Health Research Authority

Smartphones, social Media and Adolescent mental wellbeing: the impact of school policies Restricting daytime use

SMART SCHOOLS

This protocol has regard for the HRA guidance and order of content

Version 4 18/10/22

SMARTPHONES, SOCIAL MEDIA, AND ADOLESCENT MENTAL WELLBEING: THE IMPACT OF SCHOOL POLICIES RESTRICTING DAYTIME USE

SMART Schools

PROTOCOL VERSION: 4 18/10/22

RESEARCH REFERENCE NUMBERS:

ISRCTN Number:	ISRCTN77948572
CRN Number:	52232
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Research Ethics Committee	University of Birmingham Science, Technology, Engineering and Mathematics Ethical Review Committee: Approval number: ERN_22-0723

SIGNATURE PAGE

The undersigned confirm that the following protocol has been agreed and accepted and that the Chief Investigator agrees to conduct the study in compliance with the approved protocol and will adhere to the principles outlined in the Declaration of Helsinki and other regulatory requirement.

I agree to ensure that the confidential information contained in this document will not be used for any other purpose other than the evaluation or conduct of the investigation.

I also confirm that I will make the findings of the study publicly available through publication or other dissemination tools without any unnecessary delay and that an honest accurate and transparent account of the study will be given; and that any discrepancies from the study as planned in this protocol will be explained.

Chief Investigators:

Signature: 

Date: 23/02/2022

Name: (please print):

Dr Victoria Goodyear

Signature: 

Date: 23/02/2022

Name: (please print):

Dr Miranda Pallan

Sponsor statement

Support of the University of Birmingham as Sponsor is a prerequisite for ethical approval to be granted by the University of Birmingham Research Ethics Committee. Therefore, ethical approval granted from the University of Birmingham REC will serve as confirmation of approval of the protocol by the Sponsor.

i. LIST of CONTENTS

ii. LIST OF ABBREVIATIONS

API	Application Programming Interface
APPG	All Party Parliamentary Group
BAME	Black Asian and Minority Ethnic
BMC	Biomedical Central
CI(s)	Chief Investigator(s)
CMO	Chief Medical Officer
DEMC	Data Monitoring (and ethics) Committee
DHSC	Department of Health and Social Care
EAL	English as an Additional Language
FOMO	Fear Of Missing Out
FSM	Free School Meals
GAD-7	Generalised Anxiety Disorder Assessment
IDACI	Income Deprivation Affecting Children Index
ICC	Interclass Correlation Coefficient
iOS	Mobile Operating System Apple
ISRCTN	International Standard Randomised Controlled Trials Number
IT	Information Technology
MVPA	Moderate to Vigorous Physical Activity
NIHR	National Institute for Health Research
NVivo	Qualitative Analysis Software
PA	Physical Activity
PHQ-9	Patient Health Questionnaire (Depression)
PHR	Public Health Research
PPI	Patient and Public Involvement
QALY	Quality-Adjusted Life-Year
RA	Research Assistant
RDA	Research Data Archive
RDS	Research Data Store
REC	Research Ethics Committee
RCP	Royal College of Physicians
RCPCH	Royal College of Paediatrics and Child Health
SD	Standard Deviation

SEN	Special Educational Needs
SES	Socio Economic Status
SLT	Senior Leadership Team
SMG	Study Management Group
SMT	Study Management Team
SSC	Study Steering Committee
TIDieR	Template for Intervention Description and Replication
TV	Television
UK	United Kingdom
WEMWBS	Warwick-Edinburgh Mental Wellbeing Scale
WHO	World Health Organisation

iii. KEY STUDY CONTACTS

Chief Investigators	**Dr Victoria Goodyear (VG)**, Associate Professor in Pedagogy in Sport, Physical Activity and Health, School of Sport, Exercise and Rehabilitation Sciences, University of Birmingham: v.a.goodyear@bham.ac.uk **Dr Miranda Pallan (MP)**, Reader in Public Health and Epidemiology, Institute of Applied Health Research, University of Birmingham: M.J.Pallan@bham.ac.uk
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Sponsor	**Dr Birgit Whitman (BW),** Research Support Group, University of Birmingham: researchgovernance@contacts.bham.ac.uk
Funder(s)	This study is supported by funding from the National Institute for Health Research Public Health Research Programme
Committees	**Study Management Group (SMG)**: Co-chairs: Dr Victoria Goodyear & Dr Miranda Pallan. Other members: Professor

	Peymane Adab, Professor Hareth Al-Janabi, Dr Maria Michail, Dr Alice Stitch, Dr Sally Fenton, Dr Paul Patterson, Dr Matthew Wade, Ms Kirsty Jones, Mr Gareth Evans and study research staff **Study Steering Committee (SSC)**: Chair: Professor Lorraine Cale (LC, public health/education, Loughborough University, l.a.cale@lboro.ac.uk). Other members: Professor Scott Leatherdale (SL, public health, Warterloo University, sleatherdale@waterloo.ca), Dr Babara Barrett (BB, health economist, King's College London, babara.m.barrett@kcl.ac.uk), Dr Samuel Relton (SR, statistician, University of Leeds, s.d.relton@leeds.ac.uk), Mr Steve Cotton (SC, teacher and public representative, Berrymede Junior School, scotton@berrymede-jun.ealing.sch.uk), Dr Victoria Goodyear (CI) **Data Monitoring and Ethics Committee**: Chair: Dr Thomas Quarmby (TQ, education, Leeds Beckett University: t.quarmby@leedsbeckett.ac.uk). Other members: Professor Chris Owen (CO, epidemiology, St George's, University College London, cowen@sgul.ac.uk), Dr Tessa Reardon (TR, youth mental health, University of Oxford, tessa.reardon@psy.ox.ac.uk), Dr Victoria Goodyear (CI) **PPI Committees**: Dr Matthew Wade (Lead for PPI with schools, teachers and parents), Mr Gareth Evans (Lead for PPI with youth).

iv. STUDY SUMMARY

Study Title	Smartphones, social Media and Adolescent mental wellbeing: the impact of school policies Restricting dayTime use: (SMART Schools)
Internal ref. no. (or short title)	NIHR131396
Study Design	Natural experimental study using mixed methods
Study Participants	Secondary school age pupils in years 8 (age 12-13) and 10 (age 14-15); School Senior Leadership Team (SLT) members; Teachers; Parents/Carers
Planned Size of Sample (if applicable)	Secondary school age pupils (n=1170); SLT Members (n=36); Teachers (n=36); Parents/Carers (n=12)
Planned Study Period	28 months
Research Aim	To determine the impact of school time restrictions of smartphone use on mental wellbeing, anxiety, depression, sleep, physical activity, classroom behaviour, attainment and addictive use (age 12-13 & 14-15), and assess the costs of policy implementation from an education sector perspective. Impacts will be compared in 2 different school contexts: (i) Schools that do not permit smartphone use during the school day (intervention); (ii) Schools that permit smartphone use (e.g. in breaks/lunchtimes) (control).
Primary Outcome	Mental Wellbeing
Secondary Outcomes	Anxiety, depression, addictive phone/social media use, sleep, physical activity, educational attainment, disruptive classroom behaviour
Qualitative Data Collection in Case Study Schools	School-based (e.g. policy), Individual (pupil) and Family/Home (e.g. attitudes, use) contextual factors that influence relationships between school policies, phone/media use and mental wellbeing.

iv. FUNDING AND SUPPORT IN KIND

FUNDER(S)	FINANCIAL AND NON FINANCIALSUPPORT GIVEN
National Institute for Health Research	Provision of research related costs
University of Birmingham	Research sponsorship, and financial contributions to researcher salary and support costs (e.g. IT services, telephone, printing, desk space)

vi. ROLES OF STUDY SPONSOR AND FUNDER

The University of Birmingham, as the sponsor, will assume overall responsibility for initiation and management of the study, and will control final decisions regarding all aspects of the study. The National Institute of Health Research, as the funder, will contribute financial support and facilitate dissemination of the results.

vii. ROLES AND RESPONSIBILITIES OF STUDY MANAGEMENT COMMITEES, GROUPS & INDIVIDUALS

- **Study Steering Committee (SSC)**

  The role of the SSC is to provide overall supervision for the study on behalf of the funder and to ensure the study is conducted to the rigorous standards set out in the Department for Health's Research Governance Framework for Health and the Social Care. The SSC will be chaired by Professor Cale (education/public health expert), and include VG (CI), a school teacher (SC), a statistician (SR), a health economist (BB), and an international researcher in public health who leads on natural experiments and policy evaluations in schools (SL). The SSC has a level of 83% independence. The SSC will meet twice per year online and all meetings will be minuted with specified action points identified.

- **Data Monitoring (and ethics) Committee (DMEC)**

  The role of the DMEC is to monitor the data generated and make recommendations on whether there are any ethical or safety reasons that may influence the study design or conduct and/or the safety, rights and wellbeing of the study participants. The DMEC will be chaired by Dr Thomas Quarmby (education expert) and include VG (CI), an expert in youth mental health (Dr Reardon) and an epidemiologist (Prof. Owen). The DMEC has 75% level of independence. The DMEC will meet once per year online and all meetings will be minuted with specified action points identified.

- **Study Management Group (SMG)**

  The role of the SMG Management Group is to ensure all practical details of the study are progressing well and working well and everyone within the study understands them. The SMG will be chaired by both CI's (VG and MP) and members will include Co-I's and the study research staff. The SMG will meet quarterly and all meetings will be minuted with specified action points identified.

- **Core Study Management Team (SMT)**

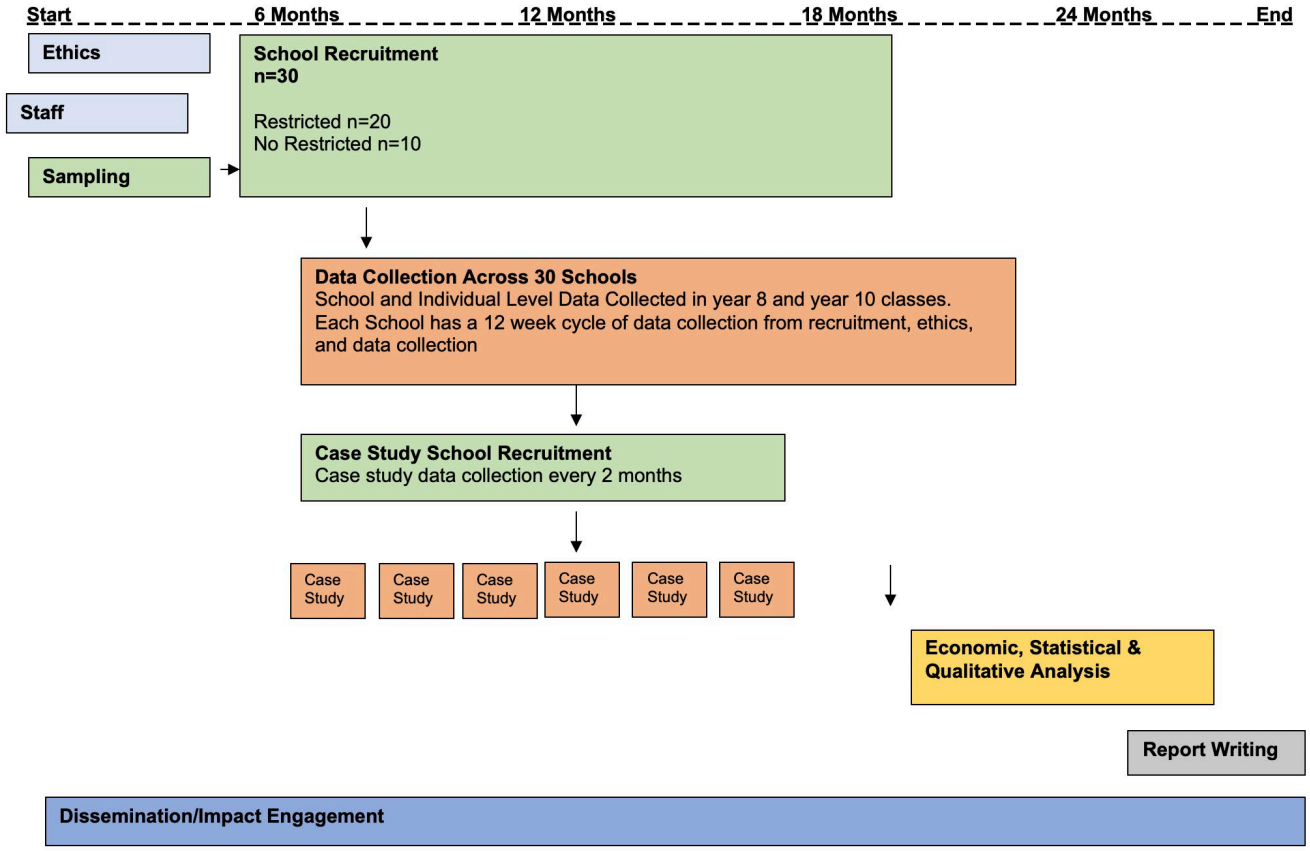
  VG and MP (CI's) will have overall responsibility for the study. VG, MP and the research study staff will form a core study management team, which will meet weekly or at an agreed regular interval to oversee all aspects of the study.

viii. Protocol contributors

The CI's (VG and MP), with the wider support of the Co-I's conceived and designed the study and drafted the original protocol. The protocol was also informed by a PPI survey and focus group consultations with 71 participants (teachers [n=51] and secondary school pupils [n=21]) who helped to refine the research questions and data collection tools. The study has undergone multiple rounds of expert peer-review as part of the funding process.

viii. KEY WORDS: Smartphones, Social Media, Adolescent Health, Mental Health, Schools, Policy

ix. Flow Diagram of Participants and timing of data collection, analysis and dissemination



x. Project Plan

Year		2022												2023												2024						
Project Month		-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Calendar Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Milestone	Description																															
1	Recruitment Research Fellow (Project Manager)	x	x	x																												
2	Start Up Tasks Submit			x				x																								
3	Ethics Approval				x	x	x	x																								
4	Recruitment of Research Fellow (Qualitative)						x	x	x																							
5	Recruitment of Research Associate (Data Collection Manager)						x	x	x																							
6	Recruitment of Admin Assistant						x	x	x																							
7	School Sampling				x	x	x	x	x																							
8	School Recruitment								x	x	x	x	x	x	x	x	x	x	x	x	x	x	x									
9	Main Data Collection									x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x					
10	Case Study School Recruitment									x	x	x	x	x	x	x	x	x	x	x												
11	Case Study School Data Collection									x		x		x		x		x		x												
12	Recruitment of Research Fellow (Statistician)																					x	x	x								
13	Recrtuitment of Research Fellow (Economics)																					x	x	x								
14	Statistical Analysis																								x	x	x	x	x	x		
15	Economic Analysis																								x	x	x	x	x	x		
16	Qualitative Analysis																				x	x	x	x								
17	Paper Writing																													x	x	x
18	Report Writing																													x	x	x
19	Study Management Group (SMG) Meetings				x				x			x			x			x			x			x			x			x		
20	Study Steering Committtee (SSC) Meetings					x						x						x						x						x		
21	Data Monitoring (and ethics) Committee (DMEC) Meetings													x												x						
22	PPI Meetings					x						x								x									x			
23	Dissemination				x						x							x					x						x	x	x	x

STUDY PROTOCOL

Smartphones, social Media and Adolescent mental wellbeing: the impact of school policies Restricting dayTime use

Short title: SMART Schools

1 BACKGROUND

1.1 Overview

Adolescence is a crucial period for developing and maintaining social and emotional habits important for mental wellbeing. The use of smartphones and social media (phones/media) is a habitual behaviour during adolescence. Evidence suggests that moderate amounts of time spent on phones/media is beneficial for mental wellbeing, but higher levels of use are associated with poorer mental wellbeing. Many, but not all schools, are currently altering adolescents' uses of phones/media through school phone/media policies that restrict daytime use. This project is a natural experiment and will take advantage of the existing variation in school phone/media policies to explore how restrictive policies may impact on phone/media use, and influence mental wellbeing and related behaviours. We want to know whether and how restrictive phone/media use school policies are an effective and cost-effective mental health intervention. To address this, we aim to determine the impact of school daytime restrictions on smartphone use on mental wellbeing (primary outcome), anxiety, depression, sleep, physical activity, classroom behaviour, attainment (age 12-13 & 14-15) (secondary outcomes) and time use. We will also examine how the school environment, individual factors and family/home factors influence relationships between school policies, phone/media use and mental wellbeing. The outcomes will inform national policy and guidance, school policy and curricula, and the design and implementation of future interventions to improve mental wellbeing. In the following sections we review the existing evidence and provide a rationale for how and why we propose to investigate relationships between school policies, phone/media use and mental wellbeing.

1.2 Mental Wellbeing

Globally, mental disorders are the leading cause of disability in children and young people. [1] Poor mental wellbeing is prevalent in adolescents: 1 in 7 (age 11-16) in the UK have a diagnosable mental health disorder, mostly anxiety or depression. [2] Half of all mental health disorders start before the age of 14 [3,4], and if left untreated, mental health problems are highly likely to persist well into adulthood. [1]

Poor mental wellbeing negatively affects other aspects of adolescents' lives, including cognitive, social and physical behaviours. [5] Poor mental wellbeing is associated with higher rates of disruptive behaviour, school absence and lower educational attainment. [6,7] Sleep problems are also very common among adolescents diagnosed with anxiety and depression and evidence points toward a bidirectional relationship between sleep disturbances and mental health problems in adolescents. [8] Physical activity is associated with higher levels of mental wellbeing [9], however rates of disengagement from physical activity increase during adolescence coinciding with increased onset of mental health problems. [4,10]

Overall, rates of mental disorders are high during adolescence. [2] The lifetime societal cost of moderate mental health problems can be estimated at £85,000 per person. [11] Hence, there is an urgent need for mental health prevention and intervention research to determine effective pathways to reach and positively impact adolescent mental wellbeing.

1.3 Smartphones, Social Media and Mental Wellbeing

Smartphone and social media use is prevalent during adolescence, and accounts for the majority of their overall screen time. [12,13] In the last 5 years, adolescents' (age 11-16) uses of phones and social media have increased substantially, with most adolescents now owning a smartphone (34% 2015; 81% 2019) and the majority of adolescents in the UK reported to be active users of social media (33% 2015; 89% 2019). [13,14] The average time spent on smartphones and social media is inconsistent and varies between adolescents. [15] Samples in the US and the UK from 2015-2018 estimate that the average time spent on phones/media is up to 5 hours per day. [12,13,16] Problematic (addictive) social media use is also prevalent with 12% of adolescents in England reported to exhibit addictive use behaviours. [17] Time spent on phones/media and problematic use is likely to have increased further in 2020, as adolescents reported spending more time online during the COVID-19 pandemic and that their dependency on digital technologies for interaction, information and entertainment increased. [18]

In moderation smartphone and social media use (e.g. <2 hours per day) can be advantageous for mental wellbeing and other associated health and behavioural outcomes (e.g. sleep, physical activity, school behaviour and attainment, lower addictive use). [19-23] Phone/media use has a number of reported benefits for mental wellbeing that include: increased interaction; more available, shared and tailored information; and peer social and emotional support. [24,25] However, at higher levels of use the reverse effect is seen, with increasing time on phones/media associated with decreasing levels of mental wellbeing, and higher anxiety and depression. [19-21, 23,26 27] Furthermore, a higher proportion of adolescents (age 11-19) with a mental disorder spend more hours per day on social media compared to those without a disorder. [28] Poor academic performance, disruptive classroom behaviour, and less time spent in physical activity and sleep are also more likely in adolescents who spend a greater proportion of time on phones/media. [19-23,26-27] Reducing the time adolescents spend on phones/media is thus a plausible intervention to improve mental wellbeing. However, it should be noted that uncertainties in strength of associations between phones/media and mental wellbeing exist, and this is mainly due to reliance on self-reported use. [14,29]

1.4 School-Based Interventions and Policies

Children and young people spend up to 14 years of their life in school, therefore, the school context is an ideal place to help children and adolescents develop social and emotional habits that are important for mental wellbeing. There is considerable evidence that school-based interventions can have profound effects on students' mental wellbeing and associated behaviours (e.g. sleep, physical activity, school behaviour and attainment). [30-31] Whole-school environment interventions that promote lifestyles conducive to good health are reported to have a more pronounced effect on mental wellbeing than individual approaches targeting knowledge and beliefs. [30,32] Such whole-school interventions and policies align with the World Health Organisation (WHO) framework for Health Promoting Schools, that focuses on altering the school environment to address the limited effectiveness of curriculum approaches alone in promoting health. [33] A whole-school approach targets physical and social influences of health, and through policies and the school 'ethos' (school values, practices, environment and teacher-pupil relationships) seeks to promote a set of values, attitudes and behaviours that encourage the development and maintenance of positive physical, social and emotional habits. [30] Evidence from other countries suggests that such whole school lifestyle policies can: (i) reduce overall screen time; (ii) positively influence mental wellbeing; and (iii) improve physical activity, sleep, disruptive behaviour and educational attainment. [34-36] However, the current evidence is not definitive, and it is unclear what types of school policies influence phone/media behaviours and, in turn, mental wellbeing.

School phone policies that restrict daytime phone/media use are an example of a current whole-school environment intervention that aims to influence mental wellbeing, and associated behaviours (e.g. pupil behaviour and attainment). In some schools, phones are not permitted to be used throughout the school day, whereas in others phones are permitted ([37]; also verified in our PPI consultations). In the UK, Australia, Sweden and Czech Republic restrictive phone/media use policies have been observed. [35,37,38] Such phone 'ban' policies are often implemented to improve educational attainment, mental wellbeing, and reduce disruptive behaviour, cyberbullying and addictive phone/media behaviours ([37-39]- also verified in our PPI activity). However, there is currently no evaluation of the effect of school policies that restrict school time smartphone use on these outcomes and there is limited evidence on how restrictive school phone/media policies are implemented in schools. [40] There is also currently no national government policy on phone/media use in schools. [40] The UK government and leading regulatory bodies (RCP, RCPCH, CMO) recently identified that school phone policies that restrict daytime use were a potentially high impact intervention in relation to mental wellbeing, and requested evidence-based guidance for phone/media use policies in schools. [23,40,41]

1.5 Factors that may modify the relationship between school phone policies and adolescent mental wellbeing

Adolescents' uses of phones/media are highly dynamic, complex and influenced by a range of contextual factors. [42] Investigating time/use effects alone will therefore provide simplistic and reductionist perspectives on adolescents' relationships with phones/media and the effects on mental wellbeing. In this study, we will explore how individual, school and family/home factors may influence school phone/media policy implementation and its impact on mental wellbeing, and associated behavioural outcomes. These contextual factors have been considered in our logic model as potential influencers of the relationship between school time restrictions of smartphone use and mental wellbeing (primary outcome), and anxiety, depression, sleep, physical activity, classroom behaviour and attainment and addictive use (secondary outcomes).

1.5.1 School Environment

Schools differ by ethos, leadership, and context. [43] In turn, school values and priorities, family/community involvement and the curriculum differ by school and these factors influence policy content and implementation. [30,38,43] There is evidence that the school's prioritisation of healthy lifestyles, behaviour, and/or attainment influence a school's decision and rationale to restrict/not restrict phone use, as well as how the phone/media use policy is implemented (e.g. features/rules). [37,38] In Canada, for example, school-level differences accounted for approximately 12% variability in overall screen time (e.g. phones, computers, TV), and students were less likely to have high screen time if they attended a school that emphasized physical activity. [34] Policy implementation is also influenced by teacher training and senior leadership support (admin/time), how teachers are supported to enact the policy, and the level of policy compliance (by teachers, students and parents/carers) [44,45] It is also important to recognise that the school curriculum has the potential to influence adolescents' knowledge, understanding and motives for using phones/media, potentially helping them to use phones/media in ways that are beneficial for mental wellbeing (e.g. social interactions or accessing relevant information). [46,47] The role of the curriculum is an important consideration in the UK, given the introduction of the new statutory Personal Social Health Education curriculum that addresses technology use in the context of mental wellbeing. [48]

1.5.2 Individual

Individual factors (e.g. including, age, gender, socio-economic position and ethnic/cultural background) moderate effects on mental wellbeing and phone/media use. For example, the time spent on social media tends to increase with age during adolescence [13], with girls tending to spend more

time on social media than boys [16] and girls are often more influenced by peers to use social media for specific purposes. [12,49] However, only marginal differences in phone/media use are observed across socio-economic status groups (SES). [12,13] In relation to mental wellbeing, there are differences between SES groups and genders. Girls also report poorer mental wellbeing and there is a greater prevalence of anxiety and depression in girls compared to boys. [28,50,51] Adolescents from low SES backgrounds are 4 times more likely to experience mental health problems than those from high SES backgrounds. [50] Similar observations are reported across other behavioural outcomes. For example, adolescents from lower SES groups and Black Asian and Minority Ethnic groups are more likely to report lower levels of physical activity. [52] Individual variation must therefore be accounted for and also explored when investigating the relationship between school phone/media policies and mental wellbeing.

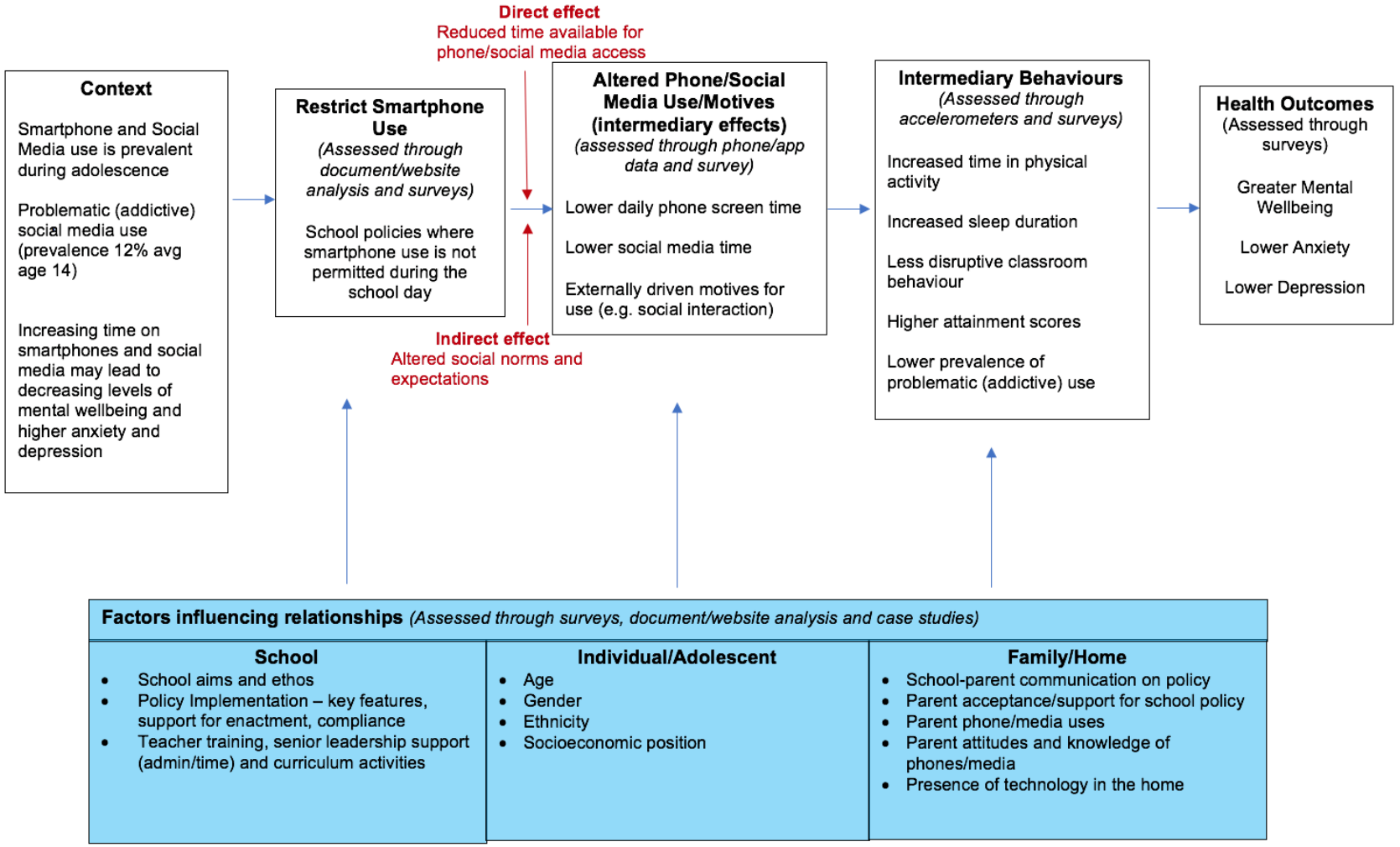
1.5.3 Family/Home

These relate to the influence of family-school interactions and family/home uses and rules on adolescent phone/media behaviours. There is evidence that adolescent compliance with school policies is more likely in schools that have communicated policies effectively with parents. [53] Student behaviour and attainment also tend to be greater when parental control and discipline strategies in the home align with school polices and the school ethos. [54-56] In relation to phones/media, there are associations between parent and child uses of phones/media, with greater levels of parent use (>2 hours) associated with greater levels of child use. [56,57] Parent phone/media rules (e.g. time on devices) also influence children's uses of these technologies. [56] However, there is large variation in home rules and parent uses of phones/media, and this variation is influenced by the presence of technology in the home, and parental attitudes and knowledge of phones/media. [56,58] Parents' awareness of school policies, school-parent communication and whether parents will act on and support the school policy are therefore important factors to consider when exploring the impact of school policies on phone/media use and mental wellbeing.

2. RATIONALE

Poor mental wellbeing is prevalent in adolescents, and the amount of time adolescents spend on phones/media is associated with mental wellbeing. Based on a review of existing evidence and our PPI activities, we suggest that school policies that do not permit smartphone use during the school day could lower the overall time adolescents spend on their phones and social media, and modify how and why they use these, thus impacting on their mental wellbeing. As a result, adolescents in schools that restrict phone/media use may have better mental wellbeing and lower levels of anxiety and depression. Furthermore, in these schools, mental wellbeing and mental health outcomes may be further strengthened because the reduced time spent on phones/media per day is likely to affect other mental wellbeing promoting behaviours, including: physical activity, sleep duration, disruptive classroom behaviour, attainment scores and the prevalence of addictive use. However, the relationship between phone/media use and mental wellbeing is highly complex and will be influenced by school, individual and family/home factors. In this project, we propose to conduct a rigorous in-depth investigation into the impact of school time restrictions on smartphone use on mental wellbeing (primary outcome), anxiety, depression, sleep, physical activity, classroom behaviour and attainment, addictive use (age 12-13 & 14-15) and time use. Within this, and through 6 in-depth case studies, we will explore how variation in individual, school and family/home factors may influence the relationship between school phone/media policy, phone/media use and mental wellbeing. The logic model in Figure 1 presents: (a) the processes by which school phone policies are assumed to influence adolescent mental wellbeing, and the school, individual and family/home factors influencing relationships; and (b) the key areas of data capture and methods.

Figure 1: Logic model and theory of change for the influence of school policies that restrict daytime use of smartphones on mental wellbeing and health outcomes in adolescents



2.1 Aim

To determine the impact of school time restrictions of smartphone use on mental wellbeing, anxiety, depression, sleep, physical activity, classroom behaviour, attainment and addictive use (age 12-13 & 14-15), and assess the costs of policy implementation from an education sector perspective. We will compare impacts in 2 different school contexts:

(i) Schools that do not permit smartphone use during the school day (intervention);
(ii) Schools that permit smartphone use (e.g. in breaks/lunchtimes) (control).

2.2 Research Questions

1. In schools that do not permit smartphone use compared with schools that permit smartphone use:

    a. Is there a difference in mental wellbeing, anxiety and depression, sleep duration, time spent in physical activity, classroom disruptive behaviour, attainment and prevalence of addictive use?

    b. Is there a difference in smartphone and social media use and duration of use within school, over a 24hr period and across 7 days and is there a difference in motives for phone/media use?

2. What are the key features/rules of school phone/media policies, how are they implemented and what school-based, individual and family/home factors influence policy implementation and impact on phone/media use and wellbeing (and associated outcomes)?

3. How do adolescents understand and explain relationships between the school policy/environment, phone/media use, and mental wellbeing?

4. What are the education costs and wellbeing consequences associated with different policy approaches to smart phone use?

3 OUTCOME MEASURES

3.1 Primary outcome

The primary outcome is mental wellbeing, which we will measure using Warwick-Edinburgh Mental Well-Being Scale (WEMWBS). [59] WEMWBS has moderate-high test-retest reliability [63]. Wellbeing is likely to fluctuate due to other factors e.g. exam periods, school holidays. To improve precision, data will be collected in each participating pupil at two time points. The time points will be between 4-8 weeks apart, and this will provide sufficient flexibility to work with schools to collect data while enhancing precision.

3.2 Secondary outcome

There are 7 secondary outcomes that we will assess in participants. For each outcome we have selected the most robust measure and reviewed evidence of their validity and reliability (including assessing test-retest reliability). [61-64] The outcomes generated from questionnaires will be measured at one time point. Accelerometer data which will be collected over a 7 day period, to account for fluctuations in physical activity and sleep at different time points in a week.

i. **Anxiety symptoms** over the previous two weeks, measured using Generalized Anxiety Disorder Assessment (GAD-7; measured over the past 2 weeks)

ii. **Depressive symptoms** over the previous two weeks, measured using the Patient Health Questionnaire (PHQ-9; measured over the past 2 weeks)

iii. **Addictive Use** using the Problematic Social Media use Scale (measures mood regulation, cognitive preoccupation, compulsion, displacement). [65, 66]

iv. **Sleep** (bed time, rise time, total time in bed and sleep efficiency [% of time in bed asleep vs awake] collected from accelerometers over 7 days

v. **Physical activity** (MVPA and overall PA) collected from accelerometers over 7 days

vi. **Attainment** collected from form tutor (or equivalent) using an adapted Progress 8 questionnaire to determine whether students are working at expected grade in English and Maths

vii. **Disruptive Classroom Behaviour** collected from form tutor (or equivalent) using the Pupil Behaviour Questionnaire [67]

3.3 Intermediate Effects – Phone Use Data

To measure the influence of the policy on phone/media use, we will collect data from participants on smartphone and social media use duration within school, over a 24hr period and across 7 days. Adolescents will self-report their smartphone and social media use within the school day. Adolescents will also self-report duration on their phone and duration on social media (by providing a breakdown of time spent on social media apps e.g. SnapChat, Instagram, YouTube, WhatsApp), using data from adolescents phones from free apps on Android (Digital Wellbeing) and iOS (Screen Time) devices. These time/use apps aim to strengthen the accuracy of self-reported data by providing adolescents with objective measurements of time spent on phones/media to self-report. Moreover, the apps are built into all current devices, and have been selected due to their feasibility and acceptability of use by our sample population, and because they navigate API issues of data generation across phone devices (e.g. iPhone, Android). In addition to measuring time/use, we will measure adolescents' motives for social media use, to assess whether the 2 school contexts influence the psychological motives of adolescents for using social media. Data will be generated from the social media motives questionnaire which measures 4 dimensions of motivation: coping, conformity, enhancement, and social. [65]

3.4 Policy Implementation Measures

3.4.1 Intervention Components and implementation – School-level data

To understand the components and the school's implementation of the intervention, we will collect data from each school on: the placement of the school policy within the school aims and/or ethos (e.g. motto that explains school priorities in relation to environment, pupils and teachers), the rules and key features of the school policy (e.g. detentions, confiscation), time period of policy implementation (e.g. 1,2, 3 years), type of policy communication with pupils and parents (e.g. letters, website), and policy adherence and fidelity (rated level of compliance (1-5) by student, parent, teachers). That data will be collected from school policy documents and handbooks, website content and a questionnaire completed by the senior leadership team.

3.4.2 Data on Individual Factors

Individual factors may influence both phone/media use and mental wellbeing, therefore we will collect data from participants on demographic variables including age, gender and ethnicity. As a proxy

measure for socioeconomic position, we will ask for free school meal entitlement and home postcode to derive the Index of Multiple Deprivation for each participant.

3.5 Contextual Factors Influencing Relationships: School Environment and Home/Family – Qualitative Data Collection in Case Study Schools

We will use in-depth focus groups to explore the school, individual and family/home factors that we have identified in our logic model to influence relationships between school policies, phone/media use and mental wellbeing. These factors are complex and dynamic, requiring in-depth and nuanced understandings generated from multiple perspectives to explain how and why school phone/media policies inform mental wellbeing. Accordingly, we will undertake focus groups with separate groups of: (i) adolescents, (ii) school staff (including governors), and (iii) parents/carers. This qualitative data collection will take place in a sub-sample of 6 case study schools.

The focus groups with adolescents will be used to explore how adolescents understand school policies on phone/media use, how they conceptualize potential impact (positive or negative) of phone/media use on their mental wellbeing and associated behaviours (i.e. anxiety, depression, sleep, physical activity, attainment, behaviour, addiction), and contextual factors of phone use (e.g. peer influence, education). Focus groups with school staff will explore in more detail the components of the restrictive or permissive phone/use school policies (e.g. rules, duration, if reversed/retained) with a focus on the factors influencing policy implementation (e.g. teacher training, leadership support) and the wider ethos, school curriculum, and whole-school approach to mental wellbeing. Focus groups with parents/carers will explore school-parent communication (specifically relating to phone use policies, and more generally), parental/carer phone uses, attitudes and knowledge of phones/media, the presence of technology in the home, and the reasons for parents' willingness (or not) to support the school phone/media policy. We have chosen to explore these issues with parents in focus groups rather than a parent survey across all schools because in addition to the need to understand the complexity of family/home factors, our previous experience with parent surveys in secondary schools indicates that response rates are likely to be very low.

3.6 Economic Variables

Economic measures will include: (i) time use in schools related to managing the policy; (ii) indirect time use from managing related behavioral problems; (iii) other related costs. Time use will be based on the teacher and senior leadership team survey recall questions and valued using published unit costs. The data will be used with primary and secondary outcomes data to conduct the economic evaluation.

Table 1. Overview of Outcomes, Measures and Timepoints of Evaluation

Outcome	Outcome Measures	Timepoint(s) of evaluation
Primary Outcome		
Mental Wellbeing	Warwick-Edinburgh Mental Well-Being Scale (WEMWBS)/ pupil survey	Measured over the past 2 weeks at 2 time points, 4-8 weeks apart
Secondary Outcomes		
Anxiety Symptoms	Generalized Anxiety Disorder Assessment (GAD-7)/ pupil survey	1 time point measured over the past 2 weeks
Depressive Symptoms	Patient Health Questionnaire (PHQ-9)/ pupil survey	1 time point measured over the past 2 weeks
Addictive Use	Problematic Social Media use Scale/ pupil survey	1 time point based on usual use
Sleep	Sleep duration, time pupils fell asleep, sleep efficacy [% of time asleep vs % time in bed] collected from accelerometers (which records sleep onset, rise time, total elapsed bed time, total sleep time, total wake time, sleep efficacy)	Over 7 days
Physical Activity	MVPA and overall PA collected from accelerometers and self-report in pupil survey (including travel and engagement with clubs related to physical activity)	Over 7 days / usual behaviours
Attainment	Assessment of whether pupils are below, above or working at their target grade in English and Maths/ teacher survey	1 time point – most recent assessment
Disruptive Classroom Behaviour	Pupil Behaviour Questionnaire/ teacher survey	1 time point – current assessment
Intermediate Effects		
Smartphone Use Duration	3 measures: (i) within school, (ii) over 24 hour period; (iii) on a weekend day / data captured on iOS and Android phones will be self-reported through the pupil survey	1 time point
Social Media Use Duration	3 measures: (i) within school, (ii) over 24 hour period; (iii) on a weekend day (data captured on IOS and Android phones will be self-reported through the pupil survey)	1 time point
Motives for Social Media Use	Social Media Motives Questionnaire/ pupil survey	1 time point measured over past 12 months
Policy Implementation Measures		
Intervention Components (School Level Data): School Timetable; School Policies (phone, mental health, behaviour, e-safety): School Phone Policy Details (e.g. rules/key features; time period of implementation; policy communication and understanding; adherence and fidelity and policy rationale)	School Policy Documents School Handbooks School Website Content SLT survey Teacher survey Pupil survey	1 time point

Individual Factors (Pupils): age, gender, ethnicity and socio-economic position	Pupil Survey Teacher Survey	1 time point
Contextual Factors: School, Individual, Family/Home	Focus Groups with school staff, pupils and parents/carers of school pupils	1 time point
Economic Variables		
Teacher Time Spent Managing Policy Indirect Time Spent Managing Behavioural Problems Other Related Costs	SLT Survey Teacher survey	1 time point
Health-related quality of life / Quality Adjusted Life Years	The Child Health Utility Instrument (CHU9D)/ Pupil survey	1 time point / current assessment

4 STUDY DESIGN

We will conduct a natural experimental study using mixed methods to compare the impact of school daytime restrictions on smartphone use on mental wellbeing in 2 secondary school contexts: schools that do not permit phone use (intervention) vs schools that permit phone use (control). Schools are already implementing policies that fall into either intervention or control groups (verified from our PPI), and this study design takes advantage of that natural grouping.

P=Adolescents aged 12-13 years and 14-15 years attending secondary schools within the sampling frame

I = school policy prohibiting use of mobile phones during the school day

C = schools that allow use of mobile phones during the school day (at break and lunch times)

O = Mental wellbeing (primary); anxiety, depression, classroom behaviour, attainment, physical activity, sleep, addictive phone/media use (secondary).

Informed by our PPI activities and school phone policy analysis by the Department for Education (DfE) [68], Table 2 identifies variations in school phone policies and how we have classified these variations as either permissive (control) or restrictive (intervention) school phone policies. We have chosen to classify schools that permit phone use for educational activities in lessons (e.g. calculator), but restrict any other use (e.g. must be placed in bags and not used for any personal/social activities during the school day) as restrictive. Based on our research questions (2.2), theory (4.2) and logic model (Figure 1) this study is interested in the personal uses of phones/social media, and not regulated uses within an educational curriculum setting.

Table 2: Classifications of Variations in School Phone Policies as Permissive (Control) or Restrictive (Intervention)

Permissive School Phone Policies (Control)	Restrictive School Phone Policies (Intervention)
Allow pupils to carry phones on them and use them at any time point during the day	Allow phones onto school premises but insist these are not to be used during the school day and are turned off and out of site
Allow pupils to carry phones on them and use them at specific time points during the day (e.g. breaks and lunch)	Allow phones onto school premises, but only allow use of the phones if sanctioned by teaching staff for educational activities (e.g. use of calculator)

Allow pupils to carry phones on them and use them for personal use with consent from school staff	Allow phones onto premises but insist that phones are left in a particular place during the school day e.g. school reception
Allow pupils to carry phones on them and use within designated areas or zones	Pupils are not allowed to carry their phones on school premises all together

4.1 Intervention Components

Following the TiDieR checklist and guide the intervention components are listed below, and these have all been co-produced and verified as part of our PPI activities:

- **Description**: School policy prohibiting the use of mobile phones during the school day.
- **Materials**: The policy may be communicated to parents and adolescents in a variety of ways, e.g. through school information packs, assemblies, letters and/or the school website.
- **Procedures**: Adolescents are not permitted to use their phones during the school day, and their phones must not be seen on the school premises.
- **Provider:** Schools develop their own policies, often in consolation with parents and/or school governors, and in relation to the school ethos.
- **Mode of Delivery:** Teachers enact the school policy and are required to administer behavioural consequences for adolescents who use their phone during the day, such as: phone confiscation, detention, parent-school meeting.
- **Time Period:** Schools vary in the duration that the school phone/media policy has been implemented (e.g. 1, 2, or 3 or more years).
- **Tailoring:** Schools have developed policies according to their specific school contexts. Policies usually apply to the whole school, although in some schools 6th form students (age 16+) may be permitted to use their phones during the school day (this age group will not be investigated in this study).
- **Adherence and Fidelity:** The degree to which students and teachers adhere to the school policy varies across schools.

4.2 Theory

The intervention and data capture is directed by our logic model that integrates multiple theories and evidence. First, we adhere to the digital goldilocks hypothesis [19] to propose that reducing adolescents' uses of phones/media (i.e. restricting school time use) is optimal for mental wellbeing. Overuse displaces other mental wellbeing promoting activities (e.g. physical activity and sleep), and very low use can deprive interactions that support mental wellbeing (e.g. affect and relationships). [19,21,23] Second, psychological motives drive phone/media use, where the psychological motives of enhancement and social interactions promote mental wellbeing, and interactions related to coping and conformity (e.g. Fear of Missing Out (FOMO)-anxiety) lead to problematic use (addiction) and poor mental wellbeing. [65,66] Hence the school policy, ethos and curriculum has the potential to alter adolescents' motives for using phones/media. Third, the ecological model of social influence proposes three agents that shape wellbeing and technology use: school environment, home/family, and individual factors. [42] Finally, policy enactment and implementation process models [31,43,45] identify that school policy implementation effects will be shaped by social processes (e.g. training, leadership, compliance, admin, family-school interactions).

5 STUDY SETTING

We are focusing on secondary schools due to the high prevalence of social media use in this age range [13], and because adolescence is a crucial period for intervention for mental wellbeing. [5]

The sampling frame for the study will compromise secondary schools in the West Midlands (Birmingham, Coventry, Dudley, Herefordshire, Sandwell, Shropshire, Solihull, Staffordshire, Stoke-on-Trent, Telford and Wrekin, Walsall, Warwickshire, Wolverhampton and Worcestershire), and schools from other regions within a 100 mile radius of the University of Birmingham, including: East Midlands (Derby, Derbyshire, Lincolnshire, Leicester, Leicestershire, North Northamptonshire, Nottingham City, Nottinghamshire, Rutland and West Northamptonshire), South East (Bracknell Forest, Buckingham, Milton Keynes, Oxfordshire, Reading, Slough, West Berkshire, Windsor, Maidenhead), East (Bedford Borough, Central Bedfordshire, Cambridgeshire, Hertfordshire, Luton, Peterborough), South West (Bath and North East Somerset, Bristol, North Somerset, Gloucestershire, South Gloucestershire, Swindon) and North West (Blackburn with Darwen, Bolton, Bury, Cheshire West and Chester, Halton, Knowsley, Liverpool, Manchester, Oldham, Rochdale, Salford, Sefton, St Helens, Stockport, Tameside, Trafford, Warrington, Wigan and Wirral). The 64 local authorities have an average mid-tier deprivation ranking of 141 out of 316, with a range of 1-307 that illustrates the sample includes local authorities with both high and low levels of deprivation [69]. The average percentage of Black Asian and Minority Ethnic (BAME) groups is 12%, which is marginally lower than the national average [70,71].

6 PARTICIPANT ELIGIBILITY CRITERIA

Data will be collected from pupils in years 8 (age 12-13) and 10 (age 14-15). These 2 groups of adolescents are likely to have different relationships with phones/media and different contextual factors that may influence their mental wellbeing. For example, in year 8, pupils are likely to be newer users of phones/media and physical activity levels begin to decline, particularly among girls. [5,13] In year 10, pupils are likely to be more established phone/media users, mental wellbeing tends to be lower, and this age group are approaching the peak onset of mental health conditions. [3] Data will also be collected from the SLT and teachers in participating schools, and from parents/carers in a subsample of schools (case study schools). Written informed school content, teacher, parental/carer consent and adolescent consent to take part will be obtained prior to data collection.

6.1 Inclusion criteria

- Secondary Schools (age 11-19) from local authorities within a 100 mile radius from the University of Birmingham (community schools, foundation and voluntary schools, academies, free schools and colleges)
- School SLT members, school staff (including, teachers, teaching assistants, admin staff, governors, building/caretakers) and parents/carers capable of giving informed consent
- School pupils aged 12-13 or 14-15 capable of giving informed consent

6.2 Exclusion criteria

- Special Schools and Pupil Referral Units: these schools are excluded from this project because in these schools it is expected that there would be additional influences on adolescent mental wellbeing, behaviour and attainment, that would affect comparisons of the 2 school policies. Furthermore, our website analysis identified that most special schools do not permit phone use during the school day.

- Independent schools: these schools are excluded from this project because in these schools it is expected that there would be additional influences on adolescent mental wellbeing and smartphone and social media use that would affect comparisons of the 2 school policies (i.e. restrictive vs permissive). Our website analysis identified that a number of independent schools: included boarding for all or some pupils; have different government funding and curriculum arrangements; and many independent schools have different phone policies for year 8 and year 10 pupils, and additional phone policies for boarding pupils.

- Secondary schools where data on the school characteristics (e.g. admissions policy, total pupil roll size) that is required for the propensity score calculations (see 7.1.1) could not be accessed

- Secondary schools that have a different phone policy for year 8 and year 10 pupils (i.e. permissive vs restrictive), because we would be unable to clearly classify these schools into one of our two identified school groups

- Secondary schools that do not have both year 8 and year 10 classes (e.g. newly established schools)

7 STUDY PROCEDURES

In each participating school, activities will take place over 8-12 weeks (accounting for school holidays) and include: recruitment, gaining informed consent, and data collection. An illustrative outline of the activities is provided in Table 2. Engagement with schools will take place over 18 months (17 months accounting for school holidays).

Table 4. illustrative Examples of Schedule of Procedures with Participating Schools

Week	Activity	Methods	Participants	Location
1	School Recruitment	Discussion	School Stakeholder	Email/Phone
2-3	Informed Consent	Paperwork	Pupils SLT Teachers Parents/Carers*	School
3-4	Data Collection 1	Pupil Survey Accelerometers Teacher Survey SLT Survey Document Analysis	Pupils Teachers SLT	School
5-7*	Case Study Schools*	Focus Groups*	Pupils* School Staff* Parents/Carers*	School/online
8-12	Data Collection 2 (primary outcome)	Pupil Survey (mental wellbeing)	Pupils	School

**Only schools identified as case study schools will complete this step*

7.1 Sampling

7.1.1 Sampling of schools

To improve the comparability of the two school groups we will develop propensity scores based on school characteristics and use these to conduct stratified sampling. We will develop the propensity scores using linear regression with restrictive/non-restrictive phone/media policy as the outcome and school characteristics as explanatory variables. We will include in the model the following school characteristics: region; school type; urban/rural; total pupil roll size; Income Deprivation Affecting Children Index (IDACI); inclusion of a sixth form; selective/non-selective admissions policy; religious affiliation; and proportion of: male/female pupils; pupils from Black, Asian and minority ethnic groups (BAME); students with English as a foreign language (EAL); students eligible for free school meals (FSM); and pupils with Special Educational Needs (SEN). We will create 6 groups of schools using propensity score terciles, and identify schools with restrictive vs. non-restrictive policies in each group, resulting in six sampling groups based on propensity score and policy. We will randomly sample within each of these six groups.

7.1.2 Sampling of case study schools

There will be 6 case study schools in total, that will be sampled from the main sample (i.e. 30 schools). The case study schools will be purposively chosen in relation to 2 school characteristics of: (i) the phone/media policy type and duration to ensure a balance of restrictive (n=3) vs permissive policies (n=3), and a range length of policy implementation in the 6 case study schools,; (ii) SES, measured by the school postcode and to include in each school category a school from low, medium and high area of deprivation, measured by the Income Deprivation Affecting Children Index (IDACI) – this has the aim of ensuring representativeness.

7.2 Recruitment

Schools will be recruited from 64 local authorities within a 100 mile radius of the University of Birmingham across the West Midlands, East Midlands, South East, East, South West, East and North West. Headteachers will be invited by email with a telephone follow-up. In participating schools, a liaison staff member will be identified and an agreement will be signed outlining expected commitments from the university and the school.

Pupils and teachers will be recruited from classes in year 8 (age 12-13) and year 10 (age 14-15) that have been identified by the liaison member of staff. In the case study schools, the liaison member will further support pupil and school staff recruitment. Parent/carer recruitment will be also supported by the liaison member, butif chosen by the liaison member, researchers will recruit parents/carers.

7.2.1 Payment

To facilitate engagement in the study £600 will be allocated to each participating school, and £5 voucher per pupil participant, with an additional £300 allocated per case study school.

7.3 Consent

For school pupils eligible to participate in the study, parents will be given written detailed information about the study, what their child's participation would involve and how their child's data will be processed. Schools will be asked to assist in the distribution of this information to parents in different formats (e.g. email, post, text messages, website etc.). Parents will not be asked for active consent, but will be given the opportunity to complete and return a form to opt their child out of taking part in the study. Prior to data collection pupils will also receive detailed study information, including what we are requesting of them and how their data will be processed. Assent will be obtained from pupils whose parents have not opted them out of participating, where pupils will be asked to complete an online assent form or provide written assent. Adult participants will be given detailed written information about the study, what their participation would involve and how their data will be processed. They will be asked to complete an online consent form or provide written consent.

7.4 Data Collection Methods

7.4.1 All Schools Data

The methods of data capture have been refined through our PPI activities with pupils and teachers. Data will be collected over a 7-day period from the following sources in all participating schools (n=30). Between 4-8 weeks later a follow up measure of mental wellbeing will be collected from pupils using WEMWBS.

7.4.1.1. Pupil Online Survey

Adolescents will complete an online survey at one time point that includes the validated measures for mental wellbeing, anxiety and depressive symptoms, addictive use, motives for social media use, health-related quality of life and demographic variables (e.g. age, gender). Within the survey, pupils will also be asked to self-report data on physical activity, sleep and data generated from their iOS or Android apps on the time they have spent on phones and specific social media apps (see Table 1). No researcher will have any direct access to any participant's mobile phone data. The survey will be completed using a university online approved software (REDCap) and on university encrypted tablets, using a portable wifi hub owned by the research team (e.g. MiFi). Based on our previous experience, tablets and portable wifi are an effective strategy to enable pupils to complete surveys efficiently, in a class space that accommodates the wider school timetable and within lesson time. RA staff will be available to administer and support students completing the survey.

7.4.1.2 Teacher Online Survey

Data will be collected from the form tutor (or an equivalent teacher responsible for teaching the class) on attainment, behavior, special educational needs and free school meal eligibility of each participating pupil, and time spent related to implementing the policy (economic analysis). The online survey will contain three primary sections to collect data on: (i) the teacher's role; (ii) the school smartphone policy; and (iii) teacher assessment of pupil attainment, disruptive classroom behavior and pupil educational needs. Teachers will be sent the online survey to be completed and RA staff will be available to support teachers completing the survey. The survey will be completed using a university online approved software (REDCap).

7.4.1.3 Senior Leadership Team Survey

A member of the senior leadership team will be asked to complete an online survey related to the restrictive or permissive phone/media policy (see section 3.4.1) that will include open and closed (binary and likert scale) questions on: (i) the senior leadership team member's role; (ii) the school timetable and school policies; (iii) the school smartphone policy (e.g. the rules/key features; time period of implementation; policy communication and understanding, adherence, and fidelity; and the policy rationale); (iv) management of the school smartphone policy (e.g. perceived time spent by school staff designing and implementing the policy); (v) knowledge and understanding of the school smartphone policy and (vi) compliance with the school smartphone policy (e.g. sanctions and adherence). One member of the senior leadership team will be sent the online survey to be completed and RA staff will be available to support the completion of the survey. The survey will be completed using a university online approved software (REDCap).

7.4.1.4 Accelerometers

Pupils will wear a GENEActiv accelerometer for 7 days. These devices will be used to measure physical activity (total physical activity levels and time spent in MVPA) and sleep (Sleep duration, time

pupils fell asleep, sleep efficacy [% of time in bed asleep vs awake] collected from accelerometers over 7 days). The devices will be given to the pupils by RA staff and who will provide an explanation for their wearables over the 7 days.

7.4.1.5 Document and Website Analysis

School policy documents and handbooks, and website documents that relate to the school policy on phones/media, the school behavior policy, the school mental health/wellbeing policy (or strategies), the school e-safety policy and the wider school aims and ethos with be collected. Documents related to the school timetable will also be collected so that time spent in physical education, and time allocated for breaks and lunch can be quantified for each school. The RA staff will work with the School Liaison Member of Staff to identify relevant documents and information to be obtained from the website and/or school administrative team.

7.4.1.6 Pupil Online Survey – Primary Outcome Follow Up Assessment

4-8 weeks post the initial data collection pupils will complete an online survey measuring mental wellbeing. The class teacher will be sent the email link for pupils to complete during class time, and pupils will complete the survey under the supervision of the class teacher. The survey will be completed using a university online approved software (REDCap).

7.4.2 Case Study Schools

Across the case study schools around 36 focus group interviews will be completed in total with adolescents (n=12), school staff (n=12) and parents/carers (n=12). Data collection will take place in the 2 weeks following the school level data collection (i.e. surveys, accelerometers and document/website analysis). In each case study school a total of 6 focus groups will be completed: adolescents (n=2), school staff (n=2) and parents/carers (n=2). Each focus group will comprise 4-6 members and will aim to balance gender, ethnicity and socio-economic status (where possible). For adolescents 1 focus group will be completed with year 8 (age 12-13) and 1 with year 10 (age 14-15) pupils, and in each group pupils will be from the same class. School staff will include a member of the Senior Leadership team who has overarching responsibility of the phone/media use policy, school governors, teachers and support staff (admin, caretakers, teaching assistants), to obtain a range of perspectives. Parents/carers will be recruited to focus groups with the assistance of the school and will include parents/carers of pupils in year 8 (age 12-13) and year 10 (age 14-15).

Focus groups will be led by RA staff and will take place in the school for pupil focus group interviews, and either in the school or online through an approved teleconferencing software platform (such as zoom) for parents/carers and school staff. Established participatory and semi-structured interview techniques will be used. For example, the school motto, a letter home to parents, or national statistics on phone/media use will be used as prompts to develop discussions in each of the focus groups. Each focus group will last approximately 60 minutes. Data will be collected from voice transcription

7.5 Withdrawal criteria

This study is a natural experiment, and therefore any risk or harm to participants is not expected as a direct result of the research intervention. Participants will have the right to withdraw from the study. If the participant withdraws within 4 weeks of the last point of data collection, they can request for their data to be deleted. The exception to this is data provided through focus group discussions. If a participant withdraws after participating in a focus group discussion, their data will remain in the study and be included in the analyses as it is not possible to separate and remove individual participant data from a focus group discussion. These procedures will be outlined to participants in the information packs, and as part of the informed consent process.

8 DATA ANALYSIS

8.1 Sample size calculation

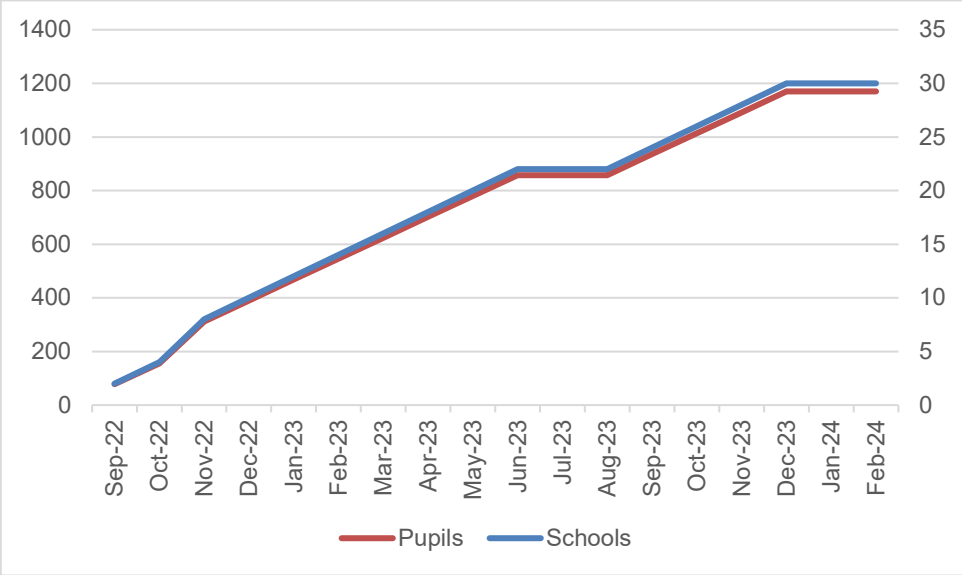
In June 2022, data from secondary school website analysis in the West Midlands (n=403) identified that 13% of schools have a permissive policy (n=53) vs 87% of schools with a restrictive policy (n=450). To account for the imbalance of schools across the two policy groups, we will recruit schools in the restrictive vs. permissive mobile phone policy groups with a 2:1 ratio. The primary outcome of mental wellbeing will be measured using the Warwick-Edinburgh Mental Well-Being Scale (WEMWBS; score range =14-70). [59] To detect a mean difference in score of 3 points (considered the minimum clinically important difference [59] between the two school groups, assuming a SD of 6.8 [61] and an ICC of 0.1 (a conservative estimate [62]), with 90% power and 5% significance, we require 20 schools in the restrictive and 10 schools in the permissive mobile phone policy groups, with an average cluster size of 39 (1170 participants in total; 780 in the restrictive, and 390 in the permissive policy groups). One class from each year group (8 and 10) will be sampled in each school, with the aim of recruiting a minimum of 19-20 pupils in each class (67% if class size=30). In studies with multiple layers of clustering (here classes within schools) it is conservative to treat clusters within clusters as one larger cluster, which is the approach used here. [63]

At a reduced level of power, at 80%, and holding all other assumptions in the calculation, we would be able to detect a difference of less than 2.6 units in the primary outcome between groups. We have used a conservative estimate of ICC at 0.1 in the sample size calculation, if this were actually 0.05 we would have 90% power to detect a difference less than 2.4 units between groups with the same number and size of clusters.

8.2 Planned recruitment rate

We expect to recruit a minimum of 2 schools and 78 pupils per month over the 18 month period of data collection (excluding school holiday periods e.g. July-August). Figure 2 illustrates the planned accrued recruitment of schools and pupils. The applicant team have a track record of working with schools in similar studies that will facilitate engagement and mitigate drop out. Based on this experience, our estimated recruitment rate is 10%.

Figure 2. Planned Accrued Recruitment of Schools and Pupils



8.3 Analysis plan

Data analysis will be informed by the theoretical models, and will use established quantitative and qualitative techniques.

8.3.1. Quantitative Data

We will use descriptive analyses to explain the school level data detailing the nature of the phone use policy, and we will summarise the individual level data (individual factors and context factors), across each type of school policy. Basic data summaries (means and standard deviations, frequencies and percentages etc.) will be used to describe participants and practices. We will undertake exploratory analysis to assess whether different forms of policy implementation (key features/rules), school factors (e.g. admin/time) and the school environment (e.g. the type of school ethos – behavior, attainment, lifestyle) relate to the adoption of either permissive or restrictive phone/media use policies, and/or mental wellbeing.

The primary analysis will examine the association between pupil mental wellbeing (primary outcome) and school policy (exposure). Multilevel linear models will be developed, accounting for repeated measures, clustering of classes and schools and adjusting for the school propensity score and relevant sociodemographic variables. This analysis will be repeated with additional adjustment for intermediate effects directed by our logic model. Secondary analyses will use the same modelling approach as for the primary analyses investigating differences in the secondary outcomes between school policy groups. This analysis will be repeated with adjustment for intermediate effects. Differential association between school policy and the primary and secondary outcomes will also be explored across: i) socioeconomic position; ii) gender; and iii) ethnicity by including relevant interaction terms in the developed models, thus providing a subgroup analysis of the association between school policy and the study outcomes by these factors.

8.3.2. Qualitative Data

All schools data (n=30)

Analysis will be framed by RQ2 and focused on policy development, policy content and policy implementation. Data will be generated from school policies (Mobile phone policy; Mental health policy; Behaviour policy; E-Safety policy and other relevant policies), school website analysis, and the

Senior Leadership Team survey. Informed by policy analysis approaches [72-76] that data will be analysed using a descriptive approach, including a narrative synthesis. This will provide a descriptive overview on *policy content, how* the policies were developed and *how* the policies are implemented. We plan to adopt a comparative approach to examine the data generated from restrictive and permissive schools.

Case Study Schools (n=6)

Analysis will be framed by RQ2 and RQ3, and informed by our logic model. A collective case [77] approach will be adopted, where data generated from each of the 3 permissive case study schools and each of the 3 restrictive schools will be combined into a single permissive and restrictive case. This collective approach will provide the means for comparative analysis between permissive and restrictive schools. A deductive thematic analysis approach [78] will be applied to analyse FG data. Analytical questions will be developed to explore intersections between: (i) adolescents' understandings of the relationships between school policy, phone/media use and mental wellbeing (RQ3) and; (ii) the individual, school-based and family/home factors that influence policy implementation, phone/media use and mental wellbeing (RQ2). The first step involves organising the data set, where the transcripts for the focus groups will be categorised according to population i.e. adolescents (n=12), school staff (n=12) and parents (n=12). Each category will be then be analysed separately. The thematic approach will follow six steps: (i) familiarisation; (ii) coding; (iii) theme searching; (iv) reviewing themes; (v) defining and naming themes; (vi) reporting/explanation. [78].

In the mixed methods explanatory approach, data extraction and coding will be informed by the *quantitative* data generated. For example, if indicated by the quantitative data, the qualitative data sets will be trawled for explanations for adolescents' high mental wellbeing in relation to lower phone/media use in schools with restrictive policies. That data will then be coded inductively to identify common explanations across the focus groups, as well as points of difference.

8.3.3 Health Economic Evaluation

We will conduct a cost-consequence analysis in view of the multiple outcomes of interest, complex nature of school budgets, and emergent nature of economic evaluation of school-based interventions. This approach has been used before for school-based interventions. [79,80] On the cost side we will include (i) time use in schools related to managing the policy; (ii) indirect time use from managing related behavioral problems; (iii) other related costs. On the outcome side we will include pupil's mental wellbeing (WEMWBS), anxiety (GAD-7), depression (PHQ-9), and attainment (% working at expected grade in English and Maths). We will also undertake an exploratory cost-utility analysis from the payer (school) perspective. This will compare the incremental education costs and incremental QALYs associated with restricting daytime smartphone use. QALYs will be estimated from: (a) CHU9D and (b) pupil mental wellbeing (WEMWBS) data, using the forthcoming University of Warwick valuation algorithm.

9 DATA MANAGEMENT

New data will be collected in the following formats:

- Numerical and text-based data from online, paper-based surveys and email (study email address), including informed consent
- Numerical and text-based data from websites, school handbooks, email and school-home communications

- Numerical data from accelerometers
- Audio recordings, transcripts and notes during focus groups

Quality assurance of the data will be the responsibility of the CI's and will be monitored by the DMEC. Direct access to data will be granted to authorised representatives from the Sponsor, host institution and the DMEC – in-line with participant consent. Data will be stored using the University of Birmingham Research Data Store (RDS). Only the study research staff, CI's and Co-Investigators will have access to the this data on the server. Upon completion of this study and publication of results, all datasets and outputs will be stored (in an anonymized format) and retained for 10 years at the University's Open Access Research Data Archive (RDA). The University of Birmingham will hold the IP for new data generated from this project. A full copy of the Data Management Plan is available on request.

10 MONITORING, AUDIT & INSPECTION

The following procedures have been identified for this study:

- A Study Monitoring Plan will be developed and agreed by the SMG, SSC, DMEC and CI's based on the study risk assessment.
- The DMEC will be responsible for monitoring data and ethical issues. The DMEC will meet annually and be sent reports prior to meetings by the CI's.
- 6 monthly progress reports will be sent to the SMG and SSC, and the SSC will meet bi-annually

11 ETHICAL AND REGULATORY CONSIDERATIONS

11.1 Research Ethics Committee (REC) review & reports

Ethical approval has been granted by the University of Birmingham's Science Technology, Engineering and Mathematics Research Ethics Committee (REC) for the study protocol, informed consent and other relevant documentation e.g. recruitment processes, information packs (ERN_22-0723). Substantial amendments that require review by the REC will not be implemented until the REC grants a favourable opinion. All correspondence with the REC will be retained in the study master file.

11.2 Assessment and Management of Risk

The risk to participants in this study is very low. There is a small possibility that the collecting of data related to physical and mental health may be a sensitive issue for some participating pupils. All participants (adults and school pupils) have the right to withdraw from the study at any time. If during the collection of data, or during focus group discussions, a school pupil participant becomes distressed, the researcher will seek agreement from the pupil to inform a member of staff at the school who can engage the student with the relevant welfare systems in place within the school. If a researcher becomes aware of a safeguarding issue in relation to a pupil, they will immediately inform the relevant member of staff within the participating school so that the school safeguarding procedures can be followed.

11.3 Peer review

The funding application, including the detailed study plan, has undergone independent, expert and proportionate peer review in line with NIHR research funding guidelines. Following submission of the funding application at stage 1 we received feedback from the Funding Board. Following submission of the funding application at stage 2 we received feedback from 5 independent peer reviewers and

further feedback from the Board. The study team responded to the feedback in detail, incorporating changes where required.

11.4 Public and Patient Involvement

The public involvement for this project has 3 components: (a) prior research on young people, digital technologies and health and associated policy and public engagement activities; (b) public involvement in the construction of this project; and (c) planned public involvement for the project.

11.3.1 Prior research and policy and public engagement

We consulted with adolescents, teachers and practitioners/professionals in health during workshops, funded by University of Birmingham Public Engagement fund, the Institute for Advanced Studies and ESRC Impact Fund. During workshops we shared findings from our prior research on young people, social media health [81], and asked participants to identify future research priorities and objectives. These activities directly led into this proposal. For example, in it was identified that school based interventions focused on policies for phone/media use had the potential to be an effective mental wellbeing intervention. In a workshop with adolescents, they identified that teachers could help them to manage their uses of phones/media, and that this could benefit their mental wellbeing. Thus this proposal has been constructed based on prior research and engagement activities with adolescents and key stakeholders.

In relation to policy, Co-PI-VG was invited to participate and provide evidence in an expert panel convened by Department for Health and Social Care (DHSC) and ESRC in 2019, that is directly cited as underpinning this NIHR commissioned call. Furthermore, Co-PI-VG has been an invited panel member for several policy hearings (e.g. Science and Technology Committee, Chief Medical Officer, APPG Social Media and Mental Health) on screens, health and mental wellbeing, of which the subsequent policy reports (e.g. House of Commons – Impact of social media and screen-use on young people's health, 2019) have cited the importance of generating further evidence on school phone/media policies to inform future mental wellbeing interventions. These engagements with policy have had a direct impact on the design and conduct of the proposed project.

11.3.2 Public involvement in the construction of the project

To prepare this application we received funding from the University of Birmingham public engagement fund (£2400) to engage with schools/teachers and adolescents on the design and conduct of the proposed work. Overall, we engaged with 71 participants through an online survey to teachers (n=40) and 5 focus group consultations (2 teacher groups (n=11; f=8, m=3]; 3 student groups [n=20, f=8, m=12; avg. age 14]). These activities helped to refine research questions, primary and secondary outcomes and determine the feasibility of methods.

The online survey with teachers helped to refine the intervention focus and the primary and secondary outcomes. For example, the survey provided initial evidence on the 2 types of school phone/media use policies (i.e. restrictive day time use and permissive day time use) and why schools had chosen to adopt the policy (e.g. mental wellbeing and behavior).

The focus group consultations provided further evidence on the primary and secondary outcomes, helping to refine the logic model. Focus groups with teachers confirmed the importance of developing effective interventions to support pupil phone/media use and mental wellbeing. Parents were reported as an issue in relation to pupil compliance with the school policy, such as, contacting their child during the school day via WhatsApp. Focus groups with pupils identified variation in pupils relationships with their phones and impacts on mental wellbeing. Teachers and pupils reported that since school phone/media policies had been introduced they had observed improvements to mental wellbeing.

The consultations also informed data collection methods:

- Feasibility of collecting self-report data from iOS and Android phones on time spent on phones/media
- Teachers and pupils rejected the initial idea to collect data from pupils via a watch
- The need to measure anxiety, attainment and behavior, as these relate to phone/media use

As previously stated (section 3d), document analysis was completed of school policies on phone/media use in the West Midlands. This analysis confirmed 292 schools in the West Midlands with school policies, and established that special schools were not to be included in the sampling.

11.3.3 Planned public involvement in the project

Approach

The approach to PPI has been constructed based on INVOLVE guidelines. We will work with 2 groups: (1) **adolescents** (from secondary schools); and (2) **adults** (from schools/teachers, parents/families, local/national health organizations and policy), because these groups are directly impacted by the research, and are representative of key stakeholders who would act on the findings.

Management

We have 1 PPI Lead and a PPI Co-applicant: MW-PPI-Lead (Head of Research, ukactive) and GE-PPI-Co-Applicant (Teacher/Senior Leadership Team, Ninestiles Academy Trust). GE will work with adolescents from secondary schools. MW will work with the adult group. We are aware that combining adolescent and adult engagement activities can be uncomfortable for both parties, the groups will benefits from different types of engagement activities, and the coordination of the 2 groups is often problematic. Hence the need to work with these groups separately.

MW and GE have the necessary skills and networks to reach, engage and involve the respective groups. MW will recruit an advisory group of 10 teachers, parents, and representatives from local/national health organizations and policy, from ukactive's established Children and Families network, that includes over 4000 professional organizations. GE will form an advisory group of 10 adolescents from 1 school in Birmingham, that his school is part of.

Activities

There will be 4 meetings per group that will take place online. The activities for each meeting will focus on:

1. **Designing and Managing (2 months**): study procedures (including recruitment, inclusivity and diversity), data collection methods (e.g. evaluation of interview topic guides), and development of PPI advisory group aims.
2. **Undertaking the Research (8 months, 16 month):** analyzing and interpreting the results of the research, helping to identify key themes, or areas of importance to young people and relevant adults
3. **Disseminating (25 month):** co-producing dissemination activities, and identifying pathways to impact, including co-designing videos, infographic and guidelines and identifying key stakeholder groups to engage with

Support

MW and GE are costed as Co-applicants, and will be provided with an induction/training session by the University of Birmingham Public Engagement Team (1 month). Members of the adolescent and

adult advisory groups will receive vouchers for engagement.

Evaluation and Impact

MW will lead the overall evaluation and impact of PPI activities. MW and GE are both members of the study management group (SMG) that will meet quarterly. The results and conclusions from each PPI group meeting will be reported to the SMG using GRIPP2 checklist for reporting PPI in research. To record the process and impact of the PPI, we will also keep an impact log to record impact activities and we will monitor whether any revisions to the groups engaged with and activities are required.

11.4 Protocol compliance

Accidental protocol deviations will documented and reported to the CI and Sponsor. Protocol non-compliance will be reported without delay by research staff to the CI, who will inform the Sponsor. The CI will ensure that the issue is investigated and appropriate actions taken. The Research Ethics Committee will be notified of any serious breach of its approval conditions, security, confidentiality, or any other incident that could undermine public confidence in the research.

11.5 Data protection and patient confidentiality

All investigators and study staff will comply with the requirements of the Data Protection Act 2018 with regards to the collection, storage, processing and disclosure of personal information and will uphold the Act's core principles.

Online survey data submitted will be held on a database on a secure local server located at the University of Birmingham. Participants data from online surveys and other sources (e.g. focus group transcripts) will be pseudo-anonymised (i.e. an assigned ID code or number will be used instead of the participant's name and a key will kept allowing the researcher to identify a participant's data) and stored within the University of Birmingham Research Data Store (RDS). We will keep separate encrypted and password protected files containing the contact details of participants and assigned ID code or number. Audio files will be transcribed by a specialist external company subject to a Confidentiality Agreement to not disclose any information to third parties

In line with the Data Protection Act 2018, all personal information collected during this project will be treated as confidential. All data will be identified using the ID number/code participants are allocated. Only the investigators listed on this study, the research staff employed to work on this study and any third parties authorised by the sponsor for monitoring purposes will have access to the data.

All data will be kept for a period of 10 years or 10 years post publication if the data are published during this 10 year period (whichever is longest), using the University of Birmingham archiving service. No confidential information or potentially personally identifying information will be included in any publications of the findings of this study.

The data custodian is the Pro-Vice-Chancellor for Research and Knowledge Transfer, who is the owner of the RDS policy.

11.8 Indemnity

The University of Birmingham, as the Sponsor, has in force a Public Liability Policy which provides cover for claims for "negligent harm." The activities of this study are included in the coverage. No provision has been made for indemnity in the event of a claim for non-negligent harm.

11.9 Amendments

Amendments to the study protocol will be submitted to the Sponsor, the Funder and the Research Ethics Committee for review. Amendments will only be implemented when agreement from these

parties has been gained. The amendment history will be tracked using version numbers and dates to identify the most recent protocol version.

11.10 Access to the final study dataset

After publication of the main findings of the study, the Chief Investigators will consider external requests to gain access to fully anonymised data. The dataset will be preserved and available for this purpose for a minimum of 10 years following the end of the study. Those requesting data will be asked to provide a brief research proposal including the objectives, timelines, intellectual property rights, and expected outputs, and a Data Sharing Agreement between the University of Birmingham and the requestor will be drawn up. Requestors will be required to acknowledge the research team and funders as a minimum and consider co-authorship of any publications arising from the data. Permission for anonymised data to be shared for the purpose of future academic research will be sought from all participants via the informed consent form.

12 DISSEMINIATION POLICY

12.1 Dissemination policy

The data from the study is owned by the University of Birmingham. On completion of the study, the data will be analysed and a final report prepared. The full study report will be available on the university website. Publication of the study data will be overseen by the SMG. The funder will be acknowledged within publications. Participating schools will receive a newsletter after the final report has been published summarising the main results of the study.

12.2 Dissemination Plan

Dissemination activities will be co-produced with our PPI participants. To maximize the potential for reach and impact with relevant groups, Co-I-SF (UoB) and Co-I-MW (ukactive, national organization) will work in partnership to co-ordinate dissemination activities, with the support of Co-I-PP (health/NHS) and Co-I-KJ (education/local authorities). Co-I-SF with advise from Co-I-MM (who works with diverse mental health groups/charities (e.g. Young Minds, NSPCC)) will work with the University of Birmingham Public Affairs and Communications Team to engage with policy and national agencies. Co-I-MW and ukactive are a key dissemination partner, and will further engagement with policy and national organizations. ukactive have an extensive membership base of national health, wellbeing, and school organizations and have relevant contacts in policy, as they frequently engage with policy makers on an ongoing basis on issues related to this proposal. Co-I-PP will further support clinical/mental health dissemination; he works within the NHS, and is a collaborator on the NIHR ARC West Midlands youth mental health program, that involves creating a network of schools and training school staff on issues related to mental health. Co-I-KJ works with local education authorities to offer guidance, resources and training to schools/teachers and will support engagement with local authorities and schools.

To ensure the outputs reach the right people and have impact, we will raise awareness of the study through ongoing communication with relevant stakeholders throughout its duration. Building on our experience of working with relevant policy groups (e.g. Science and Technology Committee), All-Party Parliamentary Groups (APPG e.g. Social Media and Mental Health), Ministers (e.g. Education Minister), national agencies (e.g. Directors/President, Public Health, National Headteachers Association), and local authorities, we will engage with these groups and disseminate findings through 1-page briefing summaries in year 3. Throughout the study we will also respond to relevant opportunities that arise, such as parliamentary calls for evidence, relevant POST-notes, and opportunities to present at panels/hearings, webinars and conferences.

To further raise awareness of the study we will provide bi-annual updates through our websites (e.g.

UoB research group – opencpd.net and ukactive main website), including blogs and podcasts. Social media will be used to share project information and findings, tagging relevant accounts and influencers to ensure widest possible reach. We will also work with the University of Birmingham Public Affairs and Communications team to communicate study findings to the wider public via the press. At the end of the study we will host a free impact dissemination event to communicate the main outcomes and outputs. Guests will include individuals from policy, national organizations, schools, parents, and academics, that we have engaged with during the study. The event will be recorded and relevant materials shared to maximize accessibility.

12.3 Anticipated Outputs

At the end of the study we will produce the following planned outputs:

1. **Policy Briefings and Research Summaries for agencies**: targeted at relevant policy select committees (e.g. Science and Technology Committee), specific MPs (e.g. Education Minister) and national health agencies (e.g. Public Health England) on the impact of school phone/media policy on adolescent mental wellbeing

2. **Guidelines and Resources for Schools**: targeted at national education agencies (e.g. National Association for Headteachers) and school senior leadership teams on the characteristics of school phone/media policy implementation that positively influence mental wellbeing.

3. **Blogs, Podcasts, Videos and Infographics:** targeted at adolescents, parents and the wider public, to raise awareness and understanding of the relationship between phone/media use and mental wellbeing

4. **NHR PHR Report**: that summarizes the main project findings

5. **Open Access Publications and Conference Presentations:** targeted at academic audiences and that focus on:

    a. The impact of school phone/media policy on adolescent mental wellbeing:
        i. Conference: International Association for Youth Mental Health
        ii. Article: British Medical Journal
    b. The characteristics of school phone/media policy implementation related to mental wellbeing
        i. Conference: British Education Research Association Conference,
        ii. Article: British Educational Research Journal
    c. The individual, school-based and family/home factors that influence relationships between school policies, phone/media use, and mental wellbeing
        i. Article: BMC Public Health Journal.

These outputs will be accessible to all participating schools in the research. To enhance accessibility and use of the outputs we will write a letter and bespoke blog for participating schools identifying relevant outputs, and resources that they might find useful to use.

12.4 Anticipated Impact

The UK government and leading regulatory bodies (RCP, RCPCH, CMO) recently requested

evidence-based guidance for phone/media use in schools and in relation to mental wellbeing. This project addresses these gaps in current evidence and policy and will provide evidence-based recommendations for how schools can support and enrich adolescents uses of phones/media and mental wellbeing. We anticipate the following impacts:

- **Short-term impacts:** the findings will inform adaptations to existing school policies in relation to phone/media use in school time. These will occur at the local level, whereby schools and local authorities will use the research findings to design school phone/media policies that can positively impact mental wellbeing.
- **Medium-term impacts**: the findings will spur changes to professional standards and best practices by the creation of new guidelines, professional training programs (teachers and parents) and school environment and curriculum interventions. These later changes will occur at an organizational level, and through national organizations, trusts and agencies (e.g. Public Health England), and with/by academics who utilize the project findings.
- **Longer-term impacts**: the findings will stimulate and inform policy change in relation to national guidance (and potentially legislation) on school phone/media use policies and mental wellbeing. These changes will occur at a national level, impacting on most UK schools, and adolescents.

Together these impacts will ultimately influence adolescent mental wellbeing, and associated outcomes of anxiety and depression, sleep, physical activity, classroom behaviour, attainment and addictive use.

12.5 Authorship eligibility guidelines and any intended use of professional writers

Authorship will be granted to the study investigators and research staff following the guidelines of the International Committee of Medical Journal Editors.

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14. APPENDIX

14.1 Protocol Amendment History

Protocol version	Date	Changes
Detailed project plan	Submitted 30.03.21	N/A
Version 1	01/03/22	1. Primary Outcome (mental wellbeing WEMWBS) second measurement changed from 2 month period between data collection point 1 to 4-8 weeks. This change has been made to provide sufficient flexibility to collect data from 30 schools over 18 months, while providing an increased level of precision 2. Sleep Measurements have been changed from circadian rhythm – sleep/wake patterns/duration to Bed time, rise time, total time in bed and sleep efficiency [% of time in bed asleep vs awake] collected from accelerometers. This change has been made to further specify the sleep outcomes to be used in the analyses.
Version 2	18/07/222	1. Updated Research References numbers to include registration ID's for ISRCTN and CRN (page ii), and the Research Ethics Committee Ethical Approval Number. 2. Changed the adolescent population from year 7 (age 11-12) and 10 pupils (age 14-15) to year 8 (age 12-13) and year 10 pupils (age 14-15). This change has been made in relation to the timing of data collection, and it being unlikely that pupils in year 7 would have had enough exposure to their school's phone policy for it be influential on the primary and secondary outcomes. By focusing on year 8 and 10 pupils we will still be able to capture: (a) the different key stages (Key Stage 3 and Key Stage 4) of pupils in schools, (b) the 2

		different periods of adolescence (early and late adolescence), as outlined in V1. This change was approved by SSC and DMEC. 3. Modifications have been made to the data collection measures and these include: a) Economic variables have been updated to include data collection on time use costs from all schools and from teacher and senior leadership team surveys, rather than just case study schools and the teacher survey. These changes have been made to provide sufficient data to answer the research questions. This approach was approved by SSC. b) To provide contextual detail on pupils' physical activity behaviours related to logic model and theory (e.g. displacement), self-reported data has been included in the pupil survey to capture travel and engagement with clubs related to physical activity. c) The measure of attainment has been changed from a measure of adapted progress 8 scores in English and Maths to an assessment of whether pupils are below, above or working at their target grade in English and Maths. This change has been made to reflect data that can be captured on individual pupils across all school types, and was informed by discussions within PPI groups and SSC. d) The measures of smartphone use duration and social media use duration have been updated from capturing data over 7 days to capturing data on a weekend day. This change has been made to reflect the data that can be generated from both iOS and Android apps. A measure of duration over 7 days can be estimated from data reporting on duration over a 24 hour period and the weekend day measure. e) Additional questions have been added to the pupil and teacher surveys to capture policy implementation, and to provide a more holistic account of policy implementation. This change was informed by our PPI activities. f) We have added pupil demographic questions to the teacher survey to capture data on pupil eligibility for free school meals (as a measure of socio-economic position), English as an additional language and Special Educational Needs. g) We have now included a preference-based quality of life measure in our planned data collection with school pupils (the Child Health Utility-9D). This will facilitate the construction of Quality-Adjusted Life Years (QALYs) and enable a cost-utility analysis. h) The SLT survey has been refined to capture further school level data on policy implementation (e.g. school policies, school timetable, and phone policy adherence and compliance) to inform descriptive and qualitative analysis, and this was

		informed by recommendations made by DMEC, SSC and PPI activities. i) The document and website analysis has been refined to specify the policies to be collected (behaviour, mental health/wellbeing, e-safety) and documents related to the school timetable, to inform descriptive and qualitative analysis, and this was informed by recommendations made by DMEC, SSC and PPI activities (similar to amendment 20). We have clarified that if this information cannot be obtained from the senior leadership team survey, the research team will work with the school liaison member of staff to obtain the relevant documents. 4. We have provided additional detail in our study design on how we plan to classify variations in school phone policies as either permissive (control) or restrictive (intervention), that has been informed by our PPI activities and school phone policy analysis by the Department for Education. 5. Following discussions with the SSC, it has been agreed that we will expand the sampling frame to include an additional 11 Local Authorities selected from the East Midlands, South East and South West (Derby, Leicester. Leicestershire, Nottingham City, West Northamptonshire, North Northamptonshire, Gloucester, Bristol, Rutland, Milton Keynes), to increase the pool of schools that have a permissive policy from which we can recruit from. 6. The inclusion criteria 6.1 has been expanded to include the following: a) Secondary schools from the East Midlands, South East and South West, to reflect amendment 5 b) School staff, as opposed to just teachers, to reflect the wider range of participants sampled for interviews in the case study schools, and this was a recommendation of the SSC. 7. The exclusion criteria 6.2 has been expanded to include the following: a) Pupil Referral units, for the same justification as special schools (p.12) b) Secondary schools where data on the school characteristics (e.g. admissions policy, total pupil roll size) that is required for the propensity score calculations (see 7.1.1) could not be accessed c) Secondary schools that have a different phone policy for year 8 and year 10 pupils (i.e. permissive vs restrictive), because we would be unable to clearly classify these schools into one of our two identified school groups d) Secondary schools that do not have both year 8 and year 10 classes (e.g. newly established schools)

		8. The method of distributing information to parents/carers as part of the opt out consent process has been expanded to include text messages, and this change was informed by our PPI activities. 9. The method of obtaining assent and consent has been expanded to include both online and written assent/consent, to reflect the study data collection procedures (e.g. the inclusion of assent at the beginning of the online pupil survey). 10. Following discussions with the SMG and SSC, it has been agreed to modify the sample size. Instead of balanced cluster sizes (15vs15schools) we will adopt an imbalanced sample size approach of 10 schools with permissive policies and 20 schools with restrictive policies. This change reflects the imbalance of schools across the two policy groups (e.g. 13% permissive vs 87% restrictive in West Midlands). To detect a mean difference in WEMWBS score of 3 points, with 90% power and 5% significance (and keeping other parameters the same as the original sample size calculation), we require 20 schools in the restrictive and 10 schools in the permissive mobile phone policy groups, with an average cluster size of 39 (1170 participants in total; 780 in the restrictive, and 390 in the permissive policy groups). To achieve this, we aim to recruit 19-20 pupils in each class (67% if class size 30). We consider this is achievable as we now have approval from our Research Ethics Committee to proceed with parental opt-out consent. a) To adjust for the increase in pupil participants, the payment to pupil participants had been reduced from £10 to £5. Our PPI activities identified that pupils are satisfied with a voucher of a lower value. b) To adjust for the increased sample size, regarding the recruitment of schools, we have updated the planned recruitment rate (8.2, and Figure 2) to reflect the increase in cluster and participant size. 11. The Data Management (DMP) has been updated to include data collection in the format of emails (e.g. email of school timetable sent to study email address). The DMP has now been approved by the University of Birmingham governance team, and is available on request. 12. Following discussions with the SMG, The PPI group for youth has been refined to 1 school rather than 3, to facilitate pupil attendance
Version 3	30/09/22	1. We have updated the exclusion criteria to exclude independent schools from the sample, because in these schools it is expected that there would be additional influences on adolescent mental wellbeing and smartphone and social media use that would affect comparisons of the 2 school policies (i.e. restrictive vs permissive). Our website analysis identified that a number of independent schools: included boarding for all or some pupils; have different government funding and curriculum

		arrangements; and many independent schools have different phone policies for year 8 and year 10 pupils, and additional phone policies for boarding pupils. This change was approved by SSC. 2. We have further increased the sampling frame to include all local authorities within a 100 mile radius from the University of Birmingham. Despite expanding the sampling frame in July 2022 to an additional 11 local authorities, there were fewer than anticipated schools with permissive phone policies. This change will increase the pool of permissive schools that we can recruit from and accommodate the reduced number of schools due to the exclusion of independent schools (amendment 1). The sample includes 1345 secondary schools from 64 local authorities across the West Midlands, South East, South West, East, and North West. The average income deprivation rank across the included local authorities is 141 and the % BME is 12%, when compared to the planned sample of the West Midlands where the average income deprivation is 124, with 14% BME. This change was approved by SSC.
Version 4	18/10/22	1. We have decided to change from 8 propensity groups (quartiles) to 6 propensity groups (terciles). This change has been made to increase the number of schools within the permissive school groups to aid recruitment and comparability of the 2 policies. This change was approved by SSC. 2. We have changed the variable of local authority to region in the school characteristic variables used for the propensity score calculation. Due to the expanded sampling frame, there were 64 local authorities and to improve the comparability across the six propensity groups adjusting to 6 regions instead of 64 local authorities was more appropriate. The six regions include: South East, South West, East, West Midlands, East Midlands, North East.
Verasion 5	27/01	1. Based on version 3, and the increased sampling frame, East has now been added to the protocol. 2. Based on guidance from SF, BM and exploring the GENEActiv software, we have updated the outcome measures for sleep quality which now include sleep duration, time pupils fell asleep, sleep efficacy [% of time asleep vs % time in bed] collected from accelerometers (which records sleep onset, rise time, total elapsed bed time, total sleep time, total wake time, sleep efficacy). 3. Case study recruitment of parents – We have made a minor amendment to the recruitment process for parents in case study schools. This minor amendment provides a second approach for recruiting parents to support the school liaison member and further facilitate recruitment of parents. The original recruitment process for parents to be recruited by the school liaison member is still used if the school liaison member chooses. To further support the school liaison member (who is still recruiting pupils and staff) and facilitate recruitment of parents, we have made a minor amendment to this process so that researchers can also recruit parents if this would be more suitable and appropriate for the school liaison member.

		4. Based on our parent and teacher PPI feedback, we have been advised that providing the option to hold the focus groups via zoom would be more convenient and accessible for some teachers and parents. This includes adding in the option for online consent via REDCap, which will be shared via the Staff Liaison Member to parents and teachers prior to online focus groups taking place. 5. After review by the SSC, the qualitative and quantitative data analysis plans have been updated. This includes using a policy analysis approach, employing a narrative synthesis, to provide a description on policy content, how the policies were developed and how the policies are implemented. For case study schools, data will be analysed at the organisational level, in which analysis will be organised by collected cases across the 3 permissive schools and 3 restrictive schools. This will support comparative analysis between permissive and restrictive schools. At the data level, a deductive thematic analysis approach will explore intersections between: (a) adolescents understandings of relationships between school, phone/media use and mental wellbeing (RQ3) and, (b) the school-based and family/home factors that influence policy implementation and impact on phone/media use and mental wellbeing (RQ2). The changes have all been approved by the SSC committee.