flexibility and engagement have been vital to secure their continuous engagement with the project. Our learning journey could enable more clinical researchers to study children's health in school settings. The combination of recruitment and retention strategies outlined in this manuscript form a working template for other health studies planning long-term engagement with schools.

Implications for Policy

The tangible benefits from this study include: (A) Creating valuable educational and health promotion opportunities in areas of high deprivation where fewer resources and opportunities are available, (B) Inform policy discussion and improve decisions leading to better air quality, health, and wellbeing. Our efforts align with the Framework for Action developed by WHO that aims to enhance the ongoing work in the health and education sectors and to contribute to the achievement of other global commitments for child health. Successful partnerships in health research offer schools, parents, teachers, communities, and other stakeholders opportunities to build healthier lives and add to the creation of global standards for health promoting schools.

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Declaration of Conflicting Interests

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Appendix 1

CHILL Study Schools Information Sheet V1.1 05.09.2018
QMERC2018/08

Children's Health in London & Luton

Information Sheet for Schools

The Children's Health in London and Luton (CHILL) Study

Summary

We would like to invite your school to take part in the CHILL study. This leaflet contains information about the study, why we are doing it and what is involved. Thank you for taking the time to read it.

CHILL is a research study to find out whether reducing air pollution from traffic is good for children's health. We are particularly interested in whether interventions to reduce air pollution improve the growth of children's lungs. We are also interested in children's respiratory symptoms (like wheezing, sneezing, coughing), whether they have had to miss school for chest problems, and what impact these may have had on their parents. Finally, we are interested in children's physical activity levels and how much air pollution they are exposed to.

To do this we plan to recruit Year 2, 3, and 4 children from schools in central London and Luton to participate in the study. We would work with your school annually for 4 years, following up the same children. We would need to visit on 2 days each year, working with up to 2 classes per day. In the first year, we would provide an exciting educational session about air pollution and health to the whole class/year group. During this session, our research team would do a health check with those children who decide to take part, at the back of the class or in a separate room. As part of the health check, we would fit each child with an activity/GPS monitor to wear on their hip for 7 days, which we would come back to collect.

To acknowledge your help we will pay your school £1,000. Parents will be sent a £5 online shopping voucher as a thank you for completing the questionnaire.

Please contact us if you require any further information or clarification. We would be happy to hear from you.

Watch a short video about CHILL at this website: https://www.youtube.com/watch?v=o8j6J3F3M3g *or by scanning the QR code:*

Contents

How to Contact Us

If you have any questions about this study please contact the CHILL team:

Barts and The London School of Medicine and Dentistry
University of Bedfordshire
King's College London
asthma UK
NHS National Institute for Health Research

1 Why are we doing this study?

- Air pollution from traffic harms children's health and the development of their lungs.
- Towns and cities like Luton and London are taking measures to try to reduce air pollution (eg, introducing busways and low emission zones, installing charging points for electric vehicles, and offering travel planning advice to schools).
- We want to find out if these measures are improving children's lung development and their health.

2 Why are we asking your school to take part?

- We are inviting schools in central London and Luton because the local councils in these areas are trying to reduce air pollution.
- We are inviting children aged 6 to 9-years (school Years 2, 3 and 4) because they are old enough to be able to perform the measurements we need to make, and because their lungs are still growing.
- We need to work with a mix of year groups so that we can follow up most of the children for 4-years (children in Year 4 at the start will have moved on to secondary school before the end of the study).
- We aim to recruit at least 40 children from each school; over 3,000 children in total.

3 How are we doing the research?

- We will measure children's lungs each year for 4-years to look at their development.
- We will also look at how physically active the children are and how they travel to school, and ask their parents to fill out some questionnaires about their child's health and wellbeing.
- We will visit each school annually to do health checks with the children who decide to take part. We will visit twice, to work with up to two classes each day.
- In the first year of the study, our award-winning education team from The Centre of the Cell will run a special science session for the whole class/year group. They will learn all about air pollution and how their lungs work.
- Once we have done all the health checks, we will ask the children's parent/guardian for permission to access their child's GP records, to count how many times they have needed treatment for breathing or chest problems over the 4-years of the study.

4 What do the children have to do if they take part?

Consent

If you decide that your school will take part, we will liaise with you to decide on which classes we can work with. We will provide study information packs for each child, to be sent home in their school bags. These packs will contain information about the study, a consent form, and a questionnaire for parents to complete. If parents decide they would like their child to participate, they will return the completed questionnaire and signed consent form to school in the child's bag. Before any measurements are taken, we will also ask each child to give their assent to participate.

Health Check

Children can opt out of any of the measurements at any time if they want to. During the health check we will:

- Measure the child's height and weight.
- Measure the size of their lungs and how well they are working.
- Ask some questions about how they travel to school.
- Fit an activity monitor that they will wear for 7-days (we will return to school to collect it).

5 Possible benefits and disadvantages of taking part

What are the possible risks and disadvantages of my school taking part?

- There is minimal risk of harm to the children from taking part in the measurements.
- All measures in this study have been used before in children of this age group and we will follow established procedures.

- All staff attending the school (education team and researchers) will have been fully trained and DBS checked.
- After the first year, if we are not able to provide science sessions for the whole class, participating children will need to be taken out of class for half an hour to complete the health check.

What are the possible benefits of my school taking part?

- Your school will get to be part of an important public health research study into the effects of air pollution on children's health.
- Children in the classes selected to take part will get to learn about air pollution and health during an interactive science lesson.
- Children who decide to participate will get a free health check for their lungs and if we find anything wrong we will write to their GP for follow up.

6 More information about taking part

Does my school have to take part?

Your local authority has given us their written approval to approach schools in your area, but it is up to you whether or not your school will be part of the study. You can decide which year groups or classes we can work with (from Years 2, 3 or 4).

Do the children have to take part?

No, it is up to each child and their parents whether or not to take part. A child can only take part if a consent form signed and dated by their parent/guardian has been returned to school. Children who do not want to take part will still get to participate in the science lesson and learn about air pollution and health.

A child can stop taking part in some parts of this study, or all of it, or their parent/guardian may withdraw them from the study at any time and without giving a reason.

Is there any payment for taking part?

We will give your school £1,000 for taking part (£250 per year) and children who participate will be given a certificate. Parents who complete the questionnaire and provide their email address will be sent a £5 online shopping voucher.

What will happen to information collected?

Queen Mary University of London is the sponsor for this study, based in the United Kingdom. We will use the children's information in order to undertake this study and will act as the data controller for this study. This means that we are responsible for looking after the information and using it properly.

You can find out more about how we use the information we collect at http://www.jrmo.org.uk/

What if the child has asthma?

Any child with asthma can take part in this study. If the child has asthma and normally uses inhalers, they should continue to use their inhalers as normal on the day of the study visit.

What if there is a problem?

If you have a concern about any aspect of this study you should ask to speak to the research team who will do their best to answer your questions. Contact details are listed in Section 6.

What will happen to the results of the study?

When the project is completed, we will publish/present the results in academic journals/conferences (or similar), so that other researchers or interested parties can see them. The identity and any personal details of all study participants will be kept confidential. No named information will be published in any works stemming from this project.

Who is organising and funding the study?

This study is organised by the Centre for Primary Care and Public Health, part of Barts and The London School of Medicine and Dentistry, at Queen Mary University of London. The study is funded by the National Institute for Health Research Public Health Research Programme (project number 16/139/01).

Who has reviewed the study?

The study has been approved by the Queen Mary University of London Ethics of Research Committee (QMERC).

7 Contact for further information

If you have any questions about the study please contact us

Principal Investigator

Prof. Chris Griffiths

Centre for Primary Care and Public Health
Barts and The London School of Medicine and Dentistry, Queen Mary University of London

Email: c.j.griffiths@qmul.ac.uk

Thank you for taking the time to consider taking part in this study

APPENDIX 2

CHILL
Children's Health in London & Luton

Information Sheet for Parents

The Children's Health in London and Luton (CHILL) Study

SCAN HERE

Summary

It's great that you're interested in finding out more about the CHILL research study. This leaflet gives more information about the study itself, and how your child can be involved. Please take time to read this information and talk it through with your family.

CHILL is a research study to find out whether strategies to reduce air pollution from traffic improve children's lung growth and health. We are interested in how children's lungs develop over time and how interventions to reduce air pollution affect the growth of their lungs. We are also interested in children's respiratory symptoms (like wheezing, sneezing, coughing), whether they have had to miss school because of such respiratory symptoms, and what impact this may have had on their parents. Finally, we are interested in children's physical activity levels and how much air pollution they are exposed to.

To do this we will visit your child's school once a year for 4 years (4 visits in total) to do a health check. This will be during the normal school day and will take about half an hour. At the end of the visit we will ask your child to wear an activity monitor on their hip for 7 days (we will return to school to collect it). We will also ask you to fill out some questionnaires about your child's health (this should take about 10-15 minutes).

For further details about the study please read the following leaflet. We hope this will give you a clear understanding of the study, what your child's participation will involve and answer any questions or concerns you might have.

Please contact us if you require any further information or clarification. We would be happy to hear from you.

Watch a short video about CHILL at this website: https://www.youtube.com/watch?v=o8j6J3F3M3g *or by scanning the QR code at the top of this page.*

Contents

How to Contact Us

If you have any questions about this study please contact the CHILL team:

In London:

1 Why are we doing this study?

- Air pollution from traffic harms children's health and the development of their lungs. This can affect their health for the rest of their lives.
- Towns and cities like Luton and London are monitoring air pollution levels and trying to reduce pollution (eg, introducing busways and low emission zones, installing charging points for electric vehicles, and offering travel planning advice to schools).
- We want to find out if these measures are improving children's lung development and their health.

2 Who can take part?

- We are inviting your child to take part because you live in an area where the council is trying to reduce air pollution.
- We are inviting children in Years 2, 3 and 4 at primary schools in these areas.
- Your child's school has agreed to take part.
- We aim to recruit over 3,000 children.

3 How are we doing the research?

- We will measure children's lungs each year for four years to look at their development.
- We will also look at how physically active the children are and how they travel to school, and ask their parents to fill out some questionnaires about their child's health and wellbeing.
- We will visit your child's school once a year to do a health check. It will be during the normal school day and will take about half an hour.
- At the first school visit all the children in the class will take part in a special science class run by our award-winning education team. They will learn all about air pollution and how their lungs work.
- Once we have done all the health checks, with your permission and with NHS approval, we will ask for a copy of your child's GP records to count how many times they have needed treatment for breathing or chest problems over the 4 years of the study.

4 What will happen to my child if he/she takes part?

Giving Consent

If you would like your child to participate, we will ask you to sign a consent form and return this to school. Before any measurements are taken, we will also ask your child if they agree to participate.

Questionnaires

We will ask you to fill out some questionnaires and return these to school, along with the consent form. These will ask about:

- Where your child has lived since birth (so we can look at the air pollution they have been exposed to).
- Whether your child has had any respiratory symptoms (like wheezing, coughing, sneezing).
- Your child's general health and wellbeing.

- Whether your child has missed school due to respiratory illness, and what impact this has had (like parents taking time off work).

Health check
We will do a health check with your child at school. They can opt out of any of the measurements at any time if they want to. During the health check we will:

- Measure your child's height and weight.
- Measure the size of their lungs and how well they are working.
- Ask some questions about how your child travels to school.
- Ask your child to wear a small device for 7 days to monitor their physical activity (we will return to school to collect it).

To measure their lungs we will ask your child to blow into a device called a spirometer (see picture below). Then we will then ask your child to breathe in 4- puffs of a medicine called salbutamol to fully open up their airways (blue salbutamol inhalers or pumps are commonly used by children with asthma). After 10-minutes, we will ask them to blow into the spirometer again. This will give us the best possible measure of your child's lung development. Any effect on the airways is short, lasting only a couple of hours. This breathing test is used by nurses in GP surgeries to measure lung function in children and adults. Salbutamol is an extremely safe medicine that has been used safely for decades by adults and children. Reactions to it can occur, but are exceedingly rare.

We will use a new, disposable filter for each child to blow into the spirometer and a clean, sterilized spacer for them to breathe in the salbutamol.

The activity monitor is a small device that is worn during waking hours on a belt on the hip (see picture above). It is not intrusive and has been used frequently to measure children's activity levels. We will give your child instructions to take home. If you lose the monitor, you will not have to pay for it (but please try to keep it safe!). Some children will be asked to wear an additional device (also on a belt on the hip) to measure their travel behaviour.

5 Possible benefits and disadvantages of taking part

What Are the Possible Risks and Disadvantages of My Child Taking Part?

- There is minimal risk of harm to your child from taking part. Breathing in salbutamol (the asthma inhaler medicine) can sometimes give the feeling that your heart is beating harder, but this only usually happens if someone takes more puffs than we are using.

- There is no chance of catching germs from other children as we always use a new filter for the spirometer, and a sterilized spacer for breathing in the salbutamol.
- All measures in this study have been used before in children and we will follow established procedures.
- Health checks will be undertaken by trained staff who have been DBS checked.

What Are the Possible Benefits of My Child Taking Part?

- Your child will get to learn about air pollution and their health during an interactive science lesson.
- Your child will get a free health check for their lungs and if we find anything wrong we will write to your GP to let them know, so that they can check things further.

6 More information about taking part

Does My Child Have to Take Part?

No, it is up to you and your child to decide whether or not to take part. If you decide your child can take part, you will need to sign the consent form and return it to school, along with the completed questionnaires. If you do not want your child to take part they will still get to participate in the science lesson and learn about air pollution and health.

Your child can stop taking part in some parts of this study, or all of it, at any time and without giving a reason, whether that is their decision or yours.

What If My Child Has Asthma?

Any child with asthma can take part in this study. If your child has asthma they should continue to use their inhalers as normal on the day of the study visit.

Will I Receive Any Payment for Taking Part?

If you complete and return the questionnaire to school, and provide us with your email address, we will send you (via email) a £5 online shopping voucher. Your child will get a certificate and we will give your school £1,000 for taking part.

What Will Happen to Information About My Child Collected During the Study?

Queen Mary University of London is the sponsor for this study based in the United Kingdom. We will be using your child's information in order to undertake this study and will act as the data controller for this study. This means that we are responsible for looking after your information and using it properly. Queen Mary University of London will keep identifiable information about your child for 20 years after the study has finished.

Your rights to access, change or move your child's information are limited, as we need to manage your child's information in specific ways in order for the research to be reliable and accurate. If you withdraw your child from the study, we will keep the information about your child that we have already obtained. To safeguard your child's rights, we will use the minimum personally-identifiable information possible. You can find out more about how we use your child's information at http://www.jrmo.org.uk/

What If There is a Problem?

If you have a concern about any aspect of this study you should ask to speak to the research team who will do their best to answer your questions. Contact details are listed in Section 7.

What Will Happen to the Results of the Study?
When the project is completed, we will publish/present the results in academic journals/conferences (or similar), so that other researchers or interested parties can see them. We will also feedback our findings to the schools and local authorities, and to you, if you wish to be kept informed. Your identity and your child's identity and any personal details will be kept confidential. No named information about you or your child will be published in any works stemming from this project.

Who is Organising and Funding the Study?
This study is organised by the Centre for Primary Care and Public Health, part of Barts and The London School of Medicine and Dentistry, at QMUL. The study is funded by the National Institute for Health Research Public Health Research Programme (project number 16/139/01).

Who Has Reviewed the Study?
This study has been reviewed by an independent group of people, called the Research Ethics Committee, to protect your safety, rights, well-being and dignity. The study has been approved by the Queen Mary University of London Ethics of Research Committee (QMERC). For access to the GP records, we will ask for approval from the NHS Research Ethics Committee.

7 Contact for further information

If you have any questions about the study please contact us

Principal Investigator
Prof. Chris Griffiths

Centre for Primary Care and Public Health
Barts and The London School of Medicine and Dentistry, Queen Mary University of London

Email: c.j.griffiths@qmul.ac.uk

Thank you for taking the time to consider your child taking part in this study

APPENDIX 3

CHILL Study Children's Information Sheet V1.1 05.09.2018
QMERC2018/08

CHILL
Children's Health in London & Luton

Information Sheet for Children

The Children's Health in London and Luton (CHILL) Study

It's great that you want to know more about the CHILL study! Please read this leaflet with your parents and decide with them if you would like to take part. If you decide to take part they will need to sign a consent form (like when you go on a school trip). You can watch a short video about CHILL at this website: https://www.youtube.com/watch?v=o8j6J3F3M3g or by scanning the QR code:

1. What is the CHILL research study about?

We want to find out if breathing cleaner air makes children more healthy. Have you heard of air pollution? It comes from cars and lorries and it's bad for your lungs. It's worse in towns and cities because there is more traffic.

2. Why are you asking me to take part?

We are inviting you to take part because you live in an area where the council is trying to lower the air pollution and make the air cleaner. We are asking all the schools in your area to take part and your school has agreed to help us. We are inviting children in Years 2, 3 and 4.

3. What will I have to do if I take part?

We will come to your school to take some measurements during one of your lessons. We will come once a year for 4 years (4 visits in total) to see how your lungs are growing. We will ask you to do some simple activities that will take about half an hour.

This is what we will ask you to do at each visit (you can choose not to do any of them):

a. Have your height and weight measured:

b. Blow into a machine that checks how big your lungs are and how well they are working. Then breathe in 4 puffs from a blue asthma pump. You might have seen other children use one of these. It contains a special medicine called salbutamol. This will make your lungs work really well. It doesn't mean you have asthma.

Wait for 10 minutes, then blow into the machine again, to see if your lungs work better after the salbutamol.

c. Wear a small activity monitor for 7 days. It fits on a belt round your waist. This will tell us how much walking and running you do. It's not a test or a competition! Some children will be asked to wear an extra monitor that will tell us about your travel. We'll collect the monitor(s) a week later.

d. Answer some questions about how you travelled to school. We'll also ask your parents to fill out some questionnaires about you and your family.

4. **Do I have to take part?**
   No, it is up to you and your parents to decide if you will take part.

5. **Can I stop taking part after I've joined the project?**
   Yes, you can always change your mind and stop taking part.

6. **What do I do if I don't want to take part anymore?**
   That is ok, just tell the researchers when they are visiting your school, or tell your parents and they will talk to the researchers. You don't have to give a reason if you don't want to take part anymore, it is your choice.

7. **Can I ask questions?**
   Yes! You can ask your parents to contact us, or you can ask us questions when we come to your school.

Thank you for reading this leaflet

APPENDIX 4


APPENDIX 4
I'm CHILLED
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Children's Health in London & Luton
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Children's Health in London & Luton
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Children's Health in London & Luton

APPENDIX 5

2018-19 (Baseline – Pollution)

Ever wondered what air pollution is? Where does it come from, how does it affect our bodies, and why should we care about it? Take on the role of a scientist and explore the insides of our lungs, plant your own mini-garden, and even investigate fake snot! The session contains the following sections:

1. What, where, why & how of air pollution
2. Sources of air pollution
3. Our body's defences, for example, white blood cells, inflammation & snot
4. Mapping our journeys – how we can reduce and avoid air pollution
5. Taking action! Planting a living wall and encouraging green modes of living

2019-20 (Follow-up Year 1 – Genes)

What is air pollution? Where does it come from? How does it affect our cells? Why would a scientist want some of your spit to investigate it? What do we need to do to prevent pollution? The session contains the following sections:

1. All about air pollution.
2. What are cells? What is DNA?
3. Genes and my characteristics.
4. Following a genetic instruction (with Lego©)
5. Reducing air pollution

2021-22 (Follow-up Year 3 – Brain)

This year's workshop is focused on cognition and how the brain works, and how air pollution may be affecting cognitive abilities in children, which links to part of the CHILL study's research. The session contains the following sections:

1. Introduction and recap previous CHILL workshops
2. How the nerves and brain work
3. What is cognition and how to trick our brains
4. How pollution affects the brain
5. What can we do?

2022-23 (Follow-up Year 4 – Overview)

The focus of this workshop will be on air pollution, its effects and using creativity to find solutions to them. Students will be using their knowledge of materials and design to build simple prototypes around a problem that they care about. The session contains the following sections:

1. Introduction and recap previous CHILL workshops
2. Hands-on building activities
3. Communication activity
4. What's next and conclusion.

APPENDIX 6


CHILL
Children's Health in London & Luton
fun science fair
+ CHILL Study health assessment
Saturday 1 JUly
10:00 am - 3:00 pm
[redacted]
gift bags
fun games
science experiments
[redacted]
CAN'T MAKE IT?
Please contact our team
[redacted]
health assessment dates
[REMOVED]

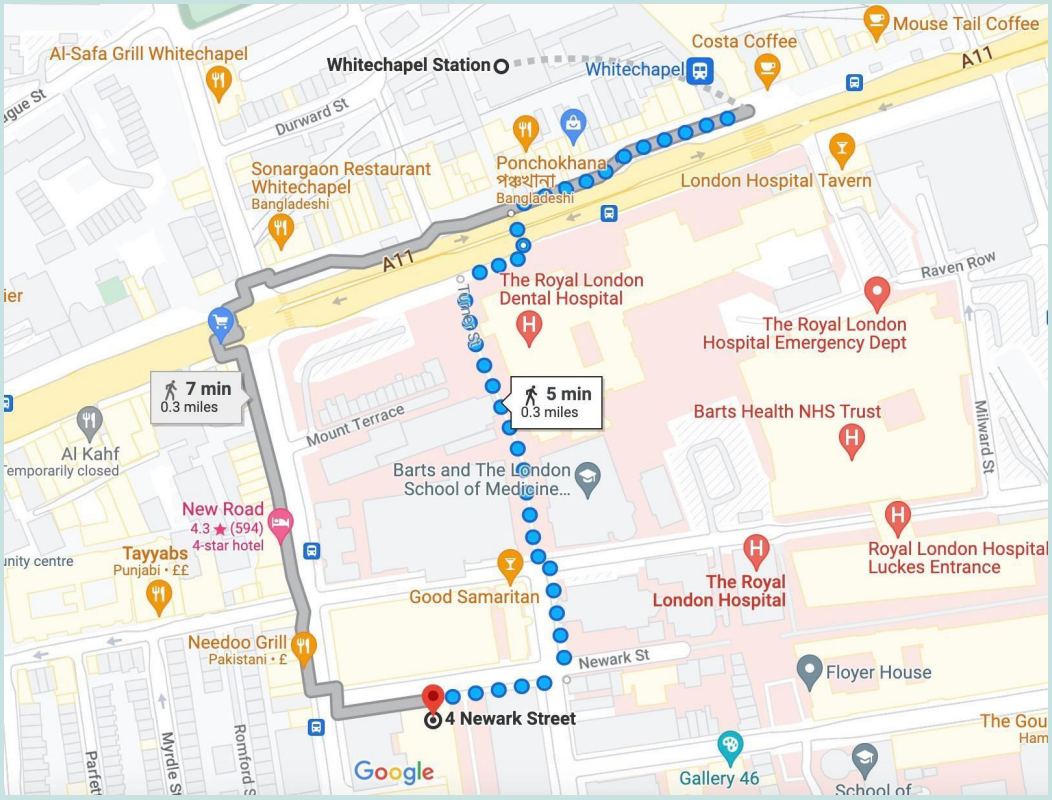
Bring the family!

Complete your CHILL Study health assessment & drop in to our science fair hosted by Centre of the Cell.

PLUS, you'll receive a £10 supermarket voucher for your participation.

RSVP to chill@qmul.ac.uk

We hope to see you there!



Queen Mary University of London