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# BMJ Open

## Collecting genetic samples and linked mental health data from adolescents in schools: Protocol co-production and a mixed-methods pilot of feasibility and acceptability

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8 adolescents in schools: Protocol co-production and a mixed-  
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12 methods pilot of feasibility and acceptability  
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## Abstract

Objectives: To co-produce a school-based protocol and examine acceptability and feasibility of collecting saliva samples for genetic studies from secondary/high school students for the purpose of mental health research.

Design: Protocol co-production and mixed-methods feasibility pilot.

Setting: Secondary schools in Wales, UK.

Participants: Students aged 11-13 years.

Primary and secondary outcome measures: Co-produced research protocol including an interactive science workshop delivered in schools; school, parental and student recruitment rates; adherence to protocol and adverse events; ability to extract and genotype saliva samples; student enjoyment of the science workshop; and qualitative analysis of teacher focus groups on acceptability and feasibility.

Results: Five secondary schools participated in the co-production phase, and three of these took part in the research study (eligible sample n=868 students). Four further schools were subsequently approached, but none participated. Parental opt-in consent was received from 98 parents (11.3% eligible sample), three parents (0.3%) actively refused and responses were not received for 767 (88.4%) parents. We obtained saliva samples plus consent for data linkage for 79 students. Only one sample was of insufficient quality to be genotyped. The science workshop received positive feedback from students. Feedback from teachers showed that undertaking research like this in schools is viewed as acceptable in principle, potentially feasible, but that there are important procedural barriers to be overcome. Key recommendations include establishing close working relationships between the research team and school classroom staff, together with improved methods for communicating with and engaging parents.

Conclusions: There are major challenges to undertaking large scale genetic mental health research in secondary schools. Such research may be acceptable in principle, and in practice DNA collected from saliva in classrooms is of sufficient quality. However, key challenges that must be overcome include ensuring representative recruitment of schools and sufficient parental engagement where opt-in parental consent is required.

Key words: school; adolescent mental health; genetics; data linkage; feasibility and acceptability

## Article Summary

### Strengths and limitations of this study

- This is the first study to test the feasibility and acceptability of collecting genetic samples in secondary schools and obtaining consent for linkage to questionnaire and record-based mental health data.
- A key strength is co-production of the research protocol with stakeholders (young people, parents/guardians, schools).
- We used a mixed-methods approach to assess the feasibility and acceptability of carrying out genetic research studies of mental health in schools.
- This pilot study was conducted in three mainstream secondary schools in Wales, UK so it is unclear whether findings are transferrable to a wider section of schools in Wales and other countries, education systems and age groups.
- It was not possible to collect data on the reasons for return or non-return of parental consent.

## Introduction

In the UK, approximately 1 in 8 (12.8%) young people aged 5-19 years old have a diagnosable mental health disorder with rates increasing in recent years.(1,2) The causes of youth mental health difficulties involve genetic and environmental risk factors acting together in complex ways. The majority of adult mental health conditions originate before the age of 24,(3,4) and early identification and prevention are important priorities. However, only a minority of young people with mental health problems seek or receive help from health-care professionals.(1,5) To better understand risk and protective factors for psychiatric conditions, data from population-based samples of young people, including relevant genetic, biological, psychological and social factors is important. Established UK birth cohorts are a valuable resource for studying the development of mental ill health, including the interplay of genetic factors and family environment. However, the costs involved in setting up and maintaining such cohorts are considerable, and information about other social contexts such as schools is often limited.(6)

An alternative approach involves collecting data on mental health and associated risk and protective factors from young people within the school setting, offering the opportunity to study the roles of classroom, peer group and school-level effects. In addition, school-based designs offer the potential to recruit and obtain data from larger population-based samples than is possible using traditional birth cohort designs. Typically, student participation rates are high when health questionnaire data are collected during the school day.(7,8) What is unclear is whether it would be acceptable to schools, students and their parents to collect saliva samples for the purpose of genetic studies involving mental health, and what the main barriers are that need to be overcome to make this feasible in practice. Challenges include ensuring schools, parents/guardians and young people themselves will be accepting of research on genetics and mental health; providing information to young people, their parents and teachers; collecting appropriate informed consent; integrating research into the every-day life of schools in a way that fits with the needs of schools and learners; and implementing robust and ethical protocols for the collection of saliva samples in a classroom setting.

Previous studies have had some success with collecting salivary cortisol samples in school settings (for reviews see (9,10)). In contrast, little is known about the acceptability and feasibility of classroom-based collection of saliva samples for genetic research. Despite increasing understanding and acceptance of genetic research, public concerns remain - particularly in relation to children,(11-15) and mental health is often stigmatised,(16,17) so it is unclear whether this type of research would be acceptable to young people, parents/guardians and school staff. Similarly, the concept of data linkage (e.g. to mental health questionnaires or health records) might elicit concerns about privacy.(18) Parent/guardian recruitment and consent is typically challenging in school-based research,(19-22) particularly in secondary school settings. Having a research study and protocol that



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3 is acceptable to key stakeholders is critical to a research study's success.(8,23,24) It will not only help  
4 with recruitment, but will also help develop a process that key stakeholders engage with or "buy into",  
5 and that fits with the context and daily life of students, teachers and parents. Indeed, co-production of  
6 research with stakeholders is critical to support the development of school-based research.(8)  
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10 To our knowledge, no other study has examined the acceptability and feasibility of collecting saliva  
11 samples from young people in schools for the purpose of genetic research on mental health.  
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### 14 The current study

15 The Mental Wellbeing in Adolescence: Genes and Environment Study (MAGES) aimed to assess the  
16 acceptability and feasibility of collecting DNA saliva samples from young people in schools with  
17 consent for linkage to other routinely collected mental health questionnaire and record-based data.  
18 The over-arching aims were to work with stakeholders (school staff, parents, young people) to co-  
19 produce an acceptable research protocol, and then test this protocol in order to inform future studies  
20 on the best ways to carry out this kind of research.  
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25 The study was conducted in Wales which provides a globally unique research infrastructure, with  
26 student health, mental health and wellbeing data collected every two years in all mainstream  
27 secondary schools via SHRN (School Health Research Network, <http://www.shrn.org.uk/>) and  
28 potential linkage to routine health, education and social care data via SAIL (Secure Anonymised  
29 Information Linkage) databank ([www.saildatabank.com](http://www.saildatabank.com)). The SHRN 2017 health and well-being  
30 survey was completed by all state-funded schools in Wales, UK (n=193) and had 97% of students take  
31 part (n=112,045).(7,8)  
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37 In the development phase we worked with stakeholders (young people, parents/guardians, schools) to  
38 develop a study protocol that had the greatest chance of being both acceptable and feasible in practice.  
39 To evaluate the MAGES protocol, we used a mixed-method design with quantitative and qualitative  
40 data. Specifically, we examined school, parent/guardian and student consent/participation rates,  
41 considered adherence to the study protocol and the occurrence of any adverse events (e.g.  
42 complaints), and the ability to genotype samples. We collected feedback from young people and  
43 undertook focus groups with teachers to gain further insights on the feasibility and acceptability of the  
44 study, and how the protocol might be adapted in future.  
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## 51 Methods

### 52 Study design

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54 The study was conducted in three stages: firstly a development phase, followed by implementation of  
55 the protocol, and then an evaluation phase (Figure 1). The development phase included co-production  
56 of the study protocol with key stakeholders. The MAGES protocol included recruitment of schools,  
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3 obtaining consent from parents/guardians and students, and collection of saliva samples for genetic  
4 analysis. Saliva collection occurred during specially developed MAGES science workshops that took  
5 the place of a normal science lesson (see below). Quantitative evaluation included numbers and  
6 percentages for each stage of recruitment, percent of usable genotyped samples, and student feedback  
7 scores on the science workshop aspect of the protocol. Qualitative evaluation included teacher focus  
8 group discussion of MAGES protocol following completion of classroom data collection.  
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### 13 Development phase

14 Stakeholders involved during development of the research protocol included young people, school  
15 staff, and parents/guardians.  
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19 Researchers discussed the study protocol and the practicalities of using saliva collection kits in a  
20 classroom setting with a group of young people aged 14-17 years old (n=11, 5 males, 6 females).  
21 Young people were part of the public patient involvement group ALPHA  
22 (<http://decipher.uk.net/public-involvement/young-people/>). Based on feedback from this session we  
23 made changes to the study protocol (including a school assembly presentation) to simplify the content  
24 and to explain technical terms (e.g. data linkage) more fully.  
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30 School staff shared their perspectives on the acceptability of taking saliva samples from students in  
31 schools and provided advice on practical issues. Teachers from 9 schools that were engaged in SHRN  
32 research were invited to take part. A total of 5 teachers (3 females, 2 males) from 5 schools and 1  
33 Healthy Schools Practitioner (female) participated. Particular consideration was given to how research  
34 participation would impact teacher workload, how researchers could give back to schools, and  
35 potential practical challenges. School staff highlighted that getting the parent/guardian consent  
36 required for participants aged under 16 years old (as is required in Wales, UK) was likely to be the  
37 most challenging aspect of the project. As a result of this session, we adapted our protocol to target  
38 younger year groups (Years 7 and 8, age 11-13 years) as it was thought that parents/guardians would  
39 be more engaged and older cohorts could not afford to take time out of core lessons. Suggested ways  
40 to engage parents/guardians were to meet in person via events at each school, and by presenting  
41 MAGES information in different formats. We therefore included a parent/guardian event in our  
42 protocol and also created a website with videos explaining why the research is important and what  
43 taking part involves ([www.cardiff.ac.uk/MAGES](http://www.cardiff.ac.uk/MAGES)). Giving back to schools was also highlighted as  
44 important and providing a science workshop to students was considered a good way to do this.  
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54 Mothers (n=10) recruited from a local parent research network took part in a discussion on the  
55 proposed research and provided feedback on the clarity and content of parent/guardian information  
56 sheets. Data linkage emerged as a key concern and we adapted information sheets to provide more  
57 information on this.  
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3 Finally, to ensure that the science workshop content was suitable and enjoyable for the proposed age  
4 range, we trialled the science workshop (see below) with a local Scout group of 12 boys aged 10-13  
5 years old and 2 adult scout leaders (1 male, 1 female).  
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## 8 9 Implementation phase

### 10 11 *Evaluation sample*

12 Participants were students in Years 7 and 8 (aged 11-13 years) at mainstream secondary schools in  
13 South Wales, UK that were part of the School Health Research Network (SHRN).(7,8)  
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### 16 17 *Recruitment and protocol*

18 Figure 1 depicts the recruitment and protocol used. Firstly, schools that were consulted in the  
19 development of the protocol (n=5) were invited to take part in MAGES via direct correspondence  
20 from the SHRN Manager to each of the SHRN school contacts. This was followed up by MAGES  
21 staff. A further four local SHRN schools were invited to participate at a second recruitment wave.  
22 Participating schools were offered £500 (£250 per year group) as a thank you for facilitating the  
23 research and to cover costs in staff time resulting from participation.  
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28 *School staff meetings:* Following initial contact, MAGES researchers met with members of each  
29 school's senior leadership teams. All schools were given the option of holding events for  
30 parents/guardians and teachers where MAGES staff would introduce the project and answer  
31 questions.  
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35 *Information packs:* Schools were asked to disseminate parent/guardian information packs (using  
36 typical communication methods). These included an overview of the study, frequently asked  
37 questions and a link to the study webpage ([www.cardiff.ac.uk/MAGES](http://www.cardiff.ac.uk/MAGES)). Parents/guardians were also  
38 given email and phone contact details for the MAGES team if they had queries or concerns.  
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42 At a later date, MAGES researchers delivered 15-20 minute assemblies to students to explain the  
43 project, following which, the schools were asked to distribute information packs to students.  
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46 *Workshops:* Feedback from stakeholders during the development phase indicated the value of science  
47 workshops on the theme of genetics for engaging schools and learners. Student science workshops  
48 were scheduled to start two weeks from the student assembly. During this period, schools distributed  
49 reminder letters to parents/guardians and collated consent forms. MAGES staff also provided  
50 reminders via social media (twitter).  
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54 MAGES researchers delivered the workshop to all classes in each participating year group in the place  
55 of a normal science lesson (lasting 50-60 minutes). Science workshops began with an introduction to  
56 MAGES and the team followed by an interactive lesson (see Figure 2) consisting of 1) a presentation  
57 teaching the basics of DNA, 2) a practical experiment extracting DNA from bananas, 3) an additional  
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3 presentation on DNA structure, heredity, traits influenced by genes and impact of  
4 environment/experience, and 4) an activity creating origami DNA models. During the origami  
5 activity, those students who had completed parent/guardian consent forms were invited to take part in  
6 the DNA collection. Students were given their own assent form to sign and then provided a saliva  
7 sample. This was conducted in a screened off area of the classroom or in a side room to provide  
8 privacy. At the end of the science workshop all students were asked to provide feedback about  
9 whether they had enjoyed the science session on a sticker chart (Supplementary Figure 1).  
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### 14 *Ethical approval and consent*

15 Ethical approval was obtained from Cardiff University School of Medicine Research Ethics  
16 Committee. As students were under 16 years, participation in MAGES required informed parental  
17 opt-in consent and student assent. Both parents/guardians and students had the option to provide or  
18 not provide additional consent/assent for linking genetic information to other routinely collected data.  
19 Consent for routinely collected data was split into two broad categories: (i) health and educational  
20 records, and (ii) student-completed health and wellbeing questionnaires.  
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### 26 *Evaluation phase*

#### 27 *Feasibility*

#### 28 *Recruitment and participants*

29 The numbers of schools recruited, parent/guardian consent forms returned, student participation and  
30 consent for data linkage were recorded and percentages of the eligible sample were calculated. Where  
31 possible, reasons for not taking part were recorded. To assess school-level response bias, participating  
32 and non-participating schools were compared on a number of routinely assessed school-level  
33 characteristics (<https://mylocalschool.gov.wales/>), including Free School Meals entitlement (%),  
34 minority ethnic pupils (%), student attendance (%), and academic achievement (% achieving 5  
35 General Certificate of Secondary Education at A\*-C grades).  
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#### 46 *Saliva samples*

47 Participants provided saliva samples (approximately 5ml) using Genotek Oragene saliva kits under  
48 the supervision of MAGES researchers (full instructions in Supplementary Figure 2). Participants  
49 were asked if they had eaten or drunk anything in the last 30 minutes and if not, were instructed to fill  
50 the saliva collection tube to the fill line. If participants had eaten or drunk in the last 30 minutes, they  
51 were asked to wait 30 minutes before providing a sample. Sample collection took around 5-10  
52 minutes per participant, and multiple students provided samples at the same time under researcher  
53 supervision. The collection tubes were labelled using barcodes and a unique participant study number.  
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3 The samples were taken to the research laboratory - MRC Centre for Neuropsychiatric Genetics and  
4 Genomics at Cardiff University. All samples were processed in accordance with the standard  
5 operating procedures for sample management, storage, and tracking of biological materials. DNA was  
6 extracted from the saliva samples in-house, following standard Genotek Oragene DNA Prep-IT  
7 protocols. DNA sample quantification was determined using Quant-iT PicoGreen dsDNA assay kits,  
8 and samples were genotyped using Illumina Infinium Global Screening arrays. Data were recorded on  
9 the number and percentage of successfully extracted and genotyped samples.  
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#### 14 Adherence to study protocol and adverse events

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16 The research team undertook a review of the protocol following completion of the study within each  
17 school and recorded data on adherence to protocol. This included instances where the protocol (Figure  
18 1) was changed and any adverse events (e.g. complaints).  
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#### 22 *Acceptability*

#### 23 Science workshop

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25 Student feedback was collected at the end of each workshop to assess the value of including the  
26 science workshops in the protocol. Students rated their enjoyment of the workshop using a sticker  
27 chart (Supplementary Figure 1) with a scale of: 1) “Yes – I had great fun”; 2) “Most of it was quite  
28 good”; 3) “Some of the time it was ok”; or 4) “No – I didn’t like it”.  
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#### 34 Teacher focus groups post-MAGES

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36 Three focus groups were held with teachers in participating schools to get feedback on MAGES.  
37 Teachers were recruited to the focus groups by each school’s key contact teacher. A £20 voucher was  
38 offered as remuneration for each teacher’s time, and schools were given £125 for holding the focus  
39 group (to cover replacement teaching time). Five teachers participated in each focus group (School 1:  
40 3 females, 2 males; School 2: 5 females; School 3: 2 females, 3 males). This sample included science  
41 teachers, members of the senior leadership team and form tutors responsible for pastoral care. Data  
42 were collected at participant’s schools at a time and date convenient to them.  
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48 Focus groups lasted approximately 45 minutes and were conducted by two female MAGES  
49 researchers (SR, Med, 3 years’ experience of conducting and analysing focus groups; and NW, PhD,  
50 with training in semi-structured clinical interviews). Researchers were responsible for workshop  
51 delivery and saliva collection, and therefore had working relationships with the teachers prior to the  
52 focus group. Teachers were asked about their views on mental health research in young people, how  
53 MAGES was conducted in their school, how they and others (parents/guardians, students) found the  
54 MAGES process and what improvements they would make to the study (see Supplementary Table 1  
55 for focus group schedule). Digital audio recordings of the three focus groups were transcribed  
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3 verbatim by a professional transcription company and supplementary handwritten notes were made.  
4 The transcribed interviews were then exported to NVivo 12, a qualitative data analysis computer  
5 software package.  
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8 Two researchers (SR and NW) conducted an inductive thematic analysis of the data following Braun  
9 and Clarke's (2006) framework. The steps in this process included: 1) data familiarisation, 2) initial  
10 code generation, 3) theme identification and framework development, 4) theme review, and 5) final  
11 theme definition. A wide range of views were collected and researchers were confident that there was  
12 no further information that could have been gained from recruiting more participants/ holding more  
13 focus groups.  
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18 Both researchers coded all the transcripts independently and then met to jointly develop a coding  
19 framework. This framework was derived inductively from the focus group data but was also  
20 influenced deductively by the research questions. They subsequently recoded the transcripts using the  
21 agreed framework using NVivo 12.  
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## 26 Patient and Public Involvement

27 The design of the protocol was informed by extensive PPI work with key stakeholders – young  
28 people, parents/guardians and school staff (see 'Development phase' above). Schools participating in  
29 the development phase of the project were offered the opportunity to take part in the main study and  
30 help recruit parents and students at their school. Results were disseminated to participating schools  
31 through electronic and paper feedback reports.  
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## 36 Results

### 37 Feasibility

#### 38 *Recruitment and participants*

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44 Three of five schools involved in the advisory stage agreed to take part in MAGES, with the two non-  
45 participating schools stating they were too busy. No schools (0/4) in the second recruitment wave  
46 agreed to meet to discuss taking part in MAGES. Researchers were unable to reach the SHRN contact  
47 prior to the end of the study in two schools and two schools declined taking part due to being too busy  
48 (n=1), and having concerns over taking DNA from children and being perceived as having young  
49 people with mental health problems (n=1). The total school participation rate was 33.3% (3 out of 9  
50 invited schools). On average, the three participating schools had lower Free School Meal (FSM)  
51 entitlement (14.0% versus 23.1%), lower proportion of minority ethnic students (15.4% versus 21.9%)  
52 than the six non-participating schools, and similar student attendance (94.3% versus 93.7%), and  
53 academic achievement (58.4% versus 60.2% students 5 GCSE A\*-C grades). In comparison to the  
54 national average, participating schools had lower FSM entitlement (Wales average 17.5%), higher  
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3 proportion of minority ethnic students (Wales average 9.8%), higher student attendance (Wales  
4 average 93.9%), and higher academic achievement (Wales average 55.1%).

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7 Table 1 details the number of parent/guardian consent forms received, saliva samples collected and  
8 consent for data linkage for each participating school. Three parents from the eligible sample of 868  
9 (0.3%) refused permission for their child to participate, either via email (n=1) or on the consent forms  
10 (n=2). 98 parents (11.3%) provided signed consent for students to participate in the study. No  
11 responses were received from the remaining eligible sample (88.4%).  
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15 Of the 98 students with parent/guardian consent, saliva samples were obtained from 90 students  
16 (89.6%; 31 males, 59 females). Five students decided they did not want to take part, two were absent  
17 on days of saliva collection, and there was not enough time to collect a sample from one student.  
18 Consent for complete data linkage was obtained for 79 (80.6%) students.  
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21  
22 Sample collection rates varied by school, ranging from 7.5% to 15.3% of eligible students. This  
23 primarily reflected variation in parent/guardian consent (8.0%-17.2%). There was also considerable  
24 within-school variation in sample collection between different classes (School 1: 0-38.2%; School 2:  
25 11.1-28.0%; School 3: 0-21.4%).  
26  
27

### 28 29 30 *DNA extraction and genotyping*

31  
32 We were able to extract DNA and genotype 89 of the 90 (98.9%) samples collected. One sample was  
33 not genotyped due to insufficient concentration of DNA.  
34  
35

### 36 37 *Adherence to study protocol*

38  
39 The study protocol was followed for School 1. However, the time-limited nature of science  
40 workshops during a normal lesson restricted the number of saliva samples that could be collected. In  
41 subsequent schools we adjusted the protocol so that the saliva collection occurred approximately one  
42 week following the science workshop to allow adequate time.  
43  
44

45  
46 After School 1 layout and formatting changes were made to the parent/guardian consent forms to  
47 increase clarity.

48  
49 Only one school (School 3) opted to provide an event to explain MAGES to parents and guardians.  
50 This event was organised specifically to discuss MAGES (Thursday evening, 5.30pm start) but was  
51 poorly attended (n=5, 1.1% of school eligible sample). This session was primarily comprised of  
52 parents and guardians with concerns and queries about the research. No school chose to have the  
53 additional event for MAGES researchers to explain the project to teachers.  
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56  
57 We did not receive any complaints about the research from students, parents/guardians or school staff.  
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## Acceptability

### *Science workshop*

Of the students who gave feedback on the science workshops, the majority (88.4%) said “Yes – I had great fun” or “Most of it was quite good” (Table 2).

### *Teacher focus groups post-MAGES*

A number of themes were identified from thematic analysis of qualitative interviews with teachers (Table 3). Here we focus on key themes that informed our understanding of acceptability and feasibility.

## Acceptability

Teachers were asked about their views on the appropriateness of conducting a study like MAGES in a school environment. Generally, teachers who were interviewed were in favour of such research.

*“You asked whether or not it’s a good idea to use the schools. I think we’re in an ideal position. A captive audience, if you want. It’s the easiest way of getting hold of those pupils and that information and of youngsters so I don’t necessarily have a problem with schools being involved.”*

The consensus was largely that the MAGES protocol was acceptable, however there was some concern that this view may not be shared by other people within the community. Some teachers suggested that people outside of the school may feel it was inappropriate for teachers to facilitate this kind of research.

*“I wonder how that might be seen by different people as in, why are they taking DNA? What are they going to do with it? Why should teachers allow them to come in and do that?”*

Teachers discussed the acceptability of MAGES from the point of view of parents/guardians and students. Although some participants suggested that they expected parents/guardians to react negatively to MAGES, all participants agreed that no parent or student approached them with any complaints or concerns.

*“When I first got sent the email about the project, as a scientist I thought some parents are not going to like that...but we took the risk and, in fact, we got more people coming back than I thought we would.”*

## Benefits

The benefits of taking part in MAGES were widely discussed, with members of all groups indicating that they would be willing to participate in MAGES again in the future. The potential contribution to



1  
2  
3 mental health research was noted in all three focus groups as a major benefit of being involved with  
4 MAGES.  
5

6  
7 *“I think there’s a lot of mental wellbeing issues in amongst children now. If we’ve got research and*  
8 *there’s data on it, if that data can be used in a positive way, then it’s a good thing but it’s just the*  
9 *feasibility of collecting that large amount of data for it to be viable.”*  
10  
11

12 Teachers also said they would have agreed to take part without the incentive of the science workshop,  
13 however there was a preference for the workshop to remain as part of MAGES.  
14

15  
16 *“I would have still agreed to do it, absolutely, but I wonder if the kids could actually link to what’s*  
17 *going on. I think that’s where the disconnect would be. We still would’ve signed up to it absolutely*  
18 *because we recognise we’ve got mental health issues in the school and the importance of these types*  
19 *of research studies.”*  
20  
21

22  
23 Similarly, teachers acknowledged the value of linking genetic information with data on mental health.  
24

25  
26 *“I would’ve thought, to make your research valuable, you’ve got to do it otherwise all you’ve got it is*  
27 *a DNA sample.”*  
28

29 The possibility that genetic research may become more acceptable to people in the future was brought  
30 up by multiple teachers.  
31

32  
33 *“I think that attitude will change in the future. This is quite early on. Everybody was initially*  
34 *technology – the beast. Now, everybody’s embracing it. I think exactly the same thing will happen*  
35 *with DNA and testing. I think it will probably become quite routine.”*  
36  
37

38 The prestige of working in partnership and forming a relationship with Cardiff University was also  
39 seen as a benefit.  
40

41  
42 *“Our incentive has been the formation of this partnership and feeling like we’re helping you with*  
43 *your samples and we’ve had something for our students back.”*  
44  
45

#### 46 Science workshop

47  
48 The biggest benefit identified was the science workshop that was delivered to all Year 7 and 8  
49 students. Teachers frequently commented on the value of having external visitors who could be  
50 viewed as role models. Science workshops were seen as helpful to clarify how students’ saliva  
51 samples would be used if they chose to take part. Teachers noted how much students enjoyed the  
52 session and suggested it gave them an opportunity to practice real, advanced science relevant to the  
53 teaching curriculum.  
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3 *“It creates a buzz that you’ve got the profile of Cardiff University coming in, it gets the children*  
4 *excited about it. When we have outside speakers, they love that and that’s why I think it’s needed*  
5 *because otherwise, it’s just spit into this thing and signing a form whereas if they did the banana*  
6 *DNA, they went home and talked about it, they were talking about it in their next lessons.”*  
7  
8

9  
10 *“I think it’s really important for students to see researchers because students have this idea that*  
11 *scientists are lab coats and you don’t all look like Albert Einstein. For you guys to come in, you’re*  
12 *normal people and to say ‘we are scientists, we are doing this’ and for them to think, ‘you’re ordinary*  
13 *people, we could do that.’”*  
14  
15

### 16 17 Concerns and potential challenges

18  
19 Although focus group participants agreed on the whole that it was acceptable to conduct MAGES  
20 within a school environment, they did acknowledge some concerns. These focused on the potential  
21 negative impact of genetic research on participants as well as privacy issues surrounding the process  
22 of data linkage.  
23  
24

25  
26 All potential MAGES participants were told that they would not receive any results from their saliva  
27 sample during the initial assembly, in the science workshop and in all MAGES information packs.  
28 However, not all teachers were present in the assembly and many had not read the information  
29 leaflets. This led to some unaddressed concern among teachers about the potential harm that could be  
30 caused to students if they were to be informed that they had an increased genetic risk for particular  
31 mental health conditions. Focus group participants felt strongly that students should not receive any  
32 feedback regarding the results of their DNA sample as feedback might lead students to believe they  
33 were predisposed to mental illness leading to a “self-fulfilling prophecy” in which the development of  
34 mental illness becomes inevitable.  
35  
36

37  
38 *“If we’ve got a young person who has mental health issues, they get a DNA test, they find they’ve got*  
39 *that gene, I fear they’d think there’s nothing they could do. They’d say, ‘I’ve got the gene, I’m*  
40 *genetically going to have mental health issues, there’s no point having therapy, there’s no point*  
41 *talking about it because that’s just who I am.’”*  
42  
43

44  
45 Concerns about how participants’ data could be used in the future and the potential negative impact  
46 this might have were discussed.  
47  
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49  
50 *“If you discover a DNA precursor to mental health, what if an insurance company in the future said*  
51 *to you is this person likely to get mental health illnesses? Or a mortgage company?”*  
52  
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54  
55 Teachers acknowledged the value of data linkage and were aware of the measures in place to protect  
56 participant’s privacy, however some did still express concern.  
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3 *“I know its numbers and barcodes but at some stage in the process, somebody will have access to the*  
4 *names and be able to link it.”*  
5  
6

7 Participant understanding of MAGES and communication were noted as challenges. Some teachers  
8 felt that the information given to students by researchers about genetic research and data linkage was  
9 too complex for young people to properly understand.  
10

11  
12 *“It’s the lost in translation thing – they didn’t quite understand what. And some of them are quite, we*  
13 *have got a very, very weak [academically] to begin with and when the kids are very, very weak*  
14 *[academically], it was more lost in translation.”*  
15  
16

17  
18 The initial MAGES assembly was felt to be too complex and that this had led to misunderstanding the  
19 purpose of the study by some students. Teachers said that some students came away from the  
20 assembly believing that the purpose of MAGES was to screen them for mental health conditions.  
21

22  
23 *“I had one student who is a very weak young lady [academically] who thought you were going to test*  
24 *her for mental health problems and was concerned that you were going to tell her there was*  
25 *something wrong with her.”*  
26  
27

28 Similarly, teachers suggested that parents/guardians may have found the information sheets to be too  
29 complex which may have impacted their decision about allowing their child to participate.  
30

31  
32 *“It’s education for the parents as well – they need to fully and truly understand what it’s for, what’s*  
33 *happening to their child’s DNA what are they going to do with it, what’s going to happen in the end?*  
34 *Obviously, we do have a lot of parents who aren’t professionals, who are out of work or whatever it*  
35 *may be, and they don’t truly understand what it means to take DNA and they just understand DNA*  
36 *from the television... If they don’t truly understand why you’re taking it then no, it’s too scary...”*  
37  
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40  
41 Communication, in particular, was seen as a challenging element of MAGES, and that this required  
42 teachers to provide additional information and answer follow-up questions from students. Teachers  
43 reported that some staff members were approached by students with questions about MAGES  
44 following the initial assembly and the distribution of the student information sheets, suggesting that  
45 the information provided by researchers was inadequate on its own.  
46  
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48  
49 *“When I gave out the packs, I asked if there were any questions and I spent 10-15 minutes with people*  
50 *asking if it will tell them if they’ve got this disease and will they have this on file forever.”*  
51  
52

53 Teachers felt that not enough school staff were given information about MAGES and that this limited  
54 the school’s ability to facilitate the recruitment of potential participants.  
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3 *“They [students] would come and ask me, some of them who are in my class, but I think because the*  
4 *other science teachers weren’t massively, well they didn’t really know what this was about and what*  
5 *was going on, perhaps they weren’t as enthusiastic as I was.”*  
6  
7

8 The majority of teachers felt that the school’s contact with parents/guardians regarding MAGES was  
9 ineffective which may have had negative implications for recruitment.  
10

11  
12 *“Parents – we didn’t get them in ... the only way we managed to get it out was on our “Schoop Line”*  
13 *and via the letters. So, it was woeful in that respect in terms of engaging the parents, which is why, as*  
14 *we mentioned previously that’s what we need to do better.”*  
15  
16

## 17 18 Recommendations for the future

### 19 20 Working with school staff

21  
22 Focus group members suggested various ways for researchers to more effectively engage staff in the  
23 participating schools. This included involving more staff throughout the school including science  
24 teachers, school nurses and teachers responsible for pastoral care. Participants suggested that the most  
25 effective way to engage with school staff would be for MAGES researchers to organise a face-to-face  
26 meeting to present information verbally.  
27  
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30  
31 *“I wonder as well... if because I spoke to Year 7 and 8 tutors only. I’ve mentioned it to other staff but*  
32 *in passing. I wonder if every member of staff in the school community could be aware of what is going*  
33 *on and the real purposes behind it.”*  
34  
35

### 36 37 Engaging students and parents/guardians

38  
39 There was significant discussion of the importance of MAGES researchers engaging with students  
40 and suggestions of several ways in which this could be improved. Proposed improvements included:  
41 simplifying the initial student assembly, making MAGES more exciting and appealing to students,  
42 and alternative DNA-related activities that may be more relevant to the research.  
43  
44

45  
46 *“I feel that maybe it could have been sold as a bit more fun and special as in you’re helping people*  
47 *out, you’re doing this, not everyone’s getting to do it. Because you had to say all the important bits*  
48 *and everything ethically, that then it didn’t seem as fun for them... You’ve got to give the information*  
49 *but I’m wondering if it could be sparkled up.”*  
50  
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52  
53 As parental consent was a necessary prerequisite for student participation in MAGES, this was  
54 discussed extensively in focus groups as a key area in which to boost recruitment. A parent event in  
55 which MAGES researchers meet face-to-face with parents/guardians to answer questions and provide  
56 detailed information was considered to be the most effective way to achieve this.  
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3 *“I think that if we were to do this again, then we would look to hold an evening for parents, as*  
4 *everybody has said, to get the elephant out of the room and have those discussions. I think that would*  
5 *be far better. I think if we had said this is a really, really good idea, you would have 100% take-up,*  
6 *you really would. But it’s the parents then that is the discussion to have.”*  
7  
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9

## 10 Discussion

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12  
13 This study aimed to develop and test a protocol to obtain genetic samples in schools for mental health  
14 research. Whilst genetic and mental health research was viewed as important and acceptable by  
15 stakeholders in the development phase, and the protocol itself proved largely acceptable, we also  
16 found that the protocol was not feasible in its current form due to a number of challenges, notably  
17 non-response from parents and securing school participation. This protocol was highly resource-  
18 intensive, and further consideration of resources is required to make the protocol more effective if  
19 data collection is to be scaled up. The quality of saliva samples was good with only one sample unable  
20 to be genotyped, which suggests researcher-supervised saliva collection using spit kits is a viable  
21 method of collecting genetic data from young people in schools. We received no complaints from  
22 students, parents or school staff concerning the study, and only three active refusals from parents at  
23 the consent stage. The MAGES science workshops were viewed as an important (but perhaps not  
24 essential) component by teachers, and received positive feedback from the majority of students.  
25 Teachers saw mental health as important, and were, in principle, accepting of collecting genetic data  
26 for the purpose of mental health research in schools; however, this information is limited to teachers  
27 from schools that took part, therefore were already interested and invested in such research. Teachers  
28 also highlighted concerns and challenges, such as improving communication and engagement, that  
29 should be addressed going forward.  
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34 A major strength of this study is the inclusion of stakeholders throughout the research process – from  
35 development through to evaluation. This allowed us to co-produce a study protocol with schools,  
36 young people and parents. Notably, the majority of schools who had been participated in the co-  
37 production phase participated in MAGES, compared with none of those contacted subsequently. We  
38 took a mixed-methods approach, giving more depth of information than just quantitative or qualitative  
39 research alone. We were also able to increase awareness of mental health and genetics amongst  
40 stakeholders especially young people which, although not our primary aim, has been a positive  
41 outcome of the study. Nevertheless, this study has limitations. Whilst parents and guardians were  
42 involved in the development phase, further information is needed to understand barriers to  
43 parents/guardian recruitment. It is unclear whether lack of returned parent/guardian consent forms was  
44 due to parents/guardians not wanting their child to take part or having a problem with the research,  
45 information not reaching the parent/guardian, or something preventing the return process.  
46 Engagement of parents/guardians can often be an important barrier to recruitment.(19–22) The current  
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3 study required opt-in parental consent but this requirement varies across countries. The study is also  
4 limited by the small number of schools that took part, and the limited uptake of teacher and parent  
5 MAGES meetings in these schools. Finally, this study took place in mainstream schools in Wales  
6 (UK) so results may not generalise to different education systems, countries and age groups.  
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10 To our knowledge, this is the first study that has assessed in detail the feasibility and acceptability of  
11 collecting saliva samples in schools for the purpose of genetic studies together with obtaining consent  
12 for data linkage. However, parent consent in the current study was lower than other school-based  
13 research in other contexts and countries. For instance, in a school-based study collecting smoking  
14 survey information and genetic samples in 14-15-year-olds there was a parental consent rate of  
15 54%,<sup>(19)</sup> and a school-based survey study trialling recruitment methods in 6-7-year-olds obtained  
16 56% parental consent in cohort 1 and 71% in cohort 2.<sup>(20)</sup> These studies were able to undertake more  
17 intensive recruitment strategies (e.g. multiple waves of letters sent directly to parents, follow-up  
18 phone calls, incentives) over a longer period of time. The added complexity of linking genetic data to  
19 health records in the current study may have also affected response rates given concerns of  
20 confidentiality rank highly in reasons for parent consent refusal,<sup>(19)</sup> and teachers in post-MAGES  
21 focus groups highlighted genetic privacy as a concern. Teacher concerns were similar to those  
22 identified in previous research such as concerns about general privacy and the negative impact of  
23 potential future data disclosure (e.g. insurance and mortgage company discrimination).<sup>(11,12)</sup>  
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33 Our study suggests that it is very difficult to reach a full cross-section of parents or for such work to  
34 be undertaken at scale or to be representative of the whole population. Family-based study designs  
35 such as population-based birth cohorts, or clinic-based recruitment of children with mental health  
36 conditions and their families appear better placed for engaging parents directly with biological sample  
37 collection, including genetics. This is particularly the case in circumstances where an effective link  
38 between the research team and the family has helped establish trust and mutual understanding, e.g. as  
39 part of ongoing longitudinal population, patient or high-risk cohorts.  
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45 Our research points to a number of recommendations for future school-based mental health genetic  
46 research based on feedback from teachers and our own experience. First, engaging all stakeholders  
47 through the entire research process, from development to evaluation, is crucial. This not only  
48 facilitates recruitment and improves research protocols, but helps promote understanding of genetics  
49 and mental health amongst stakeholders, and the needs and perspectives of stakeholders amongst  
50 researchers. Face-to-face meetings are potentially best and should be included in school-based  
51 research protocols where possible, but this does have implications for researcher time and costs.  
52 Second, clear communication is essential for getting key messages to all stakeholders at all stages of  
53 the research. Factors that can aid clear communication are: simplified and concise information letters,  
54 multiple formats of information (e.g. video messages, paper letters, website, face-to-face meetings),  
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3 direct channels of communication by the study team to all stakeholders (one limitation of our study  
4 was that it was not possible to contact parents directly), and working with stakeholders to develop  
5 information packs and to introduce the research in schools. Third, it is important to give back to  
6 schools to reflect the time and hard work required to effectively facilitate such research. The science  
7 workshops in particular were highlighted as a major benefit for students and teachers and we also  
8 provided schools remuneration for their time. Again, scaling up would have significant cost  
9 implications. Fourth, adequate time and resources need to be dedicated to the collection of saliva  
10 samples. For instance, we altered the MAGES protocol to provide additional time for this. Finally,  
11 clear strategies for parent recruitment are needed for each school based on consultation with school  
12 staff. This is likely to include multiple waves of information packs sent direct to parent addresses,  
13 telephone follow ups, and providing multiple ways to make it as easy as possible for parents to  
14 consent (e.g. paper form, electronic form by email, online forms).  
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23 Future research would benefit from investigation of how to enhance parental recruitment rates.  
24 Parental consent is a challenge in school-based research,(19–22) and may be particularly challenging  
25 in secondary schools compared to primary schools where parental links to schools are not as strong as  
26 well as with research that covers mental health, genetics and data linkage. Typically, large scale DNA  
27 collection has worked when parents have been present, for instance Spit for Science  
28 (<https://lab.research.sickkids.ca/schachar/spit-for-science/>), but this is not always possible in school  
29 settings. We chose to recruit younger students from UK secondary schools (aged 11-13 years) as  
30 consultation with key stakeholders suggested parents of this age group would be more engaged;  
31 however, our low parent recruitment numbers suggest this may not be the case. Research focusing  
32 specifically on factors that affect parental rates of opt-in consent for school-based studies of this kind  
33 is needed. It would also be beneficial to assess whether parents would be easier to reach and be more  
34 engaged at other stages in their children's school careers, for instance, parents of primary school aged  
35 children (aged 4-11 years), though this would raise new questions about children's understanding and  
36 stakeholder views on the acceptability of genetic mental health research in this age group.  
37 Alternatively, research could focus on older students (e.g. in the UK aged 16+ years) where  
38 participants are able to provide their own active consent; however, in practice this would not obviate  
39 the need to keep all stakeholders in the school community, including parents, appropriately informed  
40 about the purposes and practicalities of the research.  
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## 52 Conclusions

53 Our study suggests that it is challenging to collect genetic data for the purpose of mental health  
54 research in a school setting. Low participation rates amongst parents, indicate that the scope and scale  
55 of such research would likely be restricted to sample designs where it is less important that samples  
56 are representative at a whole population level. Ultimately, large-scale representative samples covering  
57 a broad spectrum of genetic, biological, psychological and social factors are required for  
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3 advancements of our understanding of mental health risk and resilience in young people. The current  
4 study highlights that there would be major challenges in scaling up school-based mental health  
5 genetics research. The most important barrier is the difficulty in obtaining parent/guardian opt-in  
6 consent for their child's participation.  
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For peer review only



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**Patient consent for publication:** Not required.

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4 **Data availability statement:** Data are available upon reasonable request from the  
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6 corresponding author.  
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For peer review only

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Adolescent Depression (MoodHwb): Mixed Methods Feasibility Evaluation. JMIR Ment Heal.  
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Table 1. Participation and consent rates

School (eligible sample)	Parent/guardian consent forms returned n (%)	Student saliva samples n (%)	Routine datasets linkage n (%)	School questionnaire data linkage n (%)	Routine datasets and school questionnaire linkage n (%)
School 1 (n=246)	34 (13.82%)	31 (12.60%)	29 (11.79%)	30 (12.20%)	29 (11.79%)
School 2 (n=157)	27 (17.20%)	24 (15.29%)	24 (15.29%)	21 (13.38%)	21 (13.38%)
School 3 (n=465)	37 (7.96%)	35 (7.53%)	35 (7.53%)	29 (6.24%)	29 (6.24%)
Total (n=868)	98 (11.29%)	90 (10.37%)	88 (10.14%)	80 (9.22%)	79 (9.10%)

Note: % of eligible sample

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Table 2. Student feedback on science workshops

	<b>Have you enjoyed the MAGES science workshop?</b>			
	<b>Yes - I had great fun n (%)</b>	<b>Most of it was quite good n (%)</b>	<b>Some of the time it was ok n (%)</b>	<b>No - I didn't like it n (%)</b>
School 1 (n=191)	148 (77.49%)	27 (14.14%)	12 (6.28%)	4 (2.09%)
School 2 (n=119)	79 (66.39%)	30 (25.21%)	5 (4.20%)	5 (4.20%)
School 3 (n=343)	185 (53.94%)	108 (31.49%)	34 (9.91%)	16 (4.66%)
Total (n=653)	412 (63.09%)	165 (25.27%)	51 (7.81%)	25 (3.83%)

Note: ns reflect the number of students present in class who chose to give feedback on the MAGES science workshop.



Table 3. Themes identified from qualitative analysis of teacher focus groups

Main theme	Sub-theme	Second Sub-theme
<b>Acceptability</b>	Value of data-linkage	
	More acceptability in the future	
	No expressed concerns	
	Perception of parent/guardian and child acceptability	
	School would take part again	<i>Would take part without workshop</i>
	Using schools for genetic research	
<b>Benefits</b>	Partnership with CU	
	Mental health research	
	Science workshops	<i>Advanced science</i>
		<i>Benefits research</i>
		<i>Student enjoyment</i>
		<i>External visitors</i>
		<i>Real science</i>
	<i>Role models</i>	
	<i>Useful for teaching</i>	
<b>Concerns</b>	Children don't understand	
	Future use and impact	
	Linkage - data privacy and access	
	Parent/guardian concern of genetics	
	Perceptions of mental health testing	
	Potential harm to participants	<i>Determinism</i>
	<i>Finding out</i>	
<b>Challenges</b>	Communication with parents/guardians	<i>School contact with parents/guardians</i>
		<i>Lack of parent/guardian understanding</i>
	Communication with students	
	Communication with teachers	
	Recruitment	
<b>Suggestions for the future</b>	Engaging parents/guardians	<i>More information</i>
		<i>Parent event</i>

	Engaging students	<i>Assembly</i> <i>Enthusiasm</i> <i>Science workshops</i>
	Working with teachers	<i>Engagement</i> <i>Involving form tutors</i> <i>Involving all staff</i> <i>Science department</i>
<b>Large scale MAGES</b>	Logistics	
	School variability	
	Views on expanding study	
	Workshop going forward	
<b>Mental health</b>	Awareness	
	In schools	
<b>Practicalities</b>	Disseminating MAGES information	
	Teacher workload	
	Timing and organisation	

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4 **Figure titles**  
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6 Figure 1. MAGES recruitment and procedure  
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8 Figure 2. Science workshop structure and activities  
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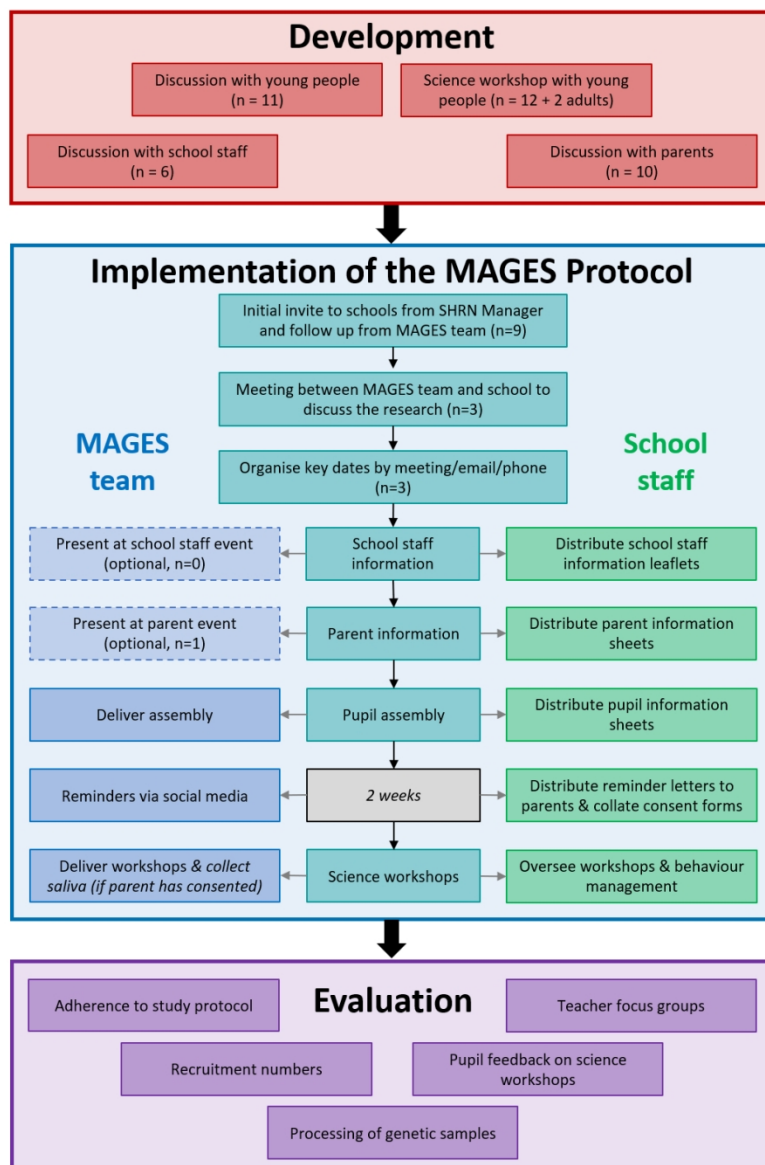


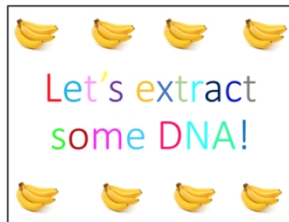
Figure 1. MAGES recruitment and procedure

### 1. Interactive presentation

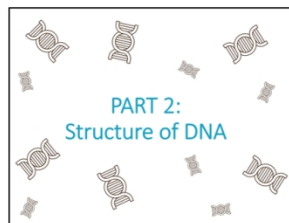


- All living things are made up of cells
- Cells are the building blocks of life
- Cell structure
- DNA is in the nucleus
- DNA is like a recipe book for your cells

### 2. Practical experiment extracting DNA from bananas



### 3. Interactive presentation



- Discovery of DNA structure
- DNA backbone and base pairs
- Genes and heredity
- External and internal traits influenced by genes
- Impact of environment and experience

### 4. Origami DNA model making



[www.yourgenome.org/activities/origami-dna](http://www.yourgenome.org/activities/origami-dna)

Figure 2. Science workshop structure and activities

Warne et al. Supplementary information for : Collecting genetic samples and linked mental health data from adolescents in schools: Protocol co-production and a mixed-methods pilot of feasibility and acceptability

### Supplementary Table 1. MAGES teacher focus group schedule

<b>Mental health research in young people</b>
Do you think schools should be involved in this kind of research? <i>PROMPT</i> Do you think your school should be involved in research on mental wellbeing and genetics? <i>PROMPT</i> How did you feel about your school taking part in research on mental wellbeing and genetics?
What do you think of researchers collecting DNA samples from children in school during the school day facilitated by teaching staff?
What do you think of linking child genetic data to other records?
<b>Evaluation of MAGES (practicalities)</b>
How did you find being a part of MAGES in your school? <i>PROMPT</i> What were the good parts? Was it beneficial? <i>PROMPT</i> What were the bad parts? Did it increase your workload significantly? What was most time consuming? <i>PROMPT</i> How could we improve?
How did you/ would you 'sell' this study to parents? To students?
Do you think the way the study was run (i.e. the study design) was practical? <i>PROMPT</i> What practical changes would you make to make it easier for schools to take part?
What would be the best way to get staff within your school to engage with MAGES?
<b>Evaluation of the school/parents/pupils</b>
How does your school communicate with parents?
Did any parents approach you with concerns about MAGES? <i>PROMPT</i> For instance, were there any concerns about taking DNA samples from children?
Did students approach you with any concerns before/ after workshop/ saliva collection?
Did any parents approach you for any further information about MAGES? <i>PROMPT</i> Did you know we have a website?
<b>Beyond the current MAGES</b>
Do you think this would work on a larger scale? <i>PROMPT</i> How about practicalities? Do you think teachers would be interested in delivering the science workshops themselves? <i>PROMPT</i> What things (incentives) would encourage all schools in Wales to take part?
Could you see your school participating in research like this in future? <i>PROMPT</i> Knowing what you do now, would you take part again? <i>PROMPT</i> How likely would you be to take part again and why?

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**Supplementary Figure 1. Sticker chart used for student feedback following each science workshop**



Mental Wellbeing in Adolescence:  
Genes and Environment Study  
Lles Meddyliol Pobl Ifanc:  
Astudiaeth Genynnau ac Amgylchedd



Have you enjoyed the **MAGES** science workshop?



Yes – I had great fun

Most of it was quite good

Some of the time it was ok

No – I didn't like it

Empty box for 'Yes – I had great fun' feedback

Empty box for 'Most of it was quite good' feedback

Empty box for 'Some of the time it was ok' feedback

Empty box for 'No – I didn't like it' feedback

Tell us how you feel by sticking a sticker in one of the columns to tell us

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**Supplementary Figure 2. Student instructions for providing a saliva sample**

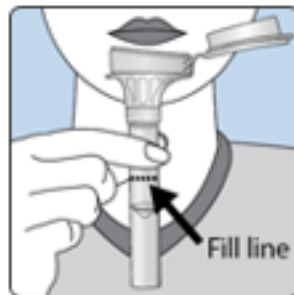
### **How to give a spit sample**

There is one saliva (spit) pot for you to fill. It's quick and easy.

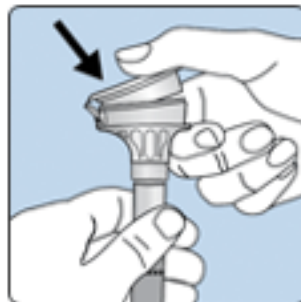
Please don't eat, drink, smoke or chew gum for 30 minutes before giving your spit sample. Also, please don't remove the plastic film from the lid.

You can then follow these simple instructions:

1. Spit saliva into the empty container, until it reaches the fill line shown below (not including bubbles):



2. Hold the tube upright with one hand. Close the funnel lid with the other hand (as shown) by firmly pushing the lid until you hear a **loud click**. The liquid in the lid will be released into the tube to mix with the saliva. Make sure that the lid is closed tightly.



3. Hold the tube upright. Unscrew the funnel from the tube.
4. Use the small cap to close the tube tightly.
5. Shake the capped tube for 5 seconds. You can discard or recycle the funnel.
6. Place into the plastic box provided and seal.
7. Return the filled tube to the researcher.



No.	Item		Description	Location in manuscript
<b>Domain 1: Research team and reflexivity</b>				
<i>Personal characteristics</i>				
1.	Interviewer/facilitator	Which author/s conducted the interview or focus group?	Interviewer SR and assistant interviewer NW	Page 9
2.	Credentials	What were the researcher’s credentials?	SR-Med; NW- PhD,	Page 9
3.	Occupation	What was their occupation at the time of the study?	SR & NW - MAGES Research Assistant	Page 9
4.	Gender	Was the researcher male or female?	SR & NW - Female	Page 9
5.	Experience and training	What experience or training did the researcher have?	SR- 3 years previous experience of working as a Research Assistant and conducting and analysing focus groups on NIHR funded RCT; NW- training in semi-structured clinical interviews	Page 9
6.	Relationship established	Was a relationship established prior to study commencement?	All focus group participants had an element of involvement with MAGES and therefore some form of previous relationship with SR and NW. Participants included form tutors who distributed MAGES information sheets and consent forms, science teachers who were present during the science workshop and the key MAGES contact teacher who was responsible for scheduling all assemblies, workshops and data collection days.	Page 9
7.	Participant knowledge of the interviewer	What did the participants know about the researcher?	All participants knew that NW and SR were Research Assistants working for Cardiff University as part of MAGES.	Page 9
8.	Interviewer characteristics	What characteristics were reported about the interviewer/facilitator?	SR and NW acknowledged their roles as Research Assistants for MAGES and outlined that the purpose of the study was to investigate the feasibility and acceptability of collecting saliva samples from children in schools and linking these samples to other information in order to understand more about the interaction between genes and environment in mental health.	Page 9
<b>Domain 2: study design</b>				
<i>Theoretical framework</i>				

9.	Methodological orientation and theory	What methodological orientation was stated to underpin the study?	Inductive thematic analysis.	Page 9
<b>Participant selection</b>				
10.	Sampling	How were participants selected?	Purposeful maximum variation sampling.	Page 9
11.	Method of approach	How were participants approached?	Face-to-face invitation from SR and NW to key MAGES school contact. Researchers asked key contact to invite other school staff with a wide range of involvement with MAGES to attend focus group.	Page 9
12.	Sample size	How many participants were in the study?	15	Page 9
13.	Non-participants	How many people refused to participate or dropped out? Reasons?	None	-
<b>Setting</b>				
14.	Setting of data collection	Where was the data collected?	Data were collected at participant's schools at a time and date convenient to them.	Page 9
15.	Presence of non-participants	Was anyone else present besides the participants and researchers?	No	-
16.	Description of sample	What are the important characteristics of the sample?	The sample included science teachers, members of the school's senior leadership team and form tutors.	Page 9
<b>Data collection</b>				
17.	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Supplementary Table 1	Supplementary Table 1
18.	Repeat interviews	Were repeat interviews carried out? If yes, how many?	No	n/a
19.	A/V recording	Did the research use audio or visual recording to collect the data?	Audio was digitally recorded.	Page 9
20.	Field notes	Were field notes made during and/or after the interview or focus group?	Supplementary hand written field notes of each focus group were made by NW.	Page 9
21.	Duration	What was the duration of the interviews or focus group?	Focus groups lasted approximately 45 minutes.	Page 9
22.	Data saturation	Was data saturation discussed?	A wide range of views were collected and researchers were confident that there was no further information that could	Page 10

			have been gained from recruiting more participants/ holding more focus groups.	
23.	Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No	-
<b>Domain 3: Findings and Analysis</b>				
<b>Data analysis</b>				
24.	Number of data coders	How many data coders coded the data?	There were two data coders (NW and SR).	Page 9-10
25.	Description of the coding tree	Did authors provide a description of the coding tree?	A full summary of the coding tree, including themes not explored within this paper, is included in Table 3	Table 3, page 27-28
26	Derivation of the coding themes	Were themes identified in advance or derived from the data?	Themes were identified from the content of the data.	Page 9-10
27.	Software	What software, if applicable, was used to manage the data?	NVivo 12 was used to code and analyse data.	Page 9-10
28.	Participant checking	Did participants provide feedback on the findings?	No	-
<b>Reporting</b>				
29.	Quotations presented	Were participant quotations presented to illustrate the themes / findings? Was each quotation identified?	Participant quotations are provided in the results to illustrate findings. Participant's quotations are anonymised.	Page 11-16
30.	Data and findings consistent	Was there consistency between the data presented and the findings?	Both NW and SR reviewed included quotes to ensure that they were fully representative of our data. Quotes were also reviewed by RB.	-
31.	Clarity of major themes	Were major themes clearly presented in the findings?	Yes - Major themes are discussed within the paper and described within table 3	Page 11-16 and Table 3, page 27-28
32.	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Yes - Minor themes are discussed within the paper and described within table 3	Page 11-16 and Table 3, page 27-28

# BMJ Open

## Collecting genetic samples and linked mental health data from adolescents in schools: Protocol co-production and a mixed-methods pilot of feasibility and acceptability

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12 methods pilot of feasibility and acceptability  
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## Abstract

Objectives: To co-produce a school-based protocol and examine acceptability and feasibility of collecting saliva samples for genetic studies from secondary/high school students for the purpose of mental health research.

Design: Protocol co-production and mixed-methods feasibility pilot.

Setting: Secondary schools in Wales, UK.

Participants: Students aged 11-13 years.

Primary and secondary outcome measures: Co-produced research protocol including an interactive science workshop delivered in schools; school, parental and student recruitment rates; adherence to protocol and adverse events; ability to extract and genotype saliva samples; student enjoyment of the science workshop; and qualitative analysis of teacher focus groups on acceptability and feasibility.

Results: Five secondary schools participated in the co-production phase, and three of these took part in the research study (eligible sample n=868 students). Four further schools were subsequently approached, but none participated. Parental opt-in consent was received from 98 parents (11.3% eligible sample), three parents (0.3%) actively refused and responses were not received for 767 (88.4%) parents. We obtained saliva samples plus consent for data linkage for 79 students. Only one sample was of insufficient quality to be genotyped. The science workshop received positive feedback from students. Feedback from teachers showed that undertaking research like this in schools is viewed as acceptable in principle, potentially feasible, but that there are important procedural barriers to be overcome. Key recommendations include establishing close working relationships between the research team and school classroom staff, together with improved methods for communicating with and engaging parents.

Conclusions: There are major challenges to undertaking large scale genetic mental health research in secondary schools. Such research may be acceptable in principle, and in practice DNA collected from saliva in classrooms is of sufficient quality. However, key challenges that must be overcome include ensuring representative recruitment of schools and sufficient parental engagement where opt-in parental consent is required.

Key words: school; adolescent mental health; genetics; data linkage; feasibility and acceptability



## Article Summary

### Strengths and limitations of this study

- This is the first study to test the feasibility and acceptability of collecting genetic samples in secondary schools and obtaining consent for linkage to questionnaire and record-based mental health data.
- A key strength is co-production of the research protocol with stakeholders (young people, parents/guardians, schools).
- We used a mixed-methods approach to assess the feasibility and acceptability of carrying out genetic research studies of mental health in schools.
- This pilot study was conducted in three mainstream secondary schools in Wales, UK so it is unclear whether findings are transferrable to a wider section of schools in Wales and other countries, education systems and age groups.
- It was not possible to collect data on the reasons for return or non-return of parental consent.

## 44 Introduction

45 In the UK, approximately 1 in 8 (12.8%) young people aged 5-19 years old have a diagnosable mental  
46 health disorder with rates increasing in recent years.(1,2) The causes of youth mental health  
47 difficulties involve genetic and environmental risk factors acting together in complex ways. The  
48 majority of adult mental health conditions originate before the age of 24,(3,4) and early identification  
49 and prevention are important priorities. However, only a minority of young people with mental health  
50 problems seek or receive help from health-care professionals.(1,5) To better understand risk and  
51 protective factors for psychiatric conditions, data from population-based samples of young people,  
52 including relevant genetic, biological, psychological and social factors is important. Established UK  
53 birth cohorts are a valuable resource for studying the development of mental ill health, including the  
54 interplay of genetic factors and family environment. However, the costs involved in setting up and  
55 maintaining such cohorts are considerable, and information about other social contexts such as  
56 schools is often limited.(6)

57 An alternative approach involves collecting data on mental health and associated risk and protective  
58 factors from young people within the school setting, offering the opportunity to study the roles of  
59 classroom, peer group and school-level effects. In addition, school-based designs offer the potential to  
60 recruit and obtain data from larger population-based samples than is possible using traditional birth  
61 cohort designs. Typically, student participation rates are high when health questionnaire data are  
62 collected during the school day.(7,8) What is unclear is whether it would be acceptable to schools,  
63 students and their parents to collect saliva samples for the purpose of genetic studies involving mental  
64 health, and what the main barriers are that need to be overcome to make this feasible in practice.  
65 Challenges include ensuring schools, parents/guardians and young people themselves will be  
66 accepting of research on genetics and mental health; providing information to young people, their  
67 parents and teachers; collecting appropriate informed consent; integrating research into the every-day  
68 life of schools in a way that fits with the needs of schools and learners; and implementing robust and  
69 ethical protocols for the collection of saliva samples in a classroom setting.

70 Previous studies have had some success with collecting salivary cortisol samples in school settings  
71 (for reviews see (9,10)). In contrast, little is known about the acceptability and feasibility of  
72 classroom-based collection of saliva samples for genetic research. Despite increasing understanding  
73 and acceptance of genetic research, public concerns remain - particularly in relation to children,(11-  
74 15) and mental health is often stigmatised,(16,17) so it is unclear whether this type of research would  
75 be acceptable to young people, parents/guardians and school staff. Similarly, the concept of data  
76 linkage (e.g. to mental health questionnaires or health records) might elicit concerns about  
77 privacy.(18) Parent/guardian recruitment and consent is typically challenging in school-based  
78 research,(19-22) particularly in secondary school settings. Having a research study and protocol that

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2  
3 79 is acceptable to key stakeholders is critical to a research study's success.(8,23,24) It will not only help  
4 80 with recruitment, but will also help develop a process that key stakeholders engage with or "buy into",  
5 81 and that fits with the context and daily life of students, teachers and parents. Indeed, co-production of  
6 82 research with stakeholders is critical to support the development of school-based research.(8)  
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10 83 To our knowledge, no other study has examined the acceptability and feasibility of collecting saliva  
11 84 samples from young people in schools for the purpose of genetic research on mental health.  
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13

## 14 85 The current study

15 86 The Mental Wellbeing in Adolescence: Genes and Environment Study (MAGES) aimed to assess the  
16 87 acceptability and feasibility of collecting DNA saliva samples from young people in schools with  
17 88 consent for linkage to other routinely collected mental health questionnaire and record-based data.  
18 89 The over-arching aims were to work with stakeholders (school staff, parents, young people) to co-  
19 90 produce an acceptable research protocol, and then test this protocol in order to inform future studies  
20 91 on the best ways to carry out this kind of research.  
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25 92 The study was conducted in Wales which provides a globally unique research infrastructure, with  
26 93 student health, mental health and wellbeing data collected every two years in all mainstream  
27 94 secondary schools via SHRN (School Health Research Network, <http://www.shrn.org.uk/>) and  
28 95 potential linkage to routine health, education and social care data via SAIL (Secure Anonymised  
29 96 Information Linkage) databank ([www.saildatabank.com](http://www.saildatabank.com)). The SHRN 2017 health and well-being  
30 97 survey was completed by all state-funded schools in Wales, UK (n=193) and had 97% of students take  
31 98 part (n=112,045).(7,8)  
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37 99 In the development phase we worked with stakeholders (young people, parents/guardians, schools) to  
38 100 develop a study protocol that had the greatest chance of being both acceptable and feasible in practice.  
39 101 To evaluate the MAGES protocol, we used a mixed-method design with quantitative and qualitative  
40 102 data. Specifically, we examined school, parent/guardian and student consent/participation rates,  
41 103 considered adherence to the study protocol and the occurrence of any adverse events (e.g.  
42 104 complaints), and the ability to genotype samples. We collected feedback from young people and  
43 105 undertook focus groups with teachers to gain further insights on the feasibility and acceptability of the  
44 106 study, and how the protocol might be adapted in future.  
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## 51 107 Methods

### 52 108 Study design

53  
54 109 The study was conducted in three stages: firstly a development phase, followed by implementation of  
55 110 the protocol, and then an evaluation phase (Figure 1). The development phase included co-production  
56 111 of the study protocol with key stakeholders. The MAGES protocol included recruitment of schools,  
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3 112 obtaining consent from parents/guardians and students, and collection of saliva samples for genetic  
4 113 analysis. Saliva collection occurred during specially developed MAGES science workshops that took  
5 114 the place of a normal science lesson (see below). No phenotypic information was collected on  
6 115 participants. Quantitative evaluation included numbers and percentages for each stage of recruitment,  
7 116 percent of usable genotyped samples, and student feedback scores on the science workshop aspect of  
8 117 the protocol. Qualitative evaluation included teacher focus group discussion of MAGES protocol  
9 118 following completion of classroom data collection.

## 15 119 Development phase

16 120 Stakeholders involved during development of the research protocol included young people, school  
17 121 staff, and parents/guardians.

18 122 Researchers discussed the study protocol and the practicalities of using saliva collection kits in a  
19 123 classroom setting with a group of young people aged 14-17 years old (n=11, 5 males, 6 females).  
20 124 Young people were part of the public patient involvement group ALPHA  
21 125 (<http://decipher.uk.net/public-involvement/young-people/>). Based on feedback from this session we  
22 126 made changes to the study protocol (including a school assembly presentation) to simplify the content  
23 127 and to explain technical terms (e.g. data linkage) more fully.

24 128 School staff shared their perspectives on the acceptability of taking saliva samples from students in  
25 129 schools and provided advice on practical issues. Teachers from 9 schools that were engaged in SHRN  
26 130 research were invited to take part. A total of 5 teachers (3 females, 2 males) from 5 schools and 1  
27 131 Healthy Schools Practitioner (female) participated. Particular consideration was given to how research  
28 132 participation would impact teacher workload, how researchers could give back to schools, and  
29 133 potential practical challenges. School staff highlighted that getting the parent/guardian consent  
30 134 required for participants aged under 16 years old (as is required in Wales, UK) was likely to be the  
31 135 most challenging aspect of the project. As a result of this session, we adapted our protocol to target  
32 136 younger year groups (Years 7 and 8, age 11-13 years) as it was thought that parents/guardians would  
33 137 be more engaged and older cohorts could not afford to take time out of core lessons. Suggested ways  
34 138 to engage parents/guardians were to meet in person via events at each school, and by presenting  
35 139 MAGES information in different formats. We therefore included a parent/guardian event in our  
36 140 protocol and also created a website with videos explaining why the research is important and what  
37 141 taking part involves ([www.cardiff.ac.uk/MAGES](http://www.cardiff.ac.uk/MAGES)). Giving back to schools was also highlighted as  
38 142 important and providing a science workshop to students was considered a good way to do this.

39 143 Mothers (n=10) recruited from a local parent research network took part in a discussion on the  
40 144 proposed research and provided feedback on the clarity and content of parent/guardian information

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3 145 sheets. Data linkage emerged as a key concern and we adapted information sheets to provide more  
4  
5 146 information on this.

6  
7 147 Finally, to ensure that the science workshop content was suitable and enjoyable for the proposed age  
8  
9 148 range, we trialled the science workshop (see below) with a local Scout group of 12 boys aged 10-13  
10  
11 149 years old and 2 adult scout leaders (1 male, 1 female).

## 12 150 Implementation phase

### 13 151 *Evaluation sample*

14  
15 152 Participants were students in Years 7 and 8 (aged 11-13 years) at mainstream secondary schools in  
16  
17 153 South Wales, UK that were part of the School Health Research Network (SHRN).(7,8)

### 18 154 *Recruitment and protocol*

19  
20 155 Figure 1 depicts the recruitment and protocol used. Firstly, schools that were consulted in the  
21  
22 156 development of the protocol (n=5) were invited to take part in MAGES via direct correspondence  
23  
24 157 from the SHRN Manager to each of the SHRN school contacts. This was followed up by MAGES  
25  
26 158 staff. A further four local SHRN schools were invited to participate at a second recruitment wave.  
27  
28 159 Participating schools were offered £500 (£250 per year group) as a thank you for facilitating the  
29  
30 160 research and to cover costs in staff time resulting from participation.

31  
32 161 *School staff meetings:* Following initial contact, MAGES researchers met with members of each  
33  
34 162 school's senior leadership teams. All schools were given the option of holding events for  
35  
36 163 parents/guardians and teachers where MAGES staff would introduce the project and answer  
37  
38 164 questions.

39 165 *Information packs:* Schools were asked to disseminate parent/guardian information packs (using  
40  
41 166 typical communication methods). These included an overview of the study, frequently asked  
42  
43 167 questions and a link to the study webpage ([www.cardiff.ac.uk/MAGES](http://www.cardiff.ac.uk/MAGES)). Parents/guardians were also  
44  
45 168 given email and phone contact details for the MAGES team if they had queries or concerns.

46 169 At a later date, MAGES researchers delivered 15-20 minute assemblies to students to explain the  
47  
48 170 project, following which, the schools were asked to distribute information packs to students.

49  
50 171 *Workshops:* Feedback from stakeholders during the development phase indicated the value of science  
51  
52 172 workshops on the theme of genetics for engaging schools and learners. Student science workshops  
53  
54 173 were scheduled to start two weeks from the student assembly. During this period, schools distributed  
55  
56 174 reminder letters to parents/guardians and collated consent forms. MAGES staff also provided  
57  
58 175 reminders via social media (twitter).

59 176 MAGES researchers delivered the workshop to all classes in each participating year group in the place  
60  
177 of a normal science lesson (lasting 50-60 minutes). Science workshops began with an introduction to

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3 178 MAGES and the team followed by an interactive lesson (see Figure 2) consisting of 1) a presentation  
4 179 teaching the basics of DNA, 2) a practical experiment extracting DNA from bananas, 3) an additional  
5 180 presentation on DNA structure, heredity, traits influenced by genes and impact of  
6 181 environment/experience, and 4) an activity creating origami DNA models. During the origami  
7 182 activity, those students who had completed parent/guardian consent forms were invited to take part in  
8 183 the DNA collection. Students were given their own assent form to sign and then provided a saliva  
9 184 sample. This was conducted in a screened off area of the classroom or in a side room to provide  
10 185 privacy. At the end of the science workshop all students were asked to provide feedback about  
11 186 whether they had enjoyed the science session on a sticker chart (Supplementary Figure 1). Science  
12 187 workshops and data collection occurred between April and July 2019.

### 188 *Ethical approval and consent*

189 Ethical approval was obtained from Cardiff University School of Medicine Research Ethics  
190 Committee. As students were under 16 years, participation in MAGES required informed parental  
191 opt-in consent and student assent. Both parents/guardians and students had the option to provide or  
192 not provide additional consent/assent for linking genetic information to other routinely collected data.  
193 Consent for routinely collected data was split into two broad categories: (i) health and educational  
194 records, and (ii) student-completed health and wellbeing questionnaires.

### 195 *Evaluation phase*

#### 196 *Feasibility*

#### 197 *Recruitment and participants*

198 The numbers of schools recruited, parent/guardian consent forms returned, student participation and  
199 consent for data linkage were recorded and percentages of the eligible sample were calculated. Where  
200 possible, reasons for not taking part were recorded. To assess school-level response bias, participating  
201 and non-participating schools were compared on a number of routinely assessed school-level  
202 characteristics (<https://mylocalschool.gov.wales/>), including Free School Meals entitlement (%),  
203 minority ethnic pupils (%), student attendance (%), and academic achievement (% achieving 5  
204 General Certificate of Secondary Education at A\*-C grades).

#### 205 *Saliva samples*

206 Participants provided saliva samples (approximately 5ml) using Genotek Oragene saliva kits under  
207 the supervision of MAGES researchers (full instructions in Supplementary Figure 2). Participants  
208 were asked if they had eaten or drunk anything in the last 30 minutes and if not, were instructed to fill  
209 the saliva collection tube to the fill line. If participants had eaten or drunk in the last 30 minutes, they  
210 were asked to wait 30 minutes before providing a sample. Sample collection took around 5-10

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3 211 minutes per participant, and multiple students provided samples at the same time under researcher  
4 212 supervision. The collection tubes were labelled using barcodes and a unique participant study number.  
5  
6 213 The samples were taken to the research laboratory - MRC Centre for Neuropsychiatric Genetics and  
7 214 Genomics at Cardiff University. All samples were processed in accordance with the standard  
8  
9 215 operating procedures for sample management, storage, and tracking of biological materials. DNA was  
10 216 extracted from the saliva samples in-house, following standard Genotek Oragene DNA Prep-IT  
11 217 protocols. DNA sample quantification was determined using Quant-iT PicoGreen dsDNA assay kits,  
12 218 and samples were genotyped using Illumina Infinium Global Screening arrays. Data were recorded on  
13 219 the number and percentage of successfully extracted and genotyped samples.

#### 17 18 220 *Adherence to study protocol and adverse events*

19  
20 221 The research team undertook a review of the protocol following completion of the study within each  
21 222 school and recorded data on adherence to protocol. This included instances where the protocol (Figure  
22 223 1) was changed and any adverse events (e.g. complaints).

#### 23 24 224 *Acceptability*

#### 25 26 225 *Science workshop*

27  
28 226 Student feedback was collected at the end of each workshop to assess the value of including the  
29 227 science workshops in the protocol. Students rated their enjoyment of the workshop using a sticker  
30 228 chart (Supplementary Figure 1) with a scale of: 1) “Yes – I had great fun”; 2) “Most of it was quite  
31 229 good”; 3) “Some of the time it was ok”; or 4) “No – I didn’t like it”.

#### 32 33 230 *Teacher focus groups post-MAGES*

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35 231 Three focus groups were held with teachers in participating schools to get feedback on MAGES.  
36 232 Teachers were recruited to the focus groups by each school’s key contact teacher. A £20 voucher was  
37 233 offered as remuneration for each teacher’s time, and schools were given £125 for holding the focus  
38 234 group (to cover replacement teaching time). Five teachers participated in each focus group (School 1:  
39 235 3 females, 2 males; School 2: 5 females; School 3: 2 females, 3 males). This sample included science  
40 236 teachers, members of the senior leadership team and form tutors responsible for pastoral care. Data  
41 237 were collected at participant’s schools at a time and date convenient to them.

42  
43 238 Focus groups lasted approximately 45 minutes and were conducted by two female MAGES  
44 239 researchers (SR, Med, 3 years’ experience of conducting and analysing focus groups; and NW, PhD,  
45 240 with training in semi-structured clinical interviews). Researchers were responsible for workshop  
46 241 delivery and saliva collection, and therefore had working relationships with the teachers prior to the  
47 242 focus group. Teachers were asked about their views on mental health research in young people, how  
48 243 MAGES was conducted in their school, how they and others (parents/guardians, students) found the  
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3 244 MAGES process and what improvements they would make to the study (see Supplementary Table 1  
4 245 for focus group schedule). Digital audio recordings of the three focus groups were transcribed  
5 246 verbatim by a professional transcription company and supplementary handwritten notes were made.  
6 247 The transcribed interviews were then exported to NVivo 12, a qualitative data analysis computer  
7 248 software package.

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11 249 Two researchers (SR and NW) conducted an inductive thematic analysis of the data following Braun  
12 250 and Clarke's (2006) framework (25). The steps in this process included: 1) data familiarisation, 2)  
13 251 initial code generation, 3) theme identification and framework development, 4) theme review, and 5)  
14 252 final theme definition. A wide range of views were collected and researchers were confident that there  
15 253 was no further information that could have been gained from recruiting more participants/ holding  
16 254 more focus groups.

17  
18 255 Both researchers coded all the transcripts independently and then met to jointly develop a coding  
19 256 framework. This framework was derived inductively from the focus group data but was also  
20 257 influenced deductively by the research questions. They subsequently recoded the transcripts using the  
21 258 agreed framework using NVivo 12.

## 22 259 Patient and Public Involvement

23 260 The design of the protocol was informed by extensive PPI work with key stakeholders – young  
24 261 people, parents/guardians and school staff (see 'Development phase' above). Schools participating in  
25 262 the development phase of the project were offered the opportunity to take part in the main study and  
26 263 help recruit parents and students at their school. Results were disseminated to participating schools  
27 264 through electronic and paper feedback reports.

## 28 265 Results

### 29 266 Feasibility

#### 30 267 *Recruitment and participants*

31 268 Three of five schools involved in the advisory stage agreed to take part in MAGES, with the two non-  
32 269 participating schools stating they were too busy. No schools (0/4) in the second recruitment wave  
33 270 agreed to meet to discuss taking part in MAGES. Researchers were unable to reach the SHRN contact  
34 271 prior to the end of the study in two schools and two schools declined taking part due to being too busy  
35 272 (n=1), and having concerns over taking DNA from children and being perceived as having young  
36 273 people with mental health problems (n=1). The total school participation rate was 33.3% (3 out of 9  
37 274 invited schools). On average, the three participating schools had lower Free School Meal (FSM)  
38 275 entitlement (14.0% versus 23.1%), lower proportion of minority ethnic students (15.4% versus 21.9%)  
39 276 than the six non-participating schools, and similar student attendance (94.3% versus 93.7%), and



277 academic achievement (58.4% versus 60.2% students 5 GCSE A\*-C grades). In comparison to the  
278 national average, participating schools had lower FSM entitlement (Wales average 17.5%), higher  
279 proportion of minority ethnic students (Wales average 9.8%), higher student attendance (Wales  
280 average 93.9%), and higher academic achievement (Wales average 55.1%).

281 Table 1 details the number of parent/guardian consent forms received, saliva samples collected and  
282 consent for data linkage for each participating school. Three parents from the eligible sample of 868  
283 (0.3%) refused permission for their child to participate, either via email (n=1) or on the consent forms  
284 (n=2). 98 parents (11.3%) provided signed consent for students to participate in the study. No  
285 responses were received from the remaining eligible sample (88.4%).

286 Of the 98 students with parent/guardian consent, saliva samples were obtained from 90 students  
287 (89.6%; 31 males, 59 females). Five students decided they did not want to take part, two were absent  
288 on days of saliva collection, and there was not enough time to collect a sample from one student.  
289 Consent for complete data linkage was obtained for 79 (80.6%) students.

290 Sample collection rates varied by school, ranging from 7.5% to 15.3% of eligible students. This  
291 primarily reflected variation in parent/guardian consent (8.0%-17.2%). There was also considerable  
292 within-school variation in sample collection between different classes (School 1: 0-38.2%; School 2:  
293 11.1-28.0%; School 3: 0-21.4%).

#### 294 *DNA extraction and genotyping*

295 We were able to extract DNA and genotype 89 of the 90 (98.9%) samples collected. One sample was  
296 not genotyped due to insufficient concentration of DNA.

#### 297 *Adherence to study protocol*

298 The study protocol was followed for School 1. However, the time-limited nature of science  
299 workshops during a normal lesson restricted the number of saliva samples that could be collected. In  
300 subsequent schools we adjusted the protocol so that the saliva collection occurred approximately one  
301 week following the science workshop to allow adequate time.

302 After School 1 layout and formatting changes were made to the parent/guardian consent forms to  
303 increase clarity.

304 Only one school (School 3) opted to provide an event to explain MAGES to parents and guardians.  
305 This event was organised specifically to discuss MAGES (Thursday evening, 5.30pm start) but was  
306 poorly attended (n=5, 1.1% of school eligible sample). This session was primarily comprised of  
307 parents and guardians with concerns and queries about the research. No school chose to have the  
308 additional event for MAGES researchers to explain the project to teachers.

309 We did not receive any complaints about the research from students, parents/guardians or school staff.

## 310 Acceptability

### 311 *Science workshop*

312 Of the students who gave feedback on the science workshops, the majority (88.4%) said “Yes – I had  
313 great fun” or “Most of it was quite good” (Table 2).

### 314 *Teacher focus groups post-MAGES*

315 A number of themes were identified from thematic analysis of qualitative interviews with teachers  
316 (Table 3). Here we focus on key themes that informed our understanding of acceptability and  
317 feasibility.

## 318 Acceptability

319 Teachers were asked about their views on the appropriateness of conducting a study like MAGES in a  
320 school environment. Generally, teachers who were interviewed were in favour of such research.

321 *“You asked whether or not it’s a good idea to use the schools. I think we’re in an ideal position. A  
322 captive audience, if you want. It’s the easiest way of getting hold of those pupils and that information  
323 and of youngsters so I don’t necessarily have a problem with schools being involved.”*

324 The consensus was largely that the MAGES protocol was acceptable, however there was some  
325 concern that this view may not be shared by other people within the community. Some teachers  
326 suggested that people outside of the school may feel it was inappropriate for teachers to facilitate this  
327 kind of research.

328 *“I wonder how that might be seen by different people as in, why are they taking DNA? What are they  
329 going to do with it? Why should teachers allow them to come in and do that?”*

330 Teachers discussed the acceptability of MAGES from the point of view of parents/guardians and  
331 students. Although some participants suggested that they expected parents/guardians to react  
332 negatively to MAGES, all participants agreed that no parent or student approached them with any  
333 complaints or concerns.

334 *“When I first got sent the email about the project, as a scientist I thought some parents are not going  
335 to like that...but we took the risk and, in fact, we got more people coming back than I thought we  
336 would.”*

## 337 Benefits

338 The benefits of taking part in MAGES were widely discussed, with members of all groups indicating  
339 that they would be willing to participate in MAGES again in the future. The potential contribution to

1  
2  
3 340 mental health research was noted in all three focus groups as a major benefit of being involved with  
4 341 MAGES.

6  
7 342 *“I think there’s a lot of mental wellbeing issues in amongst children now. If we’ve got research and*  
8 343 *there’s data on it, if that data can be used in a positive way, then it’s a good thing but it’s just the*  
9 344 *feasibility of collecting that large amount of data for it to be viable.”*

12 345 Teachers also said they would have agreed to take part without the incentive of the science workshop,  
13 346 however there was a preference for the workshop to remain as part of MAGES.

16 347 *“I would have still agreed to do it, absolutely, but I wonder if the kids could actually link to what’s*  
17 348 *going on. I think that’s where the disconnect would be. We still would’ve signed up to it absolutely*  
18 349 *because we recognise we’ve got mental health issues in the school and the importance of these types*  
20 350 *of research studies.”*

23 351 Similarly, teachers acknowledged the value of linking genetic information with data on mental health.

25 352 *“I would’ve thought, to make your research valuable, you’ve got to do it otherwise all you’ve got it is*  
26 353 *a DNA sample.”*

29 354 The possibility that genetic research may become more acceptable to people in the future was brought  
30 355 up by multiple teachers.

33 356 *“I think that attitude will change in the future. This is quite early on. Everybody was initially*  
34 357 *technology – the beast. Now, everybody’s embracing it. I think exactly the same thing will happen*  
35 358 *with DNA and testing. I think it will probably become quite routine.”*

38 359 The prestige of working in partnership and forming a relationship with Cardiff University was also  
39 360 seen as a benefit.

42 361 *“Our incentive has been the formation of this partnership and feeling like we’re helping you with*  
43 362 *your samples and we’ve had something for our students back.”*

### 46 363 Science workshop

48 364 The biggest benefit identified was the science workshop that was delivered to all Year 7 and 8  
49 365 students. Teachers frequently commented on the value of having external visitors who could be  
50 366 viewed as role models. Science workshops were seen as helpful to clarify how students’ saliva  
51 367 samples would be used if they chose to take part. Teachers noted how much students enjoyed the  
52 368 session and suggested it gave them an opportunity to practice real, advanced science relevant to the  
53 369 teaching curriculum.

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2  
3 370 *“It creates a buzz that you’ve got the profile of Cardiff University coming in, it gets the children*  
4 371 *excited about it. When we have outside speakers, they love that and that’s why I think it’s needed*  
5 372 *because otherwise, it’s just spit into this thing and signing a form whereas if they did the banana*  
6 373 *DNA, they went home and talked about it, they were talking about it in their next lessons.”*

7  
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9  
10 374 *“I think it’s really important for students to see researchers because students have this idea that*  
11 375 *scientists are lab coats and you don’t all look like Albert Einstein. For you guys to come in, you’re*  
12 376 *normal people and to say ‘we are scientists, we are doing this’ and for them to think, ‘you’re ordinary*  
13 377 *people, we could do that.’”*

### 17 378 Concerns and potential challenges

18  
19 379 Although focus group participants agreed on the whole that it was acceptable to conduct MAGES  
20 380 within a school environment, they did acknowledge some concerns. These focused on the potential  
21 381 negative impact of genetic research on participants as well as privacy issues surrounding the process  
22 382 of data linkage.

23  
24 383 All potential MAGES participants were told that they would not receive any results from their saliva  
25 384 sample during the initial assembly, in the science workshop and in all MAGES information packs.  
26 385 However, not all teachers were present in the assembly and many had not read the information  
27 386 leaflets. This led to some unaddressed concern among teachers about the potential harm that could be  
28 387 caused to students if they were to be informed that they had an increased genetic risk for particular  
29 388 mental health conditions. Focus group participants felt strongly that students should not receive  
30 389 feedback regarding the results of their DNA sample as feedback might lead students to believe they  
31 390 were predisposed to mental illness.

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33 391 *“If we’ve got a young person who has mental health issues, they get a DNA test, they find they’ve got*  
34 392 *that gene, I fear they’d think there’s nothing they could do. They’d say, ‘I’ve got the gene, I’m*  
35 393 *genetically going to have mental health issues, there’s no point having therapy, there’s no point*  
36 394 *talking about it because that’s just who I am.’”*

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40 395 Concerns about how participants’ data could be used in the future and the potential negative impact  
41 396 this might have were discussed.

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43 397 *“If you discover a DNA precursor to mental health, what if an insurance company in the future said*  
44 398 *to you is this person likely to get mental health illnesses? Or a mortgage company?”*

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47 399 Teachers acknowledged the value of data linkage and were aware of the measures in place to protect  
48 400 participant’s privacy, however some did still express concern.

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51 401 *“I know its numbers and barcodes but at some stage in the process, somebody will have access to the*  
52 402 *names and be able to link it.”*

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3 403 Participant understanding of MAGES and communication were noted as challenges. Some teachers  
4 404 felt that the information given to students by researchers about genetic research and data linkage was  
5 405 too complex for young people to properly understand.

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8 406 *“It’s the lost in translation thing – they didn’t quite understand ... and when the kids are very, very*  
9 407 *weak [academically], it was more lost in translation.”*

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12 408 The initial MAGES assembly was felt to be too complex and that this had led to misunderstanding the  
13 409 purpose of the study by some students. Teachers said that some students came away from the  
14 410 assembly believing that the purpose of MAGES was to screen them for mental health conditions.

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17 411 *“I had one student ...who thought you were going to test her for mental health problems and was*  
18 412 *concerned that you were going to tell her there was something wrong with her.”*

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21 413 Similarly, teachers suggested that parents/guardians may have found the information sheets to be too  
22 414 complex which may have impacted their decision about allowing their child to participate.

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25 415 *“It’s education for the parents as well – they need to fully and truly understand what it’s for, what’s*  
26 416 *happening to their child’s DNA what are they going to do with it, what’s going to happen in the end?*  
27 417 *Obviously, we do have a lot of parents who ... don’t truly understand what it means to take DNA and*  
28 418 *they just understand DNA from the television... If they don’t truly understand why you’re taking it*  
29 419 *then no, it’s too scary...”*

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32 420 Communication, in particular, was seen as a challenging element of MAGES, and that this required  
33 421 teachers to provide additional information and answer follow-up questions from students. Teachers  
34 422 reported that some staff members were approached by students with questions about MAGES  
35 423 following the initial assembly and the distribution of the student information sheets, suggesting that  
36 424 the information provided by researchers was inadequate on its own.

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39 425 *“When I gave out the packs, I asked if there were any questions and I spent 10-15 minutes with people*  
40 426 *asking if it will tell them if they’ve got this disease and will they have this on file forever.”*

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43 427 Teachers felt that not enough school staff were given information about MAGES and that this limited  
44 428 the school’s ability to facilitate the recruitment of potential participants.

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47 429 *“They [students] would come and ask me, some of them who are in my class, but I think because the*  
48 430 *other science teachers weren’t massively, well they didn’t really know what this was about and what*  
49 431 *was going on, perhaps they weren’t as enthusiastic as I was.”*

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52 432 The majority of teachers felt that the school’s contact with parents/guardians regarding MAGES was  
53 433 ineffective which may have had negative implications for recruitment.

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3 434 *“Parents – we didn’t get them in ... the only way we managed to get it out was on our “Schoop Line”*  
4 *and via the letters. So, it was woeful in that respect in terms of engaging the parents.”*

## 7 436 Recommendations for the future

### 10 437 Working with school staff

12 438 Focus group members suggested various ways for researchers to more effectively engage staff in the  
13 439 participating schools. This included involving more staff throughout the school including science  
14 440 teachers, school nurses and teachers responsible for pastoral care. Participants suggested that the most  
15 441 effective way to engage with school staff would be for MAGES researchers to organise a face-to-face  
16 442 meeting to present information verbally.

20 443 *“I wonder as well... if because I spoke to Year 7 and 8 tutors only. I’ve mentioned it to other staff but*  
21 444 *in passing. I wonder if every member of staff in the school community could be aware of what is going*  
22 445 *on.”*

### 26 446 Engaging students and parents/guardians

28 447 There was significant discussion of the importance of MAGES researchers engaging with students  
29 448 and suggestions of several ways in which this could be improved. Proposed improvements included:  
30 449 simplifying the initial student assembly, making MAGES more exciting and appealing to students,  
31 450 and alternative DNA-related activities that may be more relevant to the research.

35 451 *“I feel that maybe it could have been sold as a bit more fun and special as in you’re helping people*  
36 452 *out, you’re doing this, not everyone’s getting to do it. Because you had to say all the important bits*  
37 453 *and everything ethically, that then it didn’t seem as fun for them... You’ve got to give the information*  
38 454 *but I’m wondering if it could be sparkled up.”*

42 455 As parental consent was a necessary prerequisite for student participation in MAGES, this was  
43 456 discussed extensively in focus groups as a key area in which to boost recruitment. A parent event in  
44 457 which MAGES researchers meet face-to-face with parents/guardians to answer questions and provide  
45 458 detailed information was considered to be the most effective way to achieve this.

49 459 *“I think that if we were to do this again, then we would look to hold an evening for parents, as*  
50 460 *everybody has said, to get the elephant out of the room and have those discussions.”*

## 53 461 Discussion

56 462 This study aimed to develop and test a protocol to obtain genetic samples in schools for mental health  
57 463 research. Whilst genetic and mental health research was viewed as important and acceptable by  
58 464 stakeholders in the development phase, and the protocol itself proved largely acceptable, we also

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3 465 found that the protocol was not feasible in its current form due to a number of challenges, notably  
4 466 non-response from parents and securing school participation. This protocol was highly resource-  
5 467 intensive, and further consideration of resources is required to make the protocol more effective if  
6 468 data collection is to be scaled up. The quality of saliva samples was good with only one sample unable  
7 469 to be genotyped, which suggests researcher-supervised saliva collection using spit kits is a viable  
8 470 method of collecting genetic data from young people in schools. We received no complaints from  
9 471 students, parents or school staff concerning the study, and only three active refusals from parents at  
10 472 the consent stage. The MAGES science workshops were viewed as an important (but perhaps not  
11 473 essential) component by teachers, and received positive feedback from the majority of students.  
12 474 Teachers saw mental health as important, and were, in principle, accepting of collecting genetic data  
13 475 for the purpose of mental health research in schools; however, this information is limited to teachers  
14 476 from schools that took part, therefore were already interested and invested in such research. Teachers  
15 477 also highlighted concerns and challenges, such as improving communication and engagement, that  
16 478 should be addressed going forward.

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26 479 A major strength of this study is the inclusion of stakeholders throughout the research process – from  
27 480 development through to evaluation. This allowed us to co-produce a study protocol with schools,  
28 481 young people and parents. Notably, the majority of schools who had participated in the co-production  
29 482 phase participated in MAGES, compared with none of the schools contacted subsequently. We took a  
30 483 mixed-methods approach, giving more depth of information than just quantitative or qualitative  
31 484 research alone. We were also able to increase awareness of mental health and genetics amongst  
32 485 stakeholders especially young people which, although not our primary aim, has been a positive  
33 486 outcome of the study.

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39 487 Nevertheless, this study has limitations. Whilst parents and guardians were involved in the  
40 488 development phase, further information is needed to understand barriers to parent/guardian  
41 489 recruitment. At the individual level, the biggest driver of non-participation was parents not returning  
42 490 consent for their children's participation (rather than active refusal by parents or withdrawal by  
43 491 children). We were unable to contact parents directly so we were unable to collect information from  
44 492 parents regarding whether they had received information about the study and their reasons for not  
45 493 giving consent. We also did not collect phenotypic data on our participants so were unable to test  
46 494 predictors of non-participation directly. Engagement of parents/guardians can often be an important  
47 495 barrier to recruitment.(19–22) The current study required opt-in parental consent but this requirement  
48 496 varies across countries. In future, it will be important to develop research protocols that allow direct  
49 497 communication with parents. The study is also limited by the small number of schools that took part,  
50 498 and the limited uptake of teacher and parent MAGES meetings in these schools. This study took place  
51 499 in mainstream schools in Wales (UK) so results may not generalise to different education systems,  
52 500 countries and age groups.

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3 501 Another limitation is the lack of diversity in our sample. As this was a small study assessing  
4 502 feasibility, we recruited an opportunity sample which may not have fully covered the diverse set of  
5 503 contexts needed to inform decisions going forward. This is important because there is much research,  
6 504 across multiple study designs, demonstrating that there are important differences between participants  
7 505 and non-participants in mental health research, with notable predictors of response that include  
8 506 affluence, family adversity, gender, educational attainment, behavioural problems, mental health and  
9 507 elevated genetic risk for mental health and neurodevelopmental problems.(26–28) In our study, at a  
10 508 school level, factors related to non-response included eligibility for free school meals which was  
11 509 higher in non-participating schools and the national average, indicating a wealthy volunteer bias. In  
12 510 addition, although our participating schools had a greater proportion of ethnic minority students than  
13 511 the national average, they had a lower proportion compared with schools who we approached but  
14 512 which chose not to participate. In future, it will be important to understand more about recruitment  
15 513 and retention in ethnically diverse populations and develop research protocols that ensure that  
16 514 traditionally underrepresented groups are closely involved in the co-production of the research. This is  
17 515 particularly important for health-related research to ensure that research findings are relevant to  
18 516 marginalised groups who often have a high burden of mental health difficulties. It is also important so  
19 517 that policy and practice recommendations that follow from research are developed appropriately and  
20 518 fairly. We would argue that a co-production approach to genetic mental health research is essential,  
21 519 and that a priority is to find ways to develop new research of this kind that deals explicitly with  
22 520 potential barriers to participation with input from marginalised groups from the outset.

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25 521 A further important point is that, as this study was focused on feasibility to inform future decisions,  
26 522 the overall sample size was small. Whilst the findings provide helpful insights on the acceptability  
27 523 and feasibility of the methods used, it is critical to remember that data from much large numbers of  
28 524 individuals are essential for standard genomic analyses. The current approach was both labour and  
29 525 cost-intensive and it may be that broader scale awareness raising and social media campaigns may be  
30 526 more effective, such as those currently used to recruit participants to genetic mental health studies in  
31 527 adults.(29)

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37 528 Whilst the current study focused on evaluating a protocol to engage children in genetic mental health  
38 529 research in schools, it is also important to consider the role of the broader social and cultural context  
39 530 with acceptability of different approaches to genetic research also dependent on building public  
40 531 understanding and trust at a societal level. There is some evidence for a decline in trust over  
41 532 time(30)(with survey response rates showing a general decline)(31–33), as well as variation between  
42 533 countries in levels of public trust in science.(34)

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57 534 To our knowledge, this is the first study that has assessed in detail the feasibility and acceptability of  
58 535 collecting saliva samples in schools for the purpose of genetic studies together with obtaining consent  
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3 536 for data linkage. However, parent consent in the current study was lower than other school-based  
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5 537 research in other contexts and countries. For instance, in a school-based study collecting smoking  
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7 538 survey information and genetic samples in 14-15-year-olds there was a parental consent rate of  
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9 539 54%,(19) and a school-based survey study trialling recruitment methods in 6-7-year-olds obtained  
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11 540 56% parental consent in cohort 1 and 71% in cohort 2.(20) These studies were able to undertake more  
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13 541 intensive recruitment strategies (e.g. multiple waves of letters sent directly to parents, follow-up  
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15 542 phone calls, incentives) over a longer period of time. The added complexity of linking genetic data to  
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17 543 health records in the current study may have also affected response rates given concerns of  
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19 544 confidentiality rank highly in reasons for parent consent refusal,(19) and teachers in post-MAGES  
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21 545 focus groups highlighted genetic privacy as a concern. Teacher concerns were similar to those  
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23 546 identified in previous research such as concerns about general privacy and the negative impact of  
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25 547 potential future data disclosure (e.g. insurance and mortgage company discrimination).(11,12)

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27 548 Our study suggests that it is very difficult to reach a full cross-section of parents or for such work to  
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29 549 be undertaken at scale or to be representative of the whole population. Family-based study designs  
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31 550 such as population-based birth cohorts, or clinic-based recruitment of children with mental health  
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33 551 conditions and their families appear better placed for engaging parents directly with biological sample  
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35 552 collection, including genetics. This is particularly the case in circumstances where an effective link  
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37 553 between the research team and the family has helped establish trust and mutual understanding, e.g. as  
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39 554 part of ongoing longitudinal population, patient or high-risk cohorts.

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41 555 Our research points to a number of recommendations for future school-based mental health genetic  
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43 556 research based on feedback from teachers and our own experience. First, engaging all stakeholders  
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45 557 through the entire research process, from development to evaluation, is crucial. This not only  
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47 558 facilitates recruitment and improves research protocols, but helps promote understanding of genetics  
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49 559 and mental health amongst stakeholders, and the needs and perspectives of stakeholders amongst  
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51 560 researchers. Face-to-face meetings are potentially best and should be included in school-based  
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53 561 research protocols where possible, but this does have implications for researcher time and costs.  
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55 562 Second, clear communication is essential for getting key messages to all stakeholders at all stages of  
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57 563 the research. Factors that can aid clear communication are: simplified and concise information letters,  
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59 564 multiple formats of information (e.g. video messages, paper letters, website, face-to-face meetings),  
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61 565 direct channels of communication by the study team to all stakeholders (one limitation of our study  
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63 566 was that it was not possible to contact parents directly), and working with stakeholders to develop  
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65 567 information packs and to introduce the research in schools. Third, it is important to give back to  
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67 568 schools to reflect the time and hard work required to effectively facilitate such research. The science  
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69 569 workshops in particular were highlighted as a major benefit for students and teachers and we also  
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71 570 provided schools remuneration for their time. Again, scaling up would have significant cost  
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73 571 implications. Fourth, adequate time and resources need to be dedicated to the collection of saliva

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3 572 samples. For instance, we altered the MAGES protocol to provide additional time for this. Finally,  
4 573 clear strategies for parent recruitment are needed for each school based on consultation with school  
5 574 staff. This is likely to include multiple waves of information packs sent direct to parent addresses,  
6 575 telephone follow ups, and providing multiple ways to make it as easy as possible for parents to  
7 576 consent (e.g. paper form, electronic form by email, online forms).

11 577 Future research would benefit from investigation of how to enhance parental recruitment rates.  
12 578 Parental consent is a challenge in school-based research,(19–22) and may be particularly challenging  
13 579 in secondary schools compared to primary schools where parental links to schools are not as strong.  
14 580 Parental consent may also be particularly challenging with research that covers mental health,  
15 581 genetics and data linkage. Typically, large scale DNA collection has worked when parents have been  
16 582 present, for instance Spit for Science (<https://lab.research.sickkids.ca/schachar/spit-for-science/>), but  
17 583 this is not always possible in school settings. We chose to recruit younger students from UK  
18 584 secondary schools (aged 11-13 years) as consultation with key stakeholders suggested parents of this  
19 585 age group would be more engaged; however, our low parent recruitment numbers suggest this may  
20 586 not be the case. Research focusing specifically on factors that affect parental rates of opt-in consent  
21 587 for school-based studies of this kind is needed. It would also be beneficial to assess whether parents  
22 588 would be easier to reach and be more engaged at other stages in their children’s school careers, for  
23 589 instance, parents of primary school aged children (aged 4-11 years), though this would raise new  
24 590 questions about children’s understanding and stakeholder views on the acceptability of genetic mental  
25 591 health research in this age group. Alternatively, research could focus on older students (e.g. in the UK  
26 592 aged 16+ years) where participants are able to provide their own active consent; however, in practice  
27 593 this would not obviate the need to keep all stakeholders in the school community, including parents,  
28 594 appropriately informed about the purposes and practicalities of the research. The current research took  
29 595 place in 2019. In view of the ongoing challenges faced by schools in returning to face-to-face  
30 596 learning, COVID-related risk management, and the additional pressures on delivering the core  
31 597 curriculum, it is likely that researchers will face additional challenges with recruitment of schools and  
32 598 in the engagement of parents/guardians if research of this kind were to be conducted now.

## 33 599 Conclusions

34 600 Our study suggests that it is challenging to collect genetic data for the purpose of mental health  
35 601 research in a school setting. Low participation rates amongst parents, indicate that the scope and scale  
36 602 of such research would likely be restricted to sample designs where it is less important that samples  
37 603 are representative at a whole population level. Ultimately, large-scale representative samples covering  
38 604 a broad spectrum of genetic, biological, psychological and social factors are required for  
39 605 advancements of our understanding of mental health risk and resilience in young people. The current  
40 606 study highlights that there would be major challenges in scaling up school-based mental health

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607 genetics research. The most important barrier is the difficulty in obtaining parent/guardian opt-in  
608 consent for their child’s participation.

For peer review only

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3  
4 **Author Contribution:** NW contributed design of the study, data collection, conducted the  
5  
6 quantitative and qualitative analysis, drafted the manuscript, and gave final approval of the version to  
7  
8 be published. SR contributed to design of the study, data collection, conducted the qualitative  
9  
10 analysis, critically revised the manuscript for important intellectual content and gave final approval of  
11  
12 the version to be published. RBJ contributed to design of the study, contributed to the qualitative  
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14 analysis, critically revised the manuscript for important intellectual content and gave final approval of  
15  
16 the version to be published. RB contributed to design of the study, contributed to the qualitative  
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18 analysis, critically revised the manuscript for important intellectual content and gave final approval of  
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21  
22 of genetic samples, critically revised the manuscript for important intellectual content and gave final  
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26 and analysis of genetic samples, critically revised the manuscript for important intellectual content  
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29  
30 managed the storage and analysis of genetic samples, critically revised the manuscript for important  
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34 conception of the study, obtaining funding, critically revised the manuscript for important intellectual  
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36 content and gave final approval of the version to be published. KL contributed to conception and  
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38 design of the study, obtaining funding, critically revised the manuscript for important intellectual  
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42 design of the study, obtaining funding, critically revised the manuscript for important intellectual  
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46 study, obtaining funding, critically revised the manuscript for important intellectual content and gave  
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60 approval of the version to be published. SC contributed to conception and design of the study,  
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36  
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45  
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47  
48 School of Medicine Research Ethics Committee (ref 18/57).  
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51 **Data availability statement:** Data are available upon reasonable request from the  
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53 corresponding author.  
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Table 1. Participation and consent rates

<b>School (eligible sample)</b>	<b>Parent/guardian consent forms returned n (%)</b>	<b>Student saliva samples n (%)</b>	<b>Routine datasets linkage n (%)</b>	<b>School questionnaire data linkage n (%)</b>	<b>Routine datasets and school questionnaire linkage n (%)</b>
School 1 (n=246)	34 (13.82%)	31 (12.60%)	29 (11.79%)	30 (12.20%)	29 (11.79%)
School 2 (n=157)	27 (17.20%)	24 (15.29%)	24 (15.29%)	21 (13.38%)	21 (13.38%)
School 3 (n=465)	37 (7.96%)	35 (7.53%)	35 (7.53%)	29 (6.24%)	29 (6.24%)
Total (n=868)	98 (11.29%)	90 (10.37%)	88 (10.14%)	80 (9.22%)	79 (9.10%)

Note: % of eligible sample

Table 2. Student feedback on science workshops

	<b>Have you enjoyed the MAGES science workshop?</b>			
	<b>Yes - I had great fun n (%)</b>	<b>Most of it was quite good n (%)</b>	<b>Some of the time it was ok n (%)</b>	<b>No - I didn't like it n (%)</b>
School 1 (n=191)	148 (77.49%)	27 (14.14%)	12 (6.28%)	4 (2.09%)
School 2 (n=119)	79 (66.39%)	30 (25.21%)	5 (4.20%)	5 (4.20%)
School 3 (n=343)	185 (53.94%)	108 (31.49%)	34 (9.91%)	16 (4.66%)
Total (n=653)	412 (63.09%)	165 (25.27%)	51 (7.81%)	25 (3.83%)

Note: ns reflect the number of students present in class who chose to give feedback on the MAGES science workshop.

Table 3. Themes identified from qualitative analysis of teacher focus groups

Main theme	Sub-theme	Second Sub-theme
<b>Acceptability</b>	Value of data-linkage	
	More acceptability in the future	
	No expressed concerns	
	Perception of parent/guardian and child acceptability	
	School would take part again	<i>Would take part without workshop</i>
	Using schools for genetic research	
<b>Benefits</b>	Partnership with CU	
	Mental health research	
	Science workshops	<i>Advanced science</i>
		<i>Benefits research</i>
		<i>Student enjoyment</i>
		<i>External visitors</i>
		<i>Real science</i>
		<i>Role models</i>
		<i>Useful for teaching</i>
<b>Concerns</b>	Children don't understand	
	Future use and impact	
	Linkage - data privacy and access	
	Parent/guardian concern of genetics	
	Perceptions of mental health testing	
	Potential harm to participants	<i>Determinism</i>
		<i>Finding out</i>
<b>Challenges</b>	Communication with parents/guardians	<i>School contact with parents/guardians</i>
		<i>Lack of parent/guardian understanding</i>
	Communication with students	
	Communication with teachers	
	Recruitment	
<b>Suggestions for the future</b>	Engaging parents/guardians	<i>More information</i>
		<i>Parent event</i>

	Engaging students	<i>Assembly</i>
		<i>Enthusiasm</i>
		<i>Science workshops</i>
	Working with teachers	<i>Engagement</i>
		<i>Involving form tutors</i>
		<i>Involving all staff</i>
		<i>Science department</i>
<b>Large scale MAGES</b>	Logistics	
	School variability	
	Views on expanding study	
	Workshop going forward	
<b>Mental health</b>	Awareness	
	In schools	
<b>Practicalities</b>	Disseminating MAGES information	
	Teacher workload	
	Timing and organisation	

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## Figure titles

Figure 1. MAGES recruitment and procedure

Figure 2. Science workshop structure and activities

For peer review only

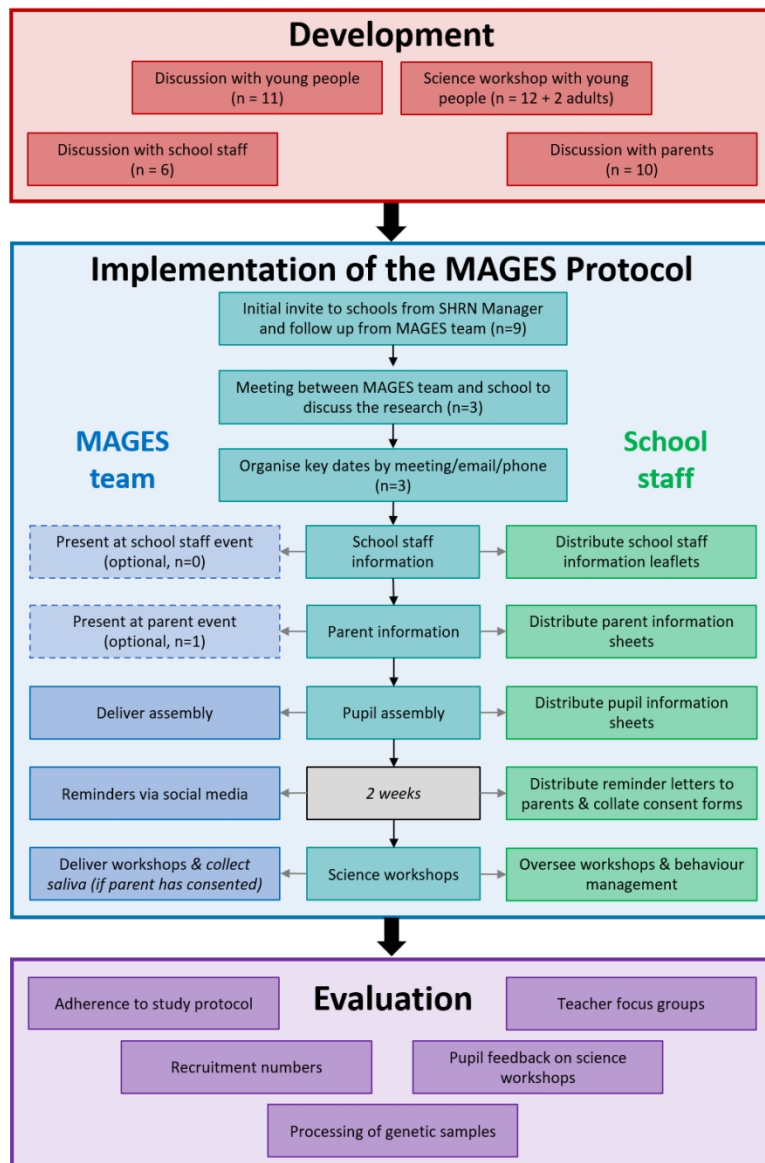


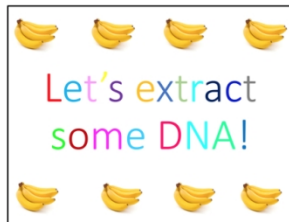
Figure 1. MAGES recruitment and procedure

### 1. Interactive presentation

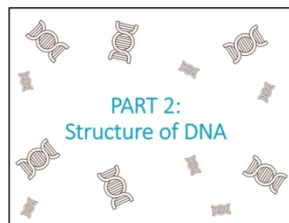


- All living things are made up of cells
- Cells are the building blocks of life
- Cell structure
- DNA is in the nucleus
- DNA is like a recipe book for your cells

### 2. Practical experiment extracting DNA from bananas



### 3. Interactive presentation



- Discovery of DNA structure
- DNA backbone and base pairs
- Genes and heredity
- External and internal traits influenced by genes
- Impact of environment and experience

### 4. Origami DNA model making



[www.yourgenome.org/activities/origami-dna](http://www.yourgenome.org/activities/origami-dna)

Figure 2. Science workshop structure and activities

Warne et al. Supplementary information for : Collecting genetic samples and linked mental health data from adolescents in schools: Protocol co-production and a mixed-methods pilot of feasibility and acceptability

### Supplementary Table 1. MAGES teacher focus group schedule

<b>Mental health research in young people</b>
Do you think schools should be involved in this kind of research? <i>PROMPT Do you think your school should be involved in research on mental wellbeing and genetics?</i> <i>PROMPT How did you feel about your school taking part in research on mental wellbeing and genetics?</i>
What do you think of researchers collecting DNA samples from children in school during the school day facilitated by teaching staff?
What do you think of linking child genetic data to other records?
<b>Evaluation of MAGES (practicalities)</b>
How did you find being a part of MAGES in your school? <i>PROMPT What were the good parts?</i> <i>Was it beneficial?</i> <i>PROMPT What were the bad parts?</i> <i>Did it increase your workload significantly?</i> <i>What was most time consuming?</i> <i>PROMPT How could we improve?</i>
How did you/ would you 'sell' this study to parents? To students?
Do you think the way the study was run (i.e. the study design) was practical? <i>PROMPT What practical changes would you make to make it easier for schools to take part?</i>
What would be the best way to get staff within your school to engage with MAGES?
<b>Evaluation of the school/parents/pupils</b>
How does your school communicate with parents?
Did any parents approach you with concerns about MAGES? <i>PROMPT For instance, were there any concerns about taking DNA samples from children?</i>
Did students approach you with any concerns before/ after workshop/ saliva collection?
Did any parents approach you for any further information about MAGES? <i>PROMPT Did you know we have a website?</i>
<b>Beyond the current MAGES</b>
Do you think this would work on a larger scale? <i>PROMPT How about practicalities? Do you think teachers would be interested in delivering the science workshops themselves?</i> <i>PROMPT What things (incentives) would encourage all schools in Wales to take part?</i>
Could you see your school participating in research like this in future? <i>PROMPT Knowing what you do now, would you take part again?</i> <i>PROMPT How likely would you be to take part again and why?</i>



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**Supplementary Figure 1. Sticker chart used for student feedback following each science workshop**



Mental Wellbeing in Adolescence:  
Genes and Environment Study  
Lles Meddyliol Pobl Ifanc:  
Astudiaeth Genynnau ac Amgylchedd



Have you enjoyed the **MAGES** science workshop?



Yes – I had great fun

Most of it was quite good

Some of the time it was ok

No – I didn't like it

Empty box for student feedback under 'Yes – I had great fun'

Empty box for student feedback under 'Most of it was quite good'

Empty box for student feedback under 'Some of the time it was ok'

Empty box for student feedback under 'No – I didn't like it'

Tell us how you feel by sticking a sticker in one of the columns to tell us

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**Supplementary Figure 2. Student instructions for providing a saliva sample**

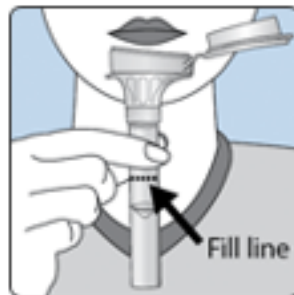
### **How to give a spit sample**

There is one saliva (spit) pot for you to fill. It's quick and easy.

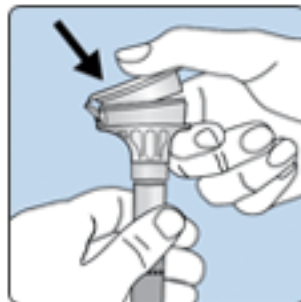
Please don't eat, drink, smoke or chew gum for 30 minutes before giving your spit sample. Also, please don't remove the plastic film from the lid.

You can then follow these simple instructions:

1. Spit saliva into the empty container, until it reaches the fill line shown below (not including bubbles):



2. Hold the tube upright with one hand. Close the funnel lid with the other hand (as shown) by firmly pushing the lid until you hear a **loud click**. The liquid in the lid will be released into the tube to mix with the saliva. Make sure that the lid is closed tightly.



3. Hold the tube upright. Unscrew the funnel from the tube.
4. Use the small cap to close the tube tightly.
5. Shake the capped tube for 5 seconds. You can discard or recycle the funnel.
6. Place into the plastic box provided and seal.
7. Return the filled tube to the researcher.

No.	Item		Description	Location in manuscript
<b>Domain 1: Research team and reflexivity</b>				
<i>Personal characteristics</i>				
1.	Interviewer/facilitator	Which author/s conducted the interview or focus group?	Interviewer SR and assistant interviewer NW	Page 9
2.	Credentials	What were the researcher’s credentials?	SR-Med; NW- PhD,	Page 9
3.	Occupation	What was their occupation at the time of the study?	SR & NW - MAGES Research Assistant	Page 9
4.	Gender	Was the researcher male or female?	SR & NW - Female	Page 9
5.	Experience and training	What experience or training did the researcher have?	SR- 3 years previous experience of working as a Research Assistant and conducting and analysing focus groups on NIHR funded RCT; NW- training in semi-structured clinical interviews	Page 9
6.	Relationship established	Was a relationship established prior to study commencement?	All focus group participants had an element of involvement with MAGES and therefore some form of previous relationship with SR and NW. Participants included form tutors who distributed MAGES information sheets and consent forms, science teachers who were present during the science workshop and the key MAGES contact teacher who was responsible for scheduling all assemblies, workshops and data collection days.	Page 9
7.	Participant knowledge of the interviewer	What did the participants know about the researcher?	All participants knew that NW and SR were Research Assistants working for Cardiff University as part of MAGES.	Page 9
8.	Interviewer characteristics	What characteristics were reported about the interviewer/facilitator?	SR and NW acknowledged their roles as Research Assistants for MAGES and outlined that the purpose of the study was to investigate the feasibility and acceptability of collecting saliva samples from children in schools and linking these samples to other information in order to understand more about the interaction between genes and environment in mental health.	Page 9
<b>Domain 2: study design</b>				
<i>Theoretical framework</i>				

9.	Methodological orientation and theory	What methodological orientation was stated to underpin the study?	Inductive thematic analysis.	Page 9
<b>Participant selection</b>				
10.	Sampling	How were participants selected?	Purposeful maximum variation sampling.	Page 9
11.	Method of approach	How were participants approached?	Face-to-face invitation from SR and NW to key MAGES school contact. Researchers asked key contact to invite other school staff with a wide range of involvement with MAGES to attend focus group.	Page 9
12.	Sample size	How many participants were in the study?	15	Page 9
13.	Non-participants	How many people refused to participate or dropped out? Reasons?	None	-
<b>Setting</b>				
14.	Setting of data collection	Where was the data collected?	Data were collected at participant's schools at a time and date convenient to them.	Page 9
15.	Presence of non-participants	Was anyone else present besides the participants and researchers?	No	-
16.	Description of sample	What are the important characteristics of the sample?	The sample included science teachers, members of the school's senior leadership team and form tutors.	Page 9
<b>Data collection</b>				
17.	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Supplementary Table 1	Supplementary Table 1
18.	Repeat interviews	Were repeat interviews carried out? If yes, how many?	No	n/a
19.	A/V recording	Did the research use audio or visual recording to collect the data?	Audio was digitally recorded.	Page 9
20.	Field notes	Were field notes made during and/or after the interview or focus group?	Supplementary hand written field notes of each focus group were made by NW.	Page 9
21.	Duration	What was the duration of the interviews or focus group?	Focus groups lasted approximately 45 minutes.	Page 9
22.	Data saturation	Was data saturation discussed?	A wide range of views were collected and researchers were confident that there was no further information that could	Page 10

			have been gained from recruiting more participants/ holding more focus groups.	
23.	Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No	-
<b>Domain 3: Findings and Analysis</b>				
<b>Data analysis</b>				
24.	Number of data coders	How many data coders coded the data?	There were two data coders (NW and SR).	Page 9-10
25.	Description of the coding tree	Did authors provide a description of the coding tree?	A full summary of the coding tree, including themes not explored within this paper, is included in Table 3	Table 3, page 27-28
26	Derivation of the coding themes	Were themes identified in advance or derived from the data?	Themes were identified from the content of the data.	Page 9-10
27.	Software	What software, if applicable, was used to manage the data?	NVivo 12 was used to code and analyse data.	Page 9-10
28.	Participant checking	Did participants provide feedback on the findings?	No	-
<b>Reporting</b>				
29.	Quotations presented	Were participant quotations presented to illustrate the themes / findings? Was each quotation identified?	Participant quotations are provided in the results to illustrate findings. Participant's quotations are anonymised.	Page 11-16
30.	Data and findings consistent	Was there consistency between the data presented and the findings?	Both NW and SR reviewed included quotes to ensure that they were fully representative of our data. Quotes were also reviewed by RB.	-
31.	Clarity of major themes	Were major themes clearly presented in the findings?	Yes - Major themes are discussed within the paper and described within table 3	Page 11-16 and Table 3, page 27-28
32.	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Yes - Minor themes are discussed within the paper and described within table 3	Page 11-16 and Table 3, page 27-28

# BMJ Open

## Collecting genetic samples and linked mental health data from adolescents in schools: Protocol co-production and a mixed-methods pilot of feasibility and acceptability

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<b>Primary Subject Heading</b>:	Mental health
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## Abstract

Objectives: To co-produce a school-based protocol and examine acceptability and feasibility of collecting saliva samples for genetic studies from secondary/high school students for the purpose of mental health research.

Design: Protocol co-production and mixed-methods feasibility pilot.

Setting: Secondary schools in Wales, UK.

Participants: Students aged 11-13 years.

Primary and secondary outcome measures: Co-produced research protocol including an interactive science workshop delivered in schools; school, parental and student recruitment rates; adherence to protocol and adverse events; ability to extract and genotype saliva samples; student enjoyment of the science workshop; and qualitative analysis of teacher focus groups on acceptability and feasibility.

Results: Five secondary schools participated in the co-production phase, and three of these took part in the research study (eligible sample n=868 students). Four further schools were subsequently approached, but none participated. Parental opt-in consent was received from 98 parents (11.3% eligible sample), three parents (0.3%) actively refused and responses were not received for 767 (88.4%) parents. We obtained saliva samples plus consent for data linkage for 79 students. Only one sample was of insufficient quality to be genotyped. The science workshop received positive feedback from students. Feedback from teachers showed that undertaking research like this in schools is viewed as acceptable in principle, potentially feasible, but that there are important procedural barriers to be overcome. Key recommendations include establishing close working relationships between the research team and school classroom staff, together with improved methods for communicating with and engaging parents.

Conclusions: There are major challenges to undertaking large scale genetic mental health research in secondary schools. Such research may be acceptable in principle, and in practice DNA collected from saliva in classrooms is of sufficient quality. However, key challenges that must be overcome include ensuring representative recruitment of schools and sufficient parental engagement where opt-in parental consent is required.

Key words: school; adolescent mental health; genetics; data linkage; feasibility and acceptability

## Article Summary

### Strengths and limitations of this study

- This is the first study to test the feasibility and acceptability of collecting genetic samples in secondary schools and obtaining consent for linkage to questionnaire and record-based mental health data.
- A key strength is co-production of the research protocol with stakeholders (young people, parents/guardians, schools).
- We used a mixed-methods approach to assess the feasibility and acceptability of carrying out genetic research studies of mental health in schools.
- This pilot study was conducted in three mainstream secondary schools in Wales, UK so it is unclear whether findings are transferrable to a wider section of schools in Wales and other countries, education systems and age groups.
- It was not possible to collect data on the reasons for return or non-return of parental consent.

## 44 Introduction

45 In the UK, approximately 1 in 8 (12.8%) young people aged 5-19 years old have a diagnosable mental  
46 health disorder with rates increasing in recent years.(1,2) The causes of youth mental health  
47 difficulties involve genetic and environmental risk factors acting together in complex ways. The  
48 majority of adult mental health conditions originate before the age of 24,(3,4) and early identification  
49 and prevention are important priorities. However, only a minority of young people with mental health  
50 problems seek or receive help from health-care professionals.(1,5) To better understand risk and  
51 protective factors for psychiatric conditions, data from population-based samples of young people,  
52 including relevant genetic, biological, psychological and social factors is important. Established UK  
53 birth cohorts are a valuable resource for studying the development of mental ill health, including the  
54 interplay of genetic factors and family environment. However, the costs involved in setting up and  
55 maintaining such cohorts are considerable, and information about other social contexts such as  
56 schools is often limited.(6)

57 An alternative approach involves collecting data on mental health and associated risk and protective  
58 factors from young people within the school setting, offering the opportunity to study the roles of  
59 classroom, peer group and school-level effects. In addition, school-based designs offer the potential to  
60 recruit and obtain data from larger population-based samples than is possible using traditional birth  
61 cohort designs. Typically, student participation rates are high when health questionnaire data are  
62 collected during the school day.(7,8) What is unclear is whether it would be acceptable to schools,  
63 students and their parents to collect saliva samples for the purpose of genetic studies involving mental  
64 health, and what the main barriers are that need to be overcome to make this feasible in practice.  
65 Challenges include ensuring schools, parents/guardians and young people themselves will be  
66 accepting of research on genetics and mental health; providing information to young people, their  
67 parents and teachers; collecting appropriate informed consent; integrating research into the every-day  
68 life of schools in a way that fits with the needs of schools and learners; and implementing robust and  
69 ethical protocols for the collection of saliva samples in a classroom setting.

70 Previous studies have had some success with collecting salivary cortisol samples in school settings  
71 (for reviews see (9,10)). In contrast, little is known about the acceptability and feasibility of  
72 classroom-based collection of saliva samples for genetic research. Despite increasing understanding  
73 and acceptance of genetic research, public concerns remain - particularly in relation to children,(11-  
74 15) and mental health is often stigmatised,(16,17) so it is unclear whether this type of research would  
75 be acceptable to young people, parents/guardians and school staff. Similarly, the concept of data  
76 linkage (e.g. to mental health questionnaires or health records) might elicit concerns about  
77 privacy.(18) Parent/guardian recruitment and consent is typically challenging in school-based  
78 research,(19-22) particularly in secondary school settings. Having a research study and protocol that

1  
2  
3 79 is acceptable to key stakeholders is critical to a research study's success.(8,23,24) It will not only help  
4 80 with recruitment, but will also help develop a process that key stakeholders engage with or "buy into",  
5 81 and that fits with the context and daily life of students, teachers and parents. Indeed, co-production of  
6 82 research with stakeholders is critical to support the development of school-based research.(8)  
7  
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9

10 83 To our knowledge, no other study has examined the acceptability and feasibility of collecting saliva  
11 84 samples from young people in schools for the purpose of genetic research on mental health.  
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13

## 14 85 The current study

15 86 The Mental Wellbeing in Adolescence: Genes and Environment Study (MAGES) aimed to assess the  
16 87 acceptability and feasibility of collecting DNA saliva samples from young people in schools with  
17 88 consent for linkage to other routinely collected mental health questionnaire and record-based data.  
18 89 The over-arching aims were to work with stakeholders (school staff, parents, young people) to co-  
19 90 produce an acceptable research protocol, and then test this protocol in order to inform future studies  
20 91 on the best ways to carry out this kind of research.  
21  
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24

25 92 The study was conducted in Wales which provides a globally unique research infrastructure, with  
26 93 student health, mental health and wellbeing data collected every two years in all mainstream  
27 94 secondary schools via SHRN (School Health Research Network, <http://www.shrn.org.uk/>) and  
28 95 potential linkage to routine health, education and social care data via SAIL (Secure Anonymised  
29 96 Information Linkage) databank ([www.saildatabank.com](http://www.saildatabank.com)). The SHRN 2017 health and well-being  
30 97 survey was completed by all state-funded schools in Wales, UK (n=193) and had 97% of students take  
31 98 part (n=112,045).(7,8)  
32  
33  
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36

37 99 In the development phase we worked with stakeholders (young people, parents/guardians, schools) to  
38 100 develop a study protocol that had the greatest chance of being both acceptable and feasible in practice.  
39 101 To evaluate the MAGES protocol, we used a mixed-method design with quantitative and qualitative  
40 102 data. Specifically, we examined school, parent/guardian and student consent/participation rates,  
41 103 considered adherence to the study protocol and the occurrence of any adverse events (e.g.  
42 104 complaints), and the ability to genotype samples. We collected feedback from young people and  
43 105 undertook focus groups with teachers to gain further insights on the feasibility and acceptability of the  
44 106 study, and how the protocol might be adapted in future.  
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## 51 107 Methods

### 52 108 Study design

53  
54 109 The study was conducted in three stages: firstly a development phase, followed by implementation of  
55 110 the protocol, and then an evaluation phase (Figure 1). The development phase included co-production  
56 111 of the study protocol with key stakeholders. The MAGES protocol included recruitment of schools,  
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1  
2  
3 112 obtaining consent from parents/guardians and students, and collection of saliva samples for genetic  
4 113 analysis. Saliva collection occurred during specially developed MAGES science workshops that took  
5 114 the place of a normal science lesson (see below). No phenotypic information was collected on  
6 115 participants. Quantitative evaluation included numbers and percentages for each stage of recruitment,  
7 116 percent of usable genotyped samples, and student feedback scores on the science workshop aspect of  
8 117 the protocol. Qualitative evaluation included teacher focus group discussion of MAGES protocol  
9 118 following completion of classroom data collection.

## 15 119 Development phase

16 120 Stakeholders involved during development of the research protocol included young people, school  
17 121 staff, and parents/guardians.

18 122 Researchers discussed the study protocol and the practicalities of using saliva collection kits in a  
19 123 classroom setting with a group of young people aged 14-17 years old (n=11, 5 males, 6 females).  
20 124 Young people were part of the public patient involvement group ALPHA  
21 125 (<http://decipher.uk.net/public-involvement/young-people/>). Based on feedback from this session we  
22 126 made changes to the study protocol (including a school assembly presentation) to simplify the content  
23 127 and to explain technical terms (e.g. data linkage) more fully.

24 128 School staff shared their perspectives on the acceptability of taking saliva samples from students in  
25 129 schools and provided advice on practical issues. Teachers from 9 schools that were engaged in SHRN  
26 130 research were invited to take part. A total of 5 teachers (3 females, 2 males) from 5 schools and 1  
27 131 Healthy Schools Practitioner (female) participated. Particular consideration was given to how research  
28 132 participation would impact teacher workload, how researchers could give back to schools, and  
29 133 potential practical challenges. School staff highlighted that getting the parent/guardian consent  
30 134 required for participants aged under 16 years old (as is required in Wales, UK) was likely to be the  
31 135 most challenging aspect of the project. As a result of this session, we adapted our protocol to target  
32 136 younger year groups (Years 7 and 8, age 11-13 years) as it was thought that parents/guardians would  
33 137 be more engaged and older cohorts could not afford to take time out of core lessons. Suggested ways  
34 138 to engage parents/guardians were to meet in person via events at each school, and by presenting  
35 139 MAGES information in different formats. We therefore included a parent/guardian event in our  
36 140 protocol and also created a website with videos explaining why the research is important and what  
37 141 taking part involves ([www.cardiff.ac.uk/MAGES](http://www.cardiff.ac.uk/MAGES)). Giving back to schools was also highlighted as  
38 142 important and providing a science workshop to students was considered a good way to do this.

39 143 Mothers (n=10) recruited from a local parent research network took part in a discussion on the  
40 144 proposed research and provided feedback on the clarity and content of parent/guardian information

1  
2  
3 145 sheets. Data linkage emerged as a key concern and we adapted information sheets to provide more  
4  
5 146 information on this.

6  
7 147 Finally, to ensure that the science workshop content was suitable and enjoyable for the proposed age  
8  
9 148 range, we trialled the science workshop (see below) with a local Scout group of 12 boys aged 10-13  
10  
11 149 years old and 2 adult scout leaders (1 male, 1 female).

## 12 150 Implementation phase

### 13 151 *Evaluation sample*

14  
15 152 Participants were students in Years 7 and 8 (aged 11-13 years) at mainstream secondary schools in  
16  
17 153 South Wales, UK that were part of the School Health Research Network (SHRN).(7,8)

### 18 154 *Recruitment and protocol*

19  
20 155 Figure 1 depicts the recruitment and protocol used. Firstly, schools that were consulted in the  
21  
22 156 development of the protocol (n=5) were invited to take part in MAGES via direct correspondence  
23  
24 157 from the SHRN Manager to each of the SHRN school contacts. This was followed up by MAGES  
25  
26 158 staff. A further four local SHRN schools were invited to participate at a second recruitment wave.  
27  
28 159 Participating schools were offered £500 (£250 per year group) as a thank you for facilitating the  
29  
30 160 research and to cover costs in staff time resulting from participation.

31  
32 161 *School staff meetings:* Following initial contact, MAGES researchers met with members of each  
33  
34 162 school's senior leadership teams. All schools were given the option of holding events for  
35  
36 163 parents/guardians and teachers where MAGES staff would introduce the project and answer  
37  
38 164 questions.

39 165 *Information packs:* Schools were asked to disseminate parent/guardian information packs (using  
40  
41 166 typical communication methods). These included an overview of the study, frequently asked  
42  
43 167 questions and a link to the study webpage ([www.cardiff.ac.uk/MAGES](http://www.cardiff.ac.uk/MAGES)). Parents/guardians were also  
44  
45 168 given email and phone contact details for the MAGES team if they had queries or concerns.

46 169 At a later date, MAGES researchers delivered 15-20 minute assemblies to students to explain the  
47  
48 170 project, following which, the schools were asked to distribute information packs to students.

49  
50 171 *Workshops:* Feedback from stakeholders during the development phase indicated the value of science  
51  
52 172 workshops on the theme of genetics for engaging schools and learners. Student science workshops  
53  
54 173 were scheduled to start two weeks from the student assembly. During this period, schools distributed  
55  
56 174 reminder letters to parents/guardians and collated consent forms. MAGES staff also provided  
57  
58 175 reminders via social media (twitter).

59 176 MAGES researchers delivered the workshop to all classes in each participating year group in the place  
60  
177 of a normal science lesson (lasting 50-60 minutes). Science workshops began with an introduction to

1  
2  
3 178 MAGES and the team followed by an interactive lesson (see Figure 2) consisting of 1) a presentation  
4 179 teaching the basics of DNA, 2) a practical experiment extracting DNA from bananas, 3) an additional  
5 180 presentation on DNA structure, heredity, traits influenced by genes and impact of  
6 181 environment/experience, as well as an interactive discussion on non-visible traits that might be related  
7 182 to variation in base pair sequences (this was directed by student responses but often covered traits  
8 183 such as mental health, IQ, talents in sports and music, and personality), and 4) an activity creating  
9 184 origami DNA models. During the origami activity, those students who had completed parent/guardian  
10 185 consent forms were invited to take part in the DNA collection. Students were given their own assent  
11 186 form to sign and then provided a saliva sample. This was conducted in a screened off area of the  
12 187 classroom or in a side room to provide privacy. At the end of the science workshop all students were  
13 188 asked to provide feedback about whether they had enjoyed the science session on a sticker chart  
14 189 (Supplementary Figure 1). Science workshops and data collection occurred between April and July  
15 190 2019.

### 191 *Ethical approval and consent*

192 Ethical approval was obtained from Cardiff University School of Medicine Research Ethics  
193 Committee. As students were under 16 years, participation in MAGES required informed parental  
194 opt-in consent and student assent. Both parents/guardians and students had the option to provide or  
195 not provide additional consent/assent for linking genetic information to other routinely collected data.  
196 Consent for routinely collected data was split into two broad categories: (i) health and educational  
197 records, and (ii) student-completed health and wellbeing questionnaires.

### 198 *Evaluation phase*

#### 199 *Feasibility*

#### 200 *Recruitment and participants*

201 The numbers of schools recruited, parent/guardian consent forms returned, student participation and  
202 consent for data linkage were recorded and percentages of the eligible sample were calculated. Where  
203 possible, reasons for not taking part were recorded. To assess school-level response bias, participating  
204 and non-participating schools were compared on a number of routinely assessed school-level  
205 characteristics (<https://mylocalschool.gov.wales/>), including Free School Meals entitlement (%),  
206 minority ethnic pupils (%), student attendance (%), and academic achievement (% achieving 5  
207 General Certificate of Secondary Education at A\*-C grades).

#### 208 *Saliva samples*

209 Participants provided saliva samples (approximately 5ml) using Genotek Oragene saliva kits under  
210 the supervision of MAGES researchers (full instructions in Supplementary Figure 2). Participants



1  
2  
3 211 were asked if they had eaten or drunk anything in the last 30 minutes and if not, were instructed to fill  
4 212 the saliva collection tube to the fill line. If participants had eaten or drunk in the last 30 minutes, they  
5 213 were asked to wait 30 minutes before providing a sample. Sample collection took around 5-10  
6 214 minutes per participant, and multiple students provided samples at the same time under researcher  
7 215 supervision. The collection tubes were labelled using barcodes and a unique participant study number.  
8 216 The samples were taken to the research laboratory - MRC Centre for Neuropsychiatric Genetics and  
9 217 Genomics at Cardiff University. All samples were processed in accordance with the standard  
10 218 operating procedures for sample management, storage, and tracking of biological materials. DNA was  
11 219 extracted from the saliva samples in-house, following standard Genotek Oragene DNA Prep-IT  
12 220 protocols. DNA sample quantification was determined using Quant-iT PicoGreen dsDNA assay kits,  
13 221 and samples were genotyped using Illumina Infinium Global Screening arrays. Data were recorded on  
14 222 the number and percentage of successfully extracted and genotyped samples.

### 223 Adherence to study protocol and adverse events

224 The research team undertook a review of the protocol following completion of the study within each  
225 school and recorded data on adherence to protocol. This included instances where the protocol (Figure  
226 1) was changed and any adverse events (e.g. complaints).

### 227 *Acceptability*

### 228 Science workshop

229 Student feedback was collected at the end of each workshop to assess the value of including the  
230 science workshops in the protocol. Students rated their enjoyment of the workshop using a sticker  
231 chart (Supplementary Figure 1) with a scale of: 1) “Yes – I had great fun”; 2) “Most of it was quite  
232 good”; 3) “Some of the time it was ok”; or 4) “No – I didn’t like it”.

### 233 Teacher focus groups post-MAGES

234 Three focus groups were held with teachers in participating schools to get feedback on MAGES.  
235 Teachers were recruited to the focus groups by each school’s key contact teacher. A £20 voucher was  
236 offered as remuneration for each teacher’s time, and schools were given £125 for holding the focus  
237 group (to cover replacement teaching time). Five teachers participated in each focus group (School 1:  
238 3 females, 2 males; School 2: 5 females; School 3: 2 females, 3 males). This sample included science  
239 teachers, members of the senior leadership team and form tutors responsible for pastoral care. Data  
240 were collected at participant’s schools at a time and date convenient to them.

241 Focus groups lasted approximately 45 minutes and were conducted by two female MAGES  
242 researchers (SR, Med, 3 years’ experience of conducting and analysing focus groups; and NW, PhD,  
243 with training in semi-structured clinical interviews). Researchers were responsible for workshop

1  
2  
3 244 delivery and saliva collection, and therefore had working relationships with the teachers prior to the  
4  
5 245 focus group. Teachers were asked about their views on mental health research in young people, how  
6  
7 246 MAGES was conducted in their school, how they and others (parents/guardians, students) found the  
8  
9 247 MAGES process and what improvements they would make to the study (see Supplementary Table 1  
10  
11 248 for focus group schedule). Digital audio recordings of the three focus groups were transcribed  
12  
13 249 verbatim by a professional transcription company and supplementary handwritten notes were made.  
14  
15 250 The transcribed interviews were then exported to NVivo 12, a qualitative data analysis computer  
16  
17 251 software package.

18  
19 252 Two researchers (SR and NW) conducted an inductive thematic analysis of the data following Braun  
20  
21 253 and Clarke's (2006) framework (25). The steps in this process included: 1) data familiarisation, 2)  
22  
23 254 initial code generation, 3) theme identification and framework development, 4) theme review, and 5)  
24  
25 255 final theme definition. A wide range of views were collected and researchers were confident that there  
26  
27 256 was no further information that could have been gained from recruiting more participants/ holding  
28  
29 257 more focus groups.

30  
31 258 Both researchers coded all the transcripts independently and then met to jointly develop a coding  
32  
33 259 framework. This framework was derived inductively from the focus group data but was also  
34  
35 260 influenced deductively by the research questions. They subsequently recoded the transcripts using the  
36  
37 261 agreed framework using NVivo 12.

## 38 262 Patient and Public Involvement

39  
40 263 The design of the protocol was informed by extensive PPI work with key stakeholders – young  
41  
42 264 people, parents/guardians and school staff (see 'Development phase' above). Schools participating in  
43  
44 265 the development phase of the project were offered the opportunity to take part in the main study and  
45  
46 266 help recruit parents and students at their school. Results were disseminated to participating schools  
47  
48 267 through electronic and paper feedback reports.

## 49 268 Results

### 50 269 Feasibility

#### 51 270 *Recruitment and participants*

52  
53 271 Three of five schools involved in the advisory stage agreed to take part in MAGES, with the two non-  
54  
55 272 participating schools stating they were too busy. No schools (0/4) in the second recruitment wave  
56  
57 273 agreed to meet to discuss taking part in MAGES. Researchers were unable to reach the SHRN contact  
58  
59 274 prior to the end of the study in two schools and two schools declined taking part due to being too busy  
60  
275 (n=1), and having concerns over taking DNA from children and being perceived as having young  
276  
276 people with mental health problems (n=1). The total school participation rate was 33.3% (3 out of 9

1  
2  
3 277 invited schools). On average, the three participating schools had lower Free School Meal (FSM)  
4 278 entitlement (14.0% versus 23.1%), lower proportion of minority ethnic students (15.4% versus 21.9%)  
5  
6 279 than the six non-participating schools, and similar student attendance (94.3% versus 93.7%), and  
7  
8 280 academic achievement (58.4% versus 60.2% students 5 GCSE A\*-C grades). In comparison to the  
9  
10 281 national average, participating schools had lower FSM entitlement (Wales average 17.5%), higher  
11  
12 282 proportion of minority ethnic students (Wales average 9.8%), higher student attendance (Wales  
13  
14 283 average 93.9%), and higher academic achievement (Wales average 55.1%).

15 284 Table 1 details the number of parent/guardian consent forms received, saliva samples collected and  
16  
17 285 consent for data linkage for each participating school. Three parents from the eligible sample of 868  
18  
19 286 (0.3%) refused permission for their child to participate, either via email (n=1) or on the consent forms  
20  
21 287 (n=2). 98 parents (11.3%) provided signed consent for students to participate in the study. No  
22  
23 288 responses were received from the remaining eligible sample (88.4%).

24 289 Of the 98 students with parent/guardian consent, saliva samples were obtained from 90 students  
25  
26 290 (89.6%; 31 males, 59 females). Five students decided they did not want to take part, two were absent  
27  
28 291 on days of saliva collection, and there was not enough time to collect a sample from one student.  
29  
30 292 Consent for complete data linkage was obtained for 79 (80.6%) students.

31 293 Sample collection rates varied by school, ranging from 7.5% to 15.3% of eligible students. This  
32  
33 294 primarily reflected variation in parent/guardian consent (8.0%-17.2%). There was also considerable  
34  
35 295 within-school variation in sample collection between different classes (School 1: 0-38.2%; School 2:  
36  
37 296 11.1-28.0%; School 3: 0-21.4%).

### 38 297 *DNA extraction and genotyping*

39  
40 298 We were able to extract DNA and genotype 89 of the 90 (98.9%) samples collected. One sample was  
41  
42 299 not genotyped due to insufficient concentration of DNA.

### 44 300 *Adherence to study protocol*

45  
46 301 The study protocol was followed for School 1. However, the time-limited nature of science  
47  
48 302 workshops during a normal lesson restricted the number of saliva samples that could be collected. In  
49  
50 303 subsequent schools we adjusted the protocol so that the saliva collection occurred approximately one  
51  
52 304 week following the science workshop to allow adequate time.

53 305 After School 1 layout and formatting changes were made to the parent/guardian consent forms to  
54  
55 306 increase clarity.

56 307 Only one school (School 3) opted to provide an event to explain MAGES to parents and guardians.  
57  
58 308 This event was organised specifically to discuss MAGES (Thursday evening, 5.30pm start) but was  
59  
60 309 poorly attended (n=5, 1.1% of school eligible sample). This session was primarily comprised of

1  
2  
3 310 parents and guardians with concerns and queries about the research. No school chose to have the  
4 311 additional event for MAGES researchers to explain the project to teachers.

6  
7 312 We did not receive any complaints about the research from students, parents/guardians or school staff.

## 9 313 Acceptability

### 11 314 *Science workshop*

12 315 Of the students who gave feedback on the science workshops, the majority (88.4%) said “Yes – I had  
13 316 great fun” or “Most of it was quite good” (Table 2).

### 15 317 *Teacher focus groups post-MAGES*

16 318 A number of themes were identified from thematic analysis of qualitative interviews with teachers  
17 319 (Table 3). Here we focus on key themes that informed our understanding of acceptability and  
18 320 feasibility.

## 20 321 Acceptability

21 322 Teachers were asked about their views on the appropriateness of conducting a study like MAGES in a  
22 323 school environment. Generally, teachers who were interviewed were in favour of such research.

23 324 *“You asked whether or not it’s a good idea to use the schools. I think we’re in an ideal position. A  
24 325 captive audience, if you want. It’s the easiest way of getting hold of those pupils and that information  
25 326 and of youngsters so I don’t necessarily have a problem with schools being involved.”*

26 327 The consensus was largely that the MAGES protocol was acceptable, however there was some  
27 328 concern that this view may not be shared by other people within the community. Some teachers  
28 329 suggested that people outside of the school may feel it was inappropriate for teachers to facilitate this  
29 330 kind of research.

30 331 *“I wonder how that might be seen by different people as in, why are they taking DNA? What are they  
31 332 going to do with it? Why should teachers allow them to come in and do that?”*

32 333 Teachers discussed the acceptability of MAGES from the point of view of parents/guardians and  
33 334 students. Although some participants suggested that they expected parents/guardians to react  
34 335 negatively to MAGES, all participants agreed that no parent or student approached them with any  
35 336 complaints or concerns.

36 337 *“When I first got sent the email about the project, as a scientist I thought some parents are not going  
37 338 to like that...but we took the risk and, in fact, we got more people coming back than I thought we  
38 339 would.”*

## 340 Benefits

341 The benefits of taking part in MAGES were widely discussed, with members of all groups indicating  
342 that they would be willing to participate in MAGES again in the future. The potential contribution to  
343 mental health research was noted in all three focus groups as a major benefit of being involved with  
344 MAGES.

345 *“I think there’s a lot of mental wellbeing issues in amongst children now. If we’ve got research and*  
346 *there’s data on it, if that data can be used in a positive way, then it’s a good thing but it’s just the*  
347 *feasibility of collecting that large amount of data for it to be viable.”*

348 Teachers also said they would have agreed to take part without the incentive of the science workshop,  
349 however there was a preference for the workshop to remain as part of MAGES.

350 *“I would have still agreed to do it, absolutely, but I wonder if the kids could actually link to what’s*  
351 *going on. I think that’s where the disconnect would be. We still would’ve signed up to it absolutely*  
352 *because we recognise we’ve got mental health issues in the school and the importance of these types*  
353 *of research studies.”*

354 Similarly, teachers acknowledged the value of linking genetic information with data on mental health.

355 *“I would’ve thought, to make your research valuable, you’ve got to do it otherwise all you’ve got it is*  
356 *a DNA sample.”*

357 The possibility that genetic research may become more acceptable to people in the future was brought  
358 up by multiple teachers.

359 *“I think that attitude will change in the future. This is quite early on. Everybody was initially*  
360 *technology – the beast. Now, everybody’s embracing it. I think exactly the same thing will happen*  
361 *with DNA and testing. I think it will probably become quite routine.”*

362 The prestige of working in partnership and forming a relationship with Cardiff University was also  
363 seen as a benefit.

364 *“Our incentive has been the formation of this partnership and feeling like we’re helping you with*  
365 *your samples and we’ve had something for our students back.”*

## 366 Science workshop

367 The biggest benefit identified was the science workshop that was delivered to all Year 7 and 8  
368 students. Teachers frequently commented on the value of having external visitors who could be  
369 viewed as role models. Science workshops were seen as helpful to clarify how students’ saliva  
370 samples would be used if they chose to take part. Teachers noted how much students enjoyed the

371 session and suggested it gave them an opportunity to practice real, advanced science relevant to the  
372 teaching curriculum.

373 *“It creates a buzz that you’ve got the profile of Cardiff University coming in, it gets the children  
374 excited about it. When we have outside speakers, they love that and that’s why I think it’s needed  
375 because otherwise, it’s just spit into this thing and signing a form whereas if they did the banana  
376 DNA, they went home and talked about it, they were talking about it in their next lessons.”*

377 *“I think it’s really important for students to see researchers because students have this idea that  
378 scientists are lab coats and you don’t all look like Albert Einstein. For you guys to come in, you’re  
379 normal people and to say ‘we are scientists, we are doing this’ and for them to think, ‘you’re ordinary  
380 people, we could do that.’”*

### 381 Concerns and potential challenges

382 Although focus group participants agreed on the whole that it was acceptable to conduct MAGES  
383 within a school environment, they did acknowledge some concerns. These focused on the potential  
384 negative impact of genetic research on participants as well as privacy issues surrounding the process  
385 of data linkage.

386 All potential MAGES participants were told that they would not receive any results from their saliva  
387 sample during the initial assembly, in the science workshop and in all MAGES information packs.  
388 However, not all teachers were present in the assembly and many had not read the information  
389 leaflets. This led to some unaddressed concern among teachers about the potential harm that could be  
390 caused to students if they were to be informed that they had an increased genetic risk for particular  
391 mental health conditions. Focus group participants felt strongly that students should not receive  
392 feedback regarding the results of their DNA sample as feedback might lead students to believe they  
393 were predisposed to mental illness.

394 *“If we’ve got a young person who has mental health issues, they get a DNA test, they find they’ve got  
395 that gene, I fear they’d think there’s nothing they could do. They’d say, ‘I’ve got the gene, I’m  
396 genetically going to have mental health issues, there’s no point having therapy, there’s no point  
397 talking about it because that’s just who I am.’”*

398 Concerns about how participants’ data could be used in the future and the potential negative impact  
399 this might have were discussed.

400 *“If you discover a DNA precursor to mental health, what if an insurance company in the future said  
401 to you is this person likely to get mental health illnesses? Or a mortgage company?”*

402 Teachers acknowledged the value of data linkage and were aware of the measures in place to protect  
403 participant’s privacy, however some did still express concern.

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3 404 *“I know its numbers and barcodes but at some stage in the process, somebody will have access to the*  
4 *names and be able to link it.”*  
5 405

6  
7 406 Participant understanding of MAGES and communication were noted as challenges. Some teachers  
8  
9 407 felt that the information given to students by researchers about genetic research and data linkage was  
10 408 too complex for young people to properly understand.

11  
12 409 *“It’s the lost in translation thing – they didn’t quite understand ... and when the kids are very, very*  
13 *weak [academically], it was more lost in translation.”*  
14 410

15  
16 411 The initial MAGES assembly was felt to be too complex and that this had led to misunderstanding the  
17  
18 412 purpose of the study by some students. Teachers said that some students came away from the  
19  
20 413 assembly believing that the purpose of MAGES was to screen them for mental health conditions.

21  
22 414 *“I had one student ...who thought you were going to test her for mental health problems and was*  
23 *concerned that you were going to tell her there was something wrong with her.”*  
24 415

25  
26 416 Similarly, teachers suggested that parents/guardians may have found the information sheets to be too  
27  
28 417 complex which may have impacted their decision about allowing their child to participate.

29  
30 418 *“It’s education for the parents as well – they need to fully and truly understand what it’s for, what’s*  
31 *happening to their child’s DNA what are they going to do with it, what’s going to happen in the end?*  
32 *Obviously, we do have a lot of parents who ... don’t truly understand what it means to take DNA and*  
33 *they just understand DNA from the television... If they don’t truly understand why you’re taking it*  
34 *then no, it’s too scary...”*  
35 421  
36 422

37  
38 423 Communication, in particular, was seen as a challenging element of MAGES, and that this required  
39  
40 424 teachers to provide additional information and answer follow-up questions from students. Teachers  
41  
42 425 reported that some staff members were approached by students with questions about MAGES  
43  
44 426 following the initial assembly and the distribution of the student information sheets, suggesting that  
45  
46 427 the information provided by researchers was inadequate on its own.

47  
48 428 *“When I gave out the packs, I asked if there were any questions and I spent 10-15 minutes with people*  
49 *asking if it will tell them if they’ve got this disease and will they have this on file forever.”*  
50 429

51  
52 430 Teachers felt that not enough school staff were given information about MAGES and that this limited  
53  
54 431 the school’s ability to facilitate the recruitment of potential participants.

55  
56 432 *“They [students] would come and ask me, some of them who are in my class, but I think because the*  
57 *other science teachers weren’t massively, well they didn’t really know what this was about and what*  
58 *was going on, perhaps they weren’t as enthusiastic as I was.”*  
59 434  
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3 435 The majority of teachers felt that the school's contact with parents/guardians regarding MAGES was  
4 436 ineffective which may have had negative implications for recruitment.

5  
6  
7 437 *"Parents – we didn't get them in ... the only way we managed to get it out was on our "Schoop Line"*  
8 438 *and via the letters. So, it was woeful in that respect in terms of engaging the parents."*

## 10 439 Recommendations for the future

### 11 440 Working with school staff

12  
13 441 Focus group members suggested various ways for researchers to more effectively engage staff in the  
14 442 participating schools. This included involving more staff throughout the school including science  
15 443 teachers, school nurses and teachers responsible for pastoral care. Participants suggested that the most  
16 444 effective way to engage with school staff would be for MAGES researchers to organise a face-to-face  
17 445 meeting to present information verbally.

18  
19 446 *"I wonder as well... if because I spoke to Year 7 and 8 tutors only. I've mentioned it to other staff but*  
20 447 *in passing. I wonder if every member of staff in the school community could be aware of what is going*  
21 448 *on."*

### 22 449 Engaging students and parents/guardians

23  
24 450 There was significant discussion of the importance of MAGES researchers engaging with students  
25 451 and suggestions of several ways in which this could be improved. Proposed improvements included:  
26 452 simplifying the initial student assembly, making MAGES more exciting and appealing to students,  
27 453 and alternative DNA-related activities that may be more relevant to the research.

28  
29 454 *"I feel that maybe it could have been sold as a bit more fun and special as in you're helping people*  
30 455 *out, you're doing this, not everyone's getting to do it. Because you had to say all the important bits*  
31 456 *and everything ethically, that then it didn't seem as fun for them... You've got to give the information*  
32 457 *but I'm wondering if it could be sparkled up."*

33  
34 458 As parental consent was a necessary prerequisite for student participation in MAGES, this was  
35 459 discussed extensively in focus groups as a key area in which to boost recruitment. A parent event in  
36 460 which MAGES researchers meet face-to-face with parents/guardians to answer questions and provide  
37 461 detailed information was considered to be the most effective way to achieve this.

38  
39 462 *"I think that if we were to do this again, then we would look to hold an evening for parents, as*  
40 463 *everybody has said, to get the elephant out of the room and have those discussions."*



## 464 Discussion

465 This study aimed to develop and test a protocol to obtain genetic samples in schools for mental health  
466 research. Whilst genetic and mental health research was viewed as important and acceptable by  
467 stakeholders in the development phase, and the protocol itself proved largely acceptable, we also  
468 found that the protocol was not feasible in its current form due to a number of challenges, notably  
469 non-response from parents and securing school participation. This protocol was highly resource-  
470 intensive, and further consideration of resources is required to make the protocol more effective if  
471 data collection is to be scaled up. The quality of saliva samples was good with only one sample unable  
472 to be genotyped, which suggests researcher-supervised saliva collection using spit kits is a viable  
473 method of collecting genetic data from young people in schools. We received no complaints from  
474 students, parents or school staff concerning the study, and only three active refusals from parents at  
475 the consent stage. The MAGES science workshops were viewed as an important (but perhaps not  
476 essential) component by teachers, and received positive feedback from the majority of students.  
477 Teachers saw mental health as important, and were, in principle, accepting of collecting genetic data  
478 for the purpose of mental health research in schools; however, this information is limited to teachers  
479 from schools that took part, therefore were already interested and invested in such research. Teachers  
480 also highlighted concerns and challenges, such as improving communication and engagement, that  
481 should be addressed going forward.

482 A major strength of this study is the inclusion of stakeholders throughout the research process – from  
483 development through to evaluation. This allowed us to co-produce a study protocol with schools,  
484 young people and parents. Notably, the majority of schools who had participated in the co-production  
485 phase participated in MAGES, compared with none of the schools contacted subsequently. We took a  
486 mixed-methods approach, giving more depth of information than just quantitative or qualitative  
487 research alone. We were also able to increase awareness of mental health and genetics amongst  
488 stakeholders especially young people which, although not our primary aim, has been a positive  
489 outcome of the study.

490 Nevertheless, this study has limitations. Whilst parents and guardians were involved in the  
491 development phase, further information is needed to understand barriers to parent/guardian  
492 recruitment. At the individual level, the biggest driver of non-participation was parents not returning  
493 consent for their children's participation (rather than active refusal by parents or withdrawal by  
494 children). We were unable to contact parents directly so we were unable to collect information from  
495 parents regarding whether they had received information about the study and their reasons for not  
496 giving consent. We also did not collect phenotypic data on our participants so were unable to test  
497 predictors of non-participation directly. Engagement of parents/guardians can often be an important  
498 barrier to recruitment.(19–22) The current study required opt-in parental consent but this requirement

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3 499 varies across countries. In future, it will be important to develop research protocols that allow direct  
4 500 communication with parents. The study is also limited by the small number of schools that took part,  
5 501 and the limited uptake of teacher and parent MAGES meetings in these schools. This study took place  
6 502 in mainstream schools in Wales (UK) so results may not generalise to different education systems,  
7 503 countries and age groups.

11 504 Another limitation is the lack of diversity in our sample. As this was a small study assessing  
12 505 feasibility, we recruited an opportunity sample which may not have fully covered the diverse set of  
13 506 contexts needed to inform decisions going forward. This is important because there is much research,  
14 507 across multiple study designs, demonstrating that there are important differences between participants  
15 508 and non-participants in mental health research, with notable predictors of response that include  
16 509 affluence, family adversity, gender, educational attainment, behavioural problems, mental health and  
17 510 elevated genetic risk for mental health and neurodevelopmental problems.(26–28) In our study, at a  
18 511 school level, factors related to non-response included eligibility for free school meals which was  
19 512 higher in non-participating schools and the national average, indicating a wealthy volunteer bias. In  
20 513 addition, although our participating schools had a greater proportion of ethnic minority students than  
21 514 the national average, they had a lower proportion compared with schools who we approached but  
22 515 which chose not to participate. In future, it will be important to understand more about recruitment  
23 516 and retention in ethnically diverse populations and develop research protocols that ensure that  
24 517 traditionally underrepresented groups are closely involved in the co-production of the research. This is  
25 518 particularly important for health-related research to ensure that research findings are relevant to  
26 519 marginalised groups who often have a high burden of mental health difficulties. It is also important so  
27 520 that policy and practice recommendations that follow from research are developed appropriately and  
28 521 fairly. We would argue that a co-production approach to genetic mental health research is essential,  
29 522 and that a priority is to find ways to develop new research of this kind that deals explicitly with  
30 523 potential barriers to participation with input from marginalised groups from the outset.

34 524 A further important point is that, as this study was focused on feasibility to inform future decisions,  
35 525 the overall sample size was small. Whilst the findings provide helpful insights on the acceptability  
36 526 and feasibility of the methods used, it is critical to remember that data from much large numbers of  
37 527 individuals are essential for standard genomic analyses. The current approach was both labour and  
38 528 cost-intensive and it may be that broader scale awareness raising and social media campaigns may be  
39 529 more effective, such as those currently used to recruit participants to genetic mental health studies in  
40 530 adults.(29)

44 531 Whilst the current study focused on evaluating a protocol to engage children in genetic mental health  
45 532 research in schools, it is also important to consider the role of the broader social and cultural context  
46 533 with acceptability of different approaches to genetic research also dependent on building public

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3 534 understanding and trust at a societal level. There is some evidence for a decline in trust over  
4 535 time(30)(with survey response rates showing a general decline)(31–33), as well as variation between  
5 536 countries in levels of public trust in science.(34)  
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8 537 To our knowledge, this is the first study that has assessed in detail the feasibility and acceptability of  
9 538 collecting saliva samples in schools for the purpose of genetic studies together with obtaining consent  
10 539 for data linkage. However, parent consent in the current study was lower than other school-based  
11 540 research in other contexts and countries. For instance, in a school-based study collecting smoking  
12 541 survey information and genetic samples in 14-15-year-olds there was a parental consent rate of  
13 542 54%,(19) and a school-based survey study trialling recruitment methods in 6-7-year-olds obtained  
14 543 56% parental consent in cohort 1 and 71% in cohort 2.(20) These studies were able to undertake more  
15 544 intensive recruitment strategies (e.g. multiple waves of letters sent directly to parents, follow-up  
16 545 phone calls, incentives) over a longer period of time. The added complexity of linking genetic data to  
17 546 health records in the current study may have also affected response rates given concerns of  
18 547 confidentiality rank highly in reasons for parent consent refusal,(19) and teachers in post-MAGES  
19 548 focus groups highlighted genetic privacy as a concern. Teacher concerns were similar to those  
20 549 identified in previous research such as concerns about general privacy and the negative impact of  
21 550 potential future data disclosure (e.g. insurance and mortgage company discrimination).(11,12)  
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24 551 Our study suggests that it is very difficult to reach a full cross-section of parents or for such work to  
25 552 be undertaken at scale or to be representative of the whole population. Family-based study designs  
26 553 such as population-based birth cohorts, or clinic-based recruitment of children with mental health  
27 554 conditions and their families appear better placed for engaging parents directly with biological sample  
28 555 collection, including genetics. This is particularly the case in circumstances where an effective link  
29 556 between the research team and the family has helped establish trust and mutual understanding, e.g. as  
30 557 part of ongoing longitudinal population, patient or high-risk cohorts.  
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33 558 Our research points to a number of recommendations for future school-based mental health genetic  
34 559 research based on feedback from teachers and our own experience. First, engaging all stakeholders  
35 560 through the entire research process, from development to evaluation, is crucial. This not only  
36 561 facilitates recruitment and improves research protocols, but helps promote understanding of genetics  
37 562 and mental health amongst stakeholders, and the needs and perspectives of stakeholders amongst  
38 563 researchers. Face-to-face meetings are potentially best and should be included in school-based  
39 564 research protocols where possible, but this does have implications for researcher time and costs.  
40 565 Second, clear communication is essential for getting key messages to all stakeholders at all stages of  
41 566 the research. Factors that can aid clear communication are: simplified and concise information letters,  
42 567 multiple formats of information (e.g. video messages, paper letters, website, face-to-face meetings),  
43 568 direct channels of communication by the study team to all stakeholders (one limitation of our study  
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3 569 was that it was not possible to contact parents directly), and working with stakeholders to develop  
4 570 information packs and to introduce the research in schools. Third, it is important to give back to  
5 571 schools to reflect the time and hard work required to effectively facilitate such research. The science  
6 572 workshops in particular were highlighted as a major benefit for students and teachers and we also  
7 573 provided schools remuneration for their time. Again, scaling up would have significant cost  
8 574 implications. Fourth, adequate time and resources need to be dedicated to the collection of saliva  
9 575 samples. For instance, we altered the MAGES protocol to provide additional time for this. Finally,  
10 576 clear strategies for parent recruitment are needed for each school based on consultation with school  
11 577 staff. This is likely to include multiple waves of information packs sent direct to parent addresses,  
12 578 telephone follow ups, and providing multiple ways to make it as easy as possible for parents to  
13 579 consent (e.g. paper form, electronic form by email, online forms).

20  
21 580 Future research would benefit from investigation of how to enhance parental recruitment rates.  
22 581 Parental consent is a challenge in school-based research,(19–22) and may be particularly challenging  
23 582 in secondary schools compared to primary schools where parental links to schools are not as strong.  
24 583 Parental consent may also be particularly challenging with research that covers mental health,  
25 584 genetics and data linkage. Typically, large scale DNA collection has worked when parents have been  
26 585 present, for instance Spit for Science (<https://lab.research.sickkids.ca/schachar/spit-for-science/>), but  
27 586 this is not always possible in school settings. We chose to recruit younger students from UK  
28 587 secondary schools (aged 11-13 years) as consultation with key stakeholders suggested parents of this  
29 588 age group would be more engaged; however, our low parent recruitment numbers suggest this may  
30 589 not be the case. Research focusing specifically on factors that affect parental rates of opt-in consent  
31 590 for school-based studies of this kind is needed. It would also be beneficial to assess whether parents  
32 591 would be easier to reach and be more engaged at other stages in their children's school careers, for  
33 592 instance, parents of primary school aged children (aged 4-11 years), though this would raise new  
34 593 questions about children's understanding and stakeholder views on the acceptability of genetic mental  
35 594 health research in this age group. Alternatively, research could focus on older students (e.g. in the UK  
36 595 aged 16+ years) where participants are able to provide their own active consent; however, in practice  
37 596 this would not obviate the need to keep all stakeholders in the school community, including parents,  
38 597 appropriately informed about the purposes and practicalities of the research. The current research took  
39 598 place in 2019. In view of the ongoing challenges faced by schools in returning to face-to-face  
40 599 learning, COVID-related risk management, and the additional pressures on delivering the core  
41 600 curriculum, it is likely that researchers will face additional challenges with recruitment of schools and  
42 601 in the engagement of parents/guardians if research of this kind were to be conducted now.

## 602 Conclusions

603 Our study suggests that it is challenging to collect genetic data for the purpose of mental health  
604 research in a school setting. Low participation rates amongst parents, indicate that the scope and scale

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3 605 of such research would likely be restricted to sample designs where it is less important that samples  
4 606 are representative at a whole population level. Ultimately, large-scale representative samples covering  
5 607 a broad spectrum of genetic, biological, psychological and social factors are required for  
6 608 advancements of our understanding of mental health risk and resilience in young people. The current  
7 609 study highlights that there would be major challenges in scaling up school-based mental health  
8 610 genetics research. The most important barrier is the difficulty in obtaining parent/guardian opt-in  
9 611 consent for their child's participation.  
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5  
6 quantitative and qualitative analysis, drafted the manuscript, and gave final approval of the version to  
7  
8 be published. SR contributed to design of the study, data collection, conducted the qualitative  
9  
10 analysis, critically revised the manuscript for important intellectual content and gave final approval of  
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14 analysis, critically revised the manuscript for important intellectual content and gave final approval of  
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58 obtaining funding, critically revised the manuscript for important intellectual content and gave final  
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41  
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43  
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45  
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47  
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53 corresponding author.  
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Table 1. Participation and consent rates

School (eligible sample)	Parent/guardian consent forms returned n (%)	Student saliva samples n (%)	Routine datasets linkage n (%)	School questionnaire data linkage n (%)	Routine datasets and school questionnaire linkage n (%)
School 1 (n=246)	34 (13.82%)	31 (12.60%)	29 (11.79%)	30 (12.20%)	29 (11.79%)
School 2 (n=157)	27 (17.20%)	24 (15.29%)	24 (15.29%)	21 (13.38%)	21 (13.38%)
School 3 (n=465)	37 (7.96%)	35 (7.53%)	35 (7.53%)	29 (6.24%)	29 (6.24%)
Total (n=868)	98 (11.29%)	90 (10.37%)	88 (10.14%)	80 (9.22%)	79 (9.10%)

Note: % of eligible sample

For peer review only

Table 2. Student feedback on science workshops

	<b>Have you enjoyed the MAGES science workshop?</b>			
	<b>Yes - I had great fun n (%)</b>	<b>Most of it was quite good n (%)</b>	<b>Some of the time it was ok n (%)</b>	<b>No - I didn't like it n (%)</b>
School 1 (n=191)	148 (77.49%)	27 (14.14%)	12 (6.28%)	4 (2.09%)
School 2 (n=119)	79 (66.39%)	30 (25.21%)	5 (4.20%)	5 (4.20%)
School 3 (n=343)	185 (53.94%)	108 (31.49%)	34 (9.91%)	16 (4.66%)
Total (n=653)	412 (63.09%)	165 (25.27%)	51 (7.81%)	25 (3.83%)

Note: ns reflect the number of students present in class who chose to give feedback on the MAGES science workshop.

Table 3. Themes identified from qualitative analysis of teacher focus groups

Main theme	Sub-theme	Second Sub-theme
<b>Acceptability</b>	Value of data-linkage	
	More acceptability in the future	
	No expressed concerns	
	Perception of parent/guardian and child acceptability	
	School would take part again	<i>Would take part without workshop</i>
	Using schools for genetic research	
<b>Benefits</b>	Partnership with CU	
	Mental health research	
	Science workshops	<i>Advanced science</i>
		<i>Benefits research</i>
		<i>Student enjoyment</i>
		<i>External visitors</i>
		<i>Real science</i>
		<i>Role models</i>
		<i>Useful for teaching</i>
<b>Concerns</b>	Children don't understand	
	Future use and impact	
	Linkage - data privacy and access	
	Parent/guardian concern of genetics	
	Perceptions of mental health testing	
	Potential harm to participants	<i>Determinism</i>
		<i>Finding out</i>
<b>Challenges</b>	Communication with parents/guardians	<i>School contact with parents/guardians</i>
		<i>Lack of parent/guardian understanding</i>
	Communication with students	
	Communication with teachers	
	Recruitment	
<b>Suggestions for the future</b>	Engaging parents/guardians	<i>More information</i>
		<i>Parent event</i>

	Engaging students	<i>Assembly</i> <i>Enthusiasm</i> <i>Science workshops</i>
	Working with teachers	<i>Engagement</i> <i>Involving form tutors</i> <i>Involving all staff</i> <i>Science department</i>
<b>Large scale MAGES</b>	Logistics	
	School variability	
	Views on expanding study	
	Workshop going forward	
<b>Mental health</b>	Awareness	
	In schools	
<b>Practicalities</b>	Disseminating MAGES information	
	Teacher workload	
	Timing and organisation	

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4 **Figure titles**  
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8 Figure 2. Science workshop structure and activities  
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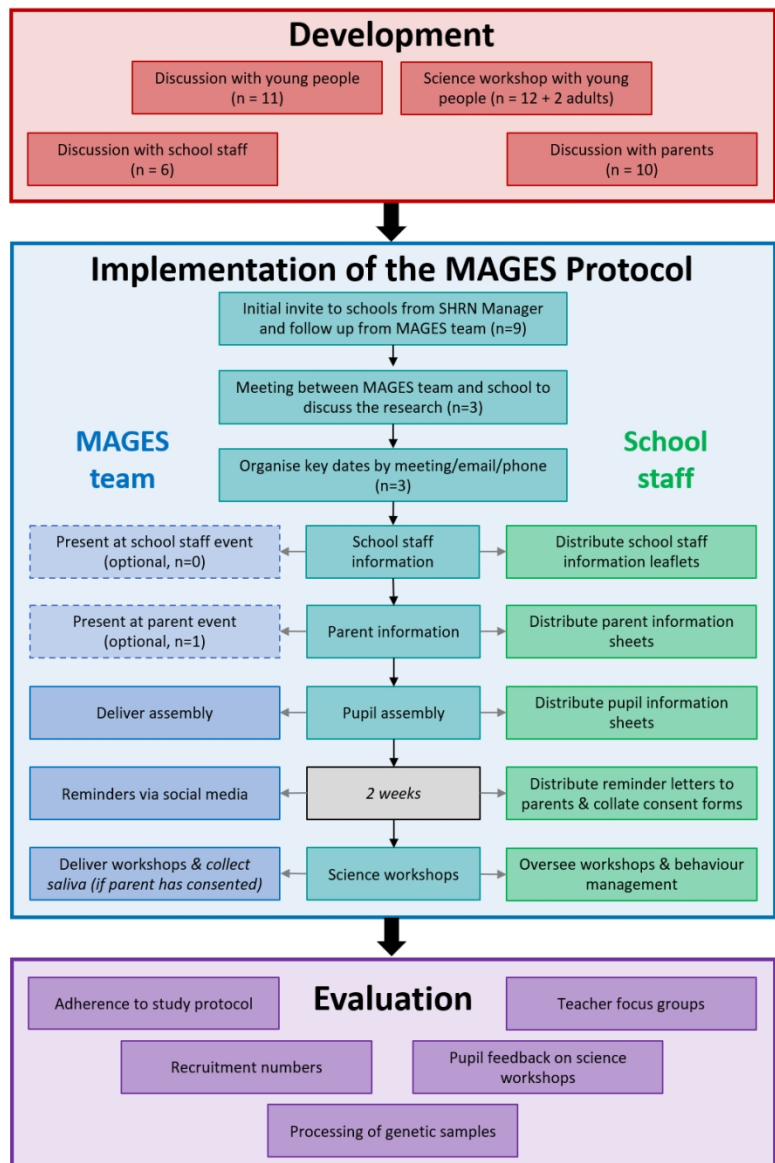


Figure 1. MAGES recruitment and procedure

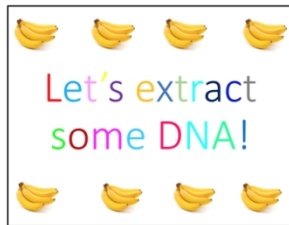


### 1. Interactive presentation

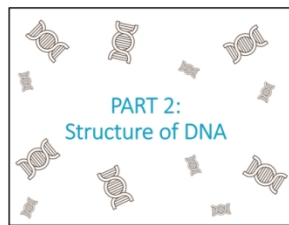


- All living things are made up of cells
- Cells are the building blocks of life
- Cell structure
- DNA is in the nucleus
- DNA is like a recipe book for your cells

### 2. Practical experiment extracting DNA from bananas



### 3. Interactive presentation



- Discovery of DNA structure
- DNA backbone and base pairs
- Genes and heredity
- External and internal traits influenced by genes
- Impact of environment and experience

### 4. Origami DNA model making



[www.yourgenome.org/activities/origami-dna](http://www.yourgenome.org/activities/origami-dna)

Figure 2. Science workshop structure and activities

Warne et al. Supplementary information for : Collecting genetic samples and linked mental health data from adolescents in schools: Protocol co-production and a mixed-methods pilot of feasibility and acceptability

### Supplementary Table 1. MAGES teacher focus group schedule

<b>Mental health research in young people</b>
Do you think schools should be involved in this kind of research? <i>PROMPT Do you think your school should be involved in research on mental wellbeing and genetics?</i> <i>PROMPT How did you feel about your school taking part in research on mental wellbeing and genetics?</i>
What do you think of researchers collecting DNA samples from children in school during the school day facilitated by teaching staff?
What do you think of linking child genetic data to other records?
<b>Evaluation of MAGES (practicalities)</b>
How did you find being a part of MAGES in your school? <i>PROMPT What were the good parts?</i> <i>Was it beneficial?</i> <i>PROMPT What were the bad parts?</i> <i>Did it increase your workload significantly?</i> <i>What was most time consuming?</i> <i>PROMPT How could we improve?</i>
How did you/ would you 'sell' this study to parents? To students?
Do you think the way the study was run (i.e. the study design) was practical? <i>PROMPT What practical changes would you make to make it easier for schools to take part?</i>
What would be the best way to get staff within your school to engage with MAGES?
<b>Evaluation of the school/parents/pupils</b>
How does your school communicate with parents?
Did any parents approach you with concerns about MAGES? <i>PROMPT For instance, were there any concerns about taking DNA samples from children?</i>
Did students approach you with any concerns before/ after workshop/ saliva collection?
Did any parents approach you for any further information about MAGES? <i>PROMPT Did you know we have a website?</i>
<b>Beyond the current MAGES</b>
Do you think this would work on a larger scale? <i>PROMPT How about practicalities? Do you think teachers would be interested in delivering the science workshops themselves?</i> <i>PROMPT What things (incentives) would encourage all schools in Wales to take part?</i>
Could you see your school participating in research like this in future? <i>PROMPT Knowing what you do now, would you take part again?</i> <i>PROMPT How likely would you be to take part again and why?</i>

Warne et al. Supplementary information for : Collecting genetic samples and linked mental health data from adolescents in schools: Protocol co-production and a mixed-methods pilot of feasibility and acceptability

**Supplementary Figure 1. Sticker chart used for student feedback following each science workshop**



Mental Wellbeing in Adolescence:  
Genes and Environment Study  
Lles Meddyliol Pobl Ifanc:  
Astudiaeth Genynnau ac Amgylchedd



Have you enjoyed the **MAGES** science workshop?



Yes – I had great fun

Most of it was quite good

Some of the time it was ok

No – I didn't like it

Empty box for student feedback under 'Yes – I had great fun'

Empty box for student feedback under 'Most of it was quite good'

Empty box for student feedback under 'Some of the time it was ok'

Empty box for student feedback under 'No – I didn't like it'

Tell us how you feel by sticking a sticker in one of the columns to tell us

Warne et al. Supplementary information for : Collecting genetic samples and linked mental health data from adolescents in schools: Protocol co-production and a mixed-methods pilot of feasibility and acceptability

**Supplementary Figure 2. Student instructions for providing a saliva sample**

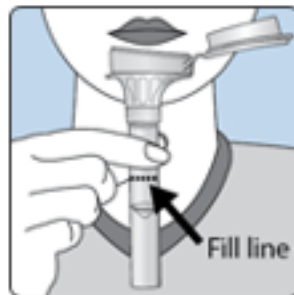
### **How to give a spit sample**

There is one saliva (spit) pot for you to fill. It's quick and easy.

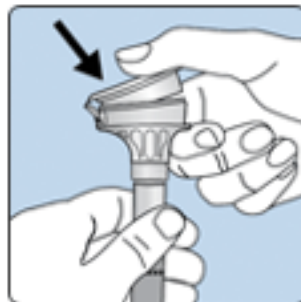
Please don't eat, drink, smoke or chew gum for 30 minutes before giving your spit sample. Also, please don't remove the plastic film from the lid.

You can then follow these simple instructions:

1. Spit saliva into the empty container, until it reaches the fill line shown below (not including bubbles):



2. Hold the tube upright with one hand. Close the funnel lid with the other hand (as shown) by firmly pushing the lid until you hear a **loud click**. The liquid in the lid will be released into the tube to mix with the saliva. Make sure that the lid is closed tightly.



3. Hold the tube upright. Unscrew the funnel from the tube.
4. Use the small cap to close the tube tightly.
5. Shake the capped tube for 5 seconds. You can discard or recycle the funnel.
6. Place into the plastic box provided and seal.
7. Return the filled tube to the researcher.

No.	Item		Description	Location in manuscript
<b>Domain 1: Research team and reflexivity</b>				
<i>Personal characteristics</i>				
1.	Interviewer/facilitator	Which author/s conducted the interview or focus group?	Interviewer SR and assistant interviewer NW	Page 9
2.	Credentials	What were the researcher’s credentials?	SR-Med; NW- PhD,	Page 9
3.	Occupation	What was their occupation at the time of the study?	SR & NW - MAGES Research Assistant	Page 9
4.	Gender	Was the researcher male or female?	SR & NW - Female	Page 9
5.	Experience and training	What experience or training did the researcher have?	SR- 3 years previous experience of working as a Research Assistant and conducting and analysing focus groups on NIHR funded RCT; NW- training in semi-structured clinical interviews	Page 9
6.	Relationship established	Was a relationship established prior to study commencement?	All focus group participants had an element of involvement with MAGES and therefore some form of previous relationship with SR and NW. Participants included form tutors who distributed MAGES information sheets and consent forms, science teachers who were present during the science workshop and the key MAGES contact teacher who was responsible for scheduling all assemblies, workshops and data collection days.	Page 9
7.	Participant knowledge of the interviewer	What did the participants know about the researcher?	All participants knew that NW and SR were Research Assistants working for Cardiff University as part of MAGES.	Page 9
8.	Interviewer characteristics	What characteristics were reported about the interviewer/facilitator?	SR and NW acknowledged their roles as Research Assistants for MAGES and outlined that the purpose of the study was to investigate the feasibility and acceptability of collecting saliva samples from children in schools and linking these samples to other information in order to understand more about the interaction between genes and environment in mental health.	Page 9
<b>Domain 2: study design</b>				
<i>Theoretical framework</i>				

9.	Methodological orientation and theory	What methodological orientation was stated to underpin the study?	Inductive thematic analysis.	Page 9
<b>Participant selection</b>				
10.	Sampling	How were participants selected?	Purposeful maximum variation sampling.	Page 9
11.	Method of approach	How were participants approached?	Face-to-face invitation from SR and NW to key MAGES school contact. Researchers asked key contact to invite other school staff with a wide range of involvement with MAGES to attend focus group.	Page 9
12.	Sample size	How many participants were in the study?	15	Page 9
13.	Non-participants	How many people refused to participate or dropped out? Reasons?	None	-
<b>Setting</b>				
14.	Setting of data collection	Where was the data collected?	Data were collected at participant's schools at a time and date convenient to them.	Page 9
15.	Presence of non-participants	Was anyone else present besides the participants and researchers?	No	-
16.	Description of sample	What are the important characteristics of the sample?	The sample included science teachers, members of the school's senior leadership team and form tutors.	Page 9
<b>Data collection</b>				
17.	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Supplementary Table 1	Supplementary Table 1
18.	Repeat interviews	Were repeat interviews carried out? If yes, how many?	No	n/a
19.	A/V recording	Did the research use audio or visual recording to collect the data?	Audio was digitally recorded.	Page 9
20.	Field notes	Were field notes made during and/or after the interview or focus group?	Supplementary hand written field notes of each focus group were made by NW.	Page 9
21.	Duration	What was the duration of the interviews or focus group?	Focus groups lasted approximately 45 minutes.	Page 9
22.	Data saturation	Was data saturation discussed?	A wide range of views were collected and researchers were confident that there was no further information that could	Page 10

			have been gained from recruiting more participants/ holding more focus groups.	
23.	Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No	-
<b>Domain 3: Findings and Analysis</b>				
<b>Data analysis</b>				
24.	Number of data coders	How many data coders coded the data?	There were two data coders (NW and SR).	Page 9-10
25.	Description of the coding tree	Did authors provide a description of the coding tree?	A full summary of the coding tree, including themes not explored within this paper, is included in Table 3	Table 3, page 27-28
26	Derivation of the coding themes	Were themes identified in advance or derived from the data?	Themes were identified from the content of the data.	Page 9-10
27.	Software	What software, if applicable, was used to manage the data?	NVivo 12 was used to code and analyse data.	Page 9-10
28.	Participant checking	Did participants provide feedback on the findings?	No	-
<b>Reporting</b>				
29.	Quotations presented	Were participant quotations presented to illustrate the themes / findings? Was each quotation identified?	Participant quotations are provided in the results to illustrate findings. Participant's quotations are anonymised.	Page 11-16
30.	Data and findings consistent	Was there consistency between the data presented and the findings?	Both NW and SR reviewed included quotes to ensure that they were fully representative of our data. Quotes were also reviewed by RB.	-
31.	Clarity of major themes	Were major themes clearly presented in the findings?	Yes - Major themes are discussed within the paper and described within table 3	Page 11-16 and Table 3, page 27-28
32.	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Yes - Minor themes are discussed within the paper and described within table 3	Page 11-16 and Table 3, page 27-28