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Protocol of the COVID-19 Health and Adherence Research in Scotland (CHARIS) study

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1 **Protocol of the COVID-19 Health and Adherence Research in Scotland (CHARIS) study:**
2 **Understanding changes in adherence to transmission-reducing behaviours, mental and**
3 **general health, in weekly or fortnightly representative samples of the Scottish population**
4

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31 **Abstract**

32 **Background**

33 The COVID-19 pandemic has unprecedented consequences on population health, with governments
34 worldwide issuing public health directives which have major impacts on normal living. In the absence
35 of a vaccine, a key way to control the pandemic is through behavioural change: people adhering to
36 transmission-reducing behaviours (TRBs), such as physical distancing, regular hand washing, and
37 wearing face covering, especially when physical distancing is difficult. The application of behavioural
38 science is central to understanding factors that influence adherence to TRBs. Non-adherence may be
39 explained by theories of how people think about the illness (the common-sense model of self-
40 regulation) and/or how they think about the TRBs (social cognition theory and protection motivation
41 theory). In addition, outbreaks of infectious diseases and the measures employed to curb them are
42 likely to have detrimental effects on people's mental and general health. Therefore, in representative
43 repeated surveys we will apply behavioural theories to model adherence to TRBs, explain variations
44 in adherence, and the effects on mental and general health in the Scottish population from June to
45 November 2020, following the initial outbreak of the COVID-19 pandemic.

46 **Methods**

47 Repeated 20-minute structured telephone surveys will be conducted with nationally representative
48 random samples of 500 adults from throughout Scotland. The first 6 weeks the survey will be
49 conducted weekly, thereafter fortnightly, for a total of 14 waves (total n=7000). Ipsos MORI will recruit
50 participants through random digit dialling. The core survey will measure adherence to TRBs, mental
51 and general health, and explanatory variables from the theories. Further questions will be added,
52 enabling more detailed measurement of constructs in the core survey, additional themes, and
53 questions that align with the evolving pandemic.

54 **Discussion**

55 This study will provide insights into the link between (changes in) adherence to TRBs and explanatory
56 factors, and their effects on mental and general health, including event-related changes (e.g., when
57 government directives change). Governments and other decision-makers may use these findings to
58 tailor public health promotion, target specific population groups, and develop behaviourally informed

59 interventions over the duration of the COVID-19 pandemic (along with any subsequent equivalent
60 events) to protect health and limit the spread of COVID-19.

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62 **Key words:** COVID-19, transmission-reducing behaviours, mental health, general health, behaviour
63 change, theory-based, adherence

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89 **Background**

90 In December 2019, a new coronavirus (SARS-CoV-2) emerged, leading to a pandemic of an
91 acute respiratory syndrome (COVID-19) in humans (1). The impact of the pandemic on European
92 countries has been highly variable, and the United Kingdom (UK) has one of the highest case and
93 death rates from COVID-19 in Europe (2).

94 As in previous outbreaks of infectious disease (e.g. SARS, H1N1 influenza) (3-5), stringent
95 public health measures were implemented to curtail the spread of SARS-CoV-2 (6). However, in the
96 current pandemic, social isolation measures were applied to whole populations rather than limited to
97 those who are known to have been in contact with the virus. This is an unprecedented response by
98 individual governments and the international community.

99 Until a vaccine against coronavirus or an effective treatment for COVID-19 becomes
100 available, adherence to transmission-reducing behaviours (TRBs) is crucial to protect lives and halt,
101 or at least slow, the pandemic. Therefore, understanding the factors that determine adherence to
102 TRBs is essential. While TRBs lessen both personal risk of acquiring COVID-19 and population level
103 rates of COVID-19, they may have detrimental impacts on people's health, especially their mental
104 health. TRBs require reduced social contact, and this combined along with the social isolation that
105 can follow, may contribute to the negative impact similar epidemics have had on mental health (7-9).
106 Further, the impact of the COVID-19 pandemic on mental health may vary between groups in the
107 general population due to pre-existing differences, including stresses of living in areas of high
108 deprivation with low income, less secure housing and related effects (10). Moreover, the impact of
109 COVID-19 may also be more pronounced for people with long-term conditions requiring supported
110 self-management (11), or people who are self-isolating (shielding) for instance due to older age (12).
111 Thus, our understanding of adherence to TRBs requires concomitant study of mental and general
112 health to enable the investigation of the relationship between them and the impact of the pandemic on
113 health more broadly.

114

115 **Transmission-reducing behaviours**

116 Health policy, including guidelines on TRBs, is the remit of each devolved nation within the
117 UK. The Scottish Government during the lockdown, and in Phase One after the lockdown has
118 required the population to adopt strict physical distancing (including staying at home and only going

119 out for a very few specific reasons, such food, medicine, work, or exercise and always staying at least
120 2 metres from other people), thorough hand hygiene measures and latterly recommended the wearing
121 of face coverings when shopping for food or using public transport (for the Scottish roadmap out of
122 the lockdown see (13)).

123 As COVID-19 is thought to spread via contact between individuals through respiratory
124 droplets (14), TRBs, such as physical distancing should be effective to reduce transmission. Indeed,
125 an early modelling study found that physical distancing measures can be effective in reducing the
126 progression of the coronavirus that causes COVID-19, delaying the epidemic peak, and delaying a
127 potential secondary peak (15). In addition to direct social exposure to respiratory droplets, COVID-19
128 is also thought to spread by contact with infected surfaces and subsequently touching the eyes, nose
129 or mouth (14). Since face-touching is frequent and habitual (16), prevention of transmission focusses
130 on improving hand hygiene (17). Good hand hygiene means washing your hands frequently, using
131 soap and water, and for at least 20 seconds (18, 19). Hand washing is advised every time one enters
132 a building, including entering one's home, when you blow your nose, sneeze or cough, and eat or
133 handle food (20). Hand washing has been shown to reduce the incidence of infectious diseases,
134 especially when hand washing is done correctly and at the correct times (21-23).

135 A study investigating public awareness of hand washing found that higher numbers of Google
136 searches for 'hand washing' were associated with lower spreading speed of COVID-19 in 21 countries
137 including England (24), suggested public interest in and adherence to effective hand washing
138 practices might go hand in hand. In contrast, the evidence for the effectiveness of wearing facemasks
139 or face coverings remains a topic of debate (25, 26). The WHO reiterated that there is limited
140 evidence that wearing medical masks by the public is an effective preventive measure (27, 28), but
141 have recently changed their advice to recommend non-medical masks of face coverings in settings
142 where physical distancing difficult (29). Nevertheless, wearing of a face covering (including
143 nonmedical face coverings) in places where social distancing is difficult, such as food shops and
144 public transport, has been advised worldwide, including recently at the start of Phase One after the
145 lockdown in Scotland (30).

146 It is not only necessary for the public to adopt these TRBs, it is also essential that they
147 maintain adherence to TRBs consistently over the long term, certainly until a vaccine or other
148 effective treatments for COVID-19 become available. Prem et al (15), in their study of the

149 effectiveness of physical distancing, concluded that little is known about maintenance of the
150 behaviour changes required of the population over time. Further, there are some easily identifiable
151 challenges to the maintenance of TRBs. Hand washing is a highly habitual behaviour that is
152 particularly resistant to sustained change (31), and the COVID-19 response required an increased
153 frequency and probably thoroughness of hand washing for people in the general population. Whilst
154 some have argued that the precautionary principle be applied to the recommendation to wear face
155 coverings (25, 32), others have cautioned against recommending their use without careful
156 consideration of their potential side effects (26), such as the potential to engender a false sense of
157 security in relation to other TRBs, such as physical distancing and hand washing. This could result in
158 reduced adherence to these TRBs that have demonstrated efficacy in relation to COVID-19 control
159 (32). In addition, to wear face coverings safely might necessitate adoption of additional TRBs, such as
160 not touching the masks, otherwise their use may be counterproductive (26). There is an important and
161 urgent need, therefore, to understand adherence to TRBs over time. This need is especially pressing
162 as lockdown restrictions are eased and adherence to TRBs, especially physical distancing, arguably
163 becomes more challenging.

164

165 **Theoretical approaches to human motivation and behaviour explaining TRB adherence**

166 Three types of psychological theory are particularly pertinent to the situation of a pandemic
167 and explaining how people behave when faced with an illness threat and with the requirement or
168 advice to change their behaviour. First, models of how people think about the illness are important,
169 second how people think about the recommended behaviours, and third how people think about the
170 risks.

171 The common-sense model of self-regulation (CS-SRM) is a model of how an individual
172 represents a potential illness threat, in this case COVID-19 (33), and has for example previously been
173 applied to predict psychological responses to Influenza A, H1N1 (34). The CS-SRM identifies
174 cognitive and emotional representations of illness and proposes that these representations affect the
175 behavioural response to it. Cognitive representations that CS-SRM identifies are beliefs about illness
176 identity (e.g. label, symptoms), personal consequences of the illness, timeline including duration and
177 fluctuations, whether and how the illness can be cured or controlled by the individual or by medical
178 treatment, and what causes the illness (35). Emotional representations indicate the emotions that are

179 engendered by the illness threat (such as anxiety or worries). The person's response, or way of
180 coping with the threat, may be directed at the cognitive or emotional representations or at both: for
181 example, they might engage in TRBs to reduce anxiety and/or to control exposure to the illness, but it
182 is also possible that they might manage the emotional representation by avoiding thinking about the
183 illness to avoid anxiety and so neglect to engage in TRBs.

184 Very few studies have looked at how illness representations change over time, as information
185 about a disease spreads through a population, and experiences and government directives potentially
186 change how the illness is represented (34, 36). In the CS-SRM, behaviours are determined by illness
187 representations, but TRBs may also be influenced by representations of the behaviours, for instance
188 the beliefs people have regarding their capability to adhere to the TRBs.

189 Social cognitive theory (SCT; (37)) posits that people's motivation and action are extensively
190 regulated by forethought about the behaviour (38). Key constructs of SCT are self-efficacy and
191 outcome expectancies. Self-efficacy refers to the belief that one is capable of performing a
192 recommended behaviour to attain a desired outcome (i.e., not getting COVID-19). Outcome
193 expectancies refer to beliefs about the consequences of a given behaviour (e.g., if I wash my hands
194 regularly with soap and water, I will reduce my risk of getting COVID-19). A category of belief that is
195 often explored in relation to infectious disease outbreaks, but that is not specified explicitly in SCT, is
196 risk perception, or perceived vulnerability to the infectious disease (39).

197 Protection motivation theory (PMT; (40, 41)) was developed to understand the impact of fear
198 appeals and including the perception of vulnerability. PMT posits that people make a threat appraisal
199 based on evaluating how severe the threat is, and how vulnerable they perceive themselves to be to
200 the threat. In addition, an individual makes a coping appraisal based on two efficacy beliefs, self-
201 efficacy (as in SCT, e.g., how confident is the person that they can wash their hands every time they
202 enter a building) and response efficacy (how effective is washing hands every time they enter a
203 building at mitigating vulnerability to getting COVID-19). Considering both the threat and coping
204 appraisal could result in greater understanding of the engagement in protective behaviours, in this
205 case adherence to TRBs (39).

206 Given the importance of motivational and behavioural factors to get COVID-19 under control,
207 it is vitally important to determine how these theorised factors are linked to adherence to TRBs and
208 how this affects mental and general health. Previous research has shown that greater perceived

209 susceptibility, perceived severity of the illness as well as, perceived efficacy of behaviour, and self-
210 efficacy of TRBs during previous infectious disease pandemics were associated with more avoidance
211 (i.e., physical distancing) or preventive behaviour (i.e., hand washing) (42). Furthermore, during the
212 current COVID-19 pandemic in Vietnam, perceived risk was associated with increased likelihood of
213 wearing a face covering (43). Multiple theoretical positions applied to TRBs, and measured over
214 repeated epochs, should provide novel insights into behavioural changes emerging from the
215 population in Scotland.

216

217 **The CHARIS study and objectives**

218 The aim of the CHARIS study is to investigate adherence to TRBs required and advised by
219 The Scottish Government and how adherence changes over time, as post-lockdown restriction are
220 carefully and gradually lifted across four Phases (13). CHARIS will examine what theorised
221 motivational and behavioural factors explain (changes in) TRB adherence, any associated mental and
222 general health over time. The following objectives will be addressed:

223

- 224 1. To **describe** people's adherence to TRBs, and their mental and general health status.
- 225 2. To **describe** people's beliefs about COVID-19 and beliefs about TRBs.
- 226 3. To **explain** variations in people's adherence to TRBs by examining associations between these
227 behaviours and sociodemographic factors, and theorised motivational and behavioural factors,
228 specifically considering,
 - 229 a. Who is (not) adhering to the TRBs (associations with sociodemographic variables)?
 - 230 b. Why there is variation in adherence to TRBs (associations with theorised motivational and
231 behavioural factors)?
 - 232 c. What might explain (non-)adherence to TRBs among groups of people
233 (moderation/mediation of theorised motivational and behavioural factors between
234 sociodemographic variables and adherence to TRBs)?
- 235 4. To **explain** variations in people's mental and general health status by examining associations
236 between health and sociodemographic and theorised motivational and behavioural factors. That is,
 - 237 a. Who is experiencing mental and general health problems (associations with the
238 sociodemographic variables)?

- 239 b. Why there is variation in mental and general health (associations with theorised
240 motivational and behavioural factors)?
- 241 c. What might explain variations in mental and general health among groups of people
242 (moderation/mediation of theorised motivational and behavioural factors between
243 sociodemographic variables and adherence to TRBs)?

244 5. To **examine** the influence of government guidance and media reporting of COVID-19 on people's
245 beliefs and behaviours over time.

246

247 **Methods**

248 **Design**

249 A cross-sectional observational study of 500 randomly selected adults will be conducted each
250 week for the first six weeks, and fortnightly after that, for a total of 14 waves (n=7000). We will
251 compare motivations, behaviours, and health in different population groups (by age group, gender,
252 area deprivation), and use this data to understand population-level changes in adherence to TRBs
253 and health from 3 June 2020 and to 07 November 2020. Whilst a serial cross-sectional design will not
254 allow for the assessment of actual causal relations over time it does allow rapid and adaptive
255 monitoring of crucial variables over time, the assessment of the relations between them and,
256 importantly, since there is no attrition, maintains the representativeness of the sample over the whole
257 study period.

258

259 **Setting and participants**

260 The study will be conducted across Scotland which has a total population of 5.4 million, 83 per cent of
261 whom are adults. Adult men and women aged 16 or older, able to speak English, and currently living
262 in Scotland are eligible to participate. No other inclusion criteria will be applied. The CHARIS study
263 will be administered by a commercial polling company (Ipsos MORI Scotland). They sample
264 participants using random digit dialling to both landlines and targeted mobiles. Quotas are applied to
265 ensure that a representative sample of Scotland adults is achieved. Quotas are based on gender
266 (48% male), age, working status (42% working fulltime), and geographical locations (distribution over
267 the Scottish Parliament regions). A leeway on the quotas (30% approximately) is allowed to help

268 ensure the overall sample is achieved in a reasonable time, any resulting data skews will be corrected
269 with statistical weighting in analyses.

270 Ipsos MORI will conduct telephone interviews using Computer Aided Telephone Interviewing
271 (CATI). Interviewers from Ipsos MORI have received training and have significant experience in
272 conducting interviews into sensitive topics including mental and general health.

273

274 **Questionnaire development and procedure**

275 Using methods from studies of previous pandemics (e.g. SARS, MERS, H1N1) and theories
276 of human motivation and behaviour, the survey will assess adherence to TRBs, and mental and
277 general health. Where possible, validated and reliable scales will be used. However, some of the
278 standard measurement scales have been adapted to fit with the CATI methodology. A draft version of
279 the questionnaire was developed by the core research group (DD, GH, MJ and CDD) and then shared
280 with the CHARIS-consortium (a wider group of behavioural and health scientists drawn from
281 Universities and Research Institutes across Scotland), who provided feedback on missing themes and
282 items, redundant themes and items, and suggestions for clarification and adjustment. In addition, the
283 questionnaire was presented to two patient and public involvement groups. The Scottish Health
284 Council (SHC) Public Engagement Group and the NHS Research Scotland Primary Care Patient and
285 Public Involvement group (NRSPC-PPI), have reviewed and critiqued the survey questions and
286 suggested items. Questions about physical or mental health condition, and their effect on day-to-day
287 activities were added.

288 The primary researchers processed all recommendations and made changes to the
289 questionnaire. This procedure of questionnaire design was then repeated iteratively until consensus
290 was reached. The questionnaire was sent to Ipsos MORI for an internal reviewing process. All survey
291 questions were piloted and refined to check wording, sensitivity, and questioning styles. The pilot
292 work indicated that the questionnaire exceeded the 20-minute time limit for the CATI interview and
293 some of the questions needed clarification. The primary researchers in collaboration with the
294 consortium members adapted and finalised the questionnaire.

295 A core set of questions will be administered weekly. In addition, each week a changing set of
296 questions will assess non-core themes and questions based on triggers/events over time as required
297 (up to 15% of the total questionnaire is available for modification each week). The additional themes

298 and questions will be sent to Ipsos MORI four days in advance for review, scripting, and testing.
299 Weekly, Ipsos MORI takes three days for data processing and will provide the primary researchers
300 with a raw data set for analysis.

301

302 **Core survey variables**

303 The questions of the wave 1 questionnaire, including the core survey are detailed in Appendix 1.

304 **Transmission-reducing behaviours.** Adherence for transmission-reducing behaviours (TRBs) will
305 be assessed for three domains of behaviours, namely physical distancing, hand washing, and
306 wearing a face coverings, based on Scottish Government directives and NHS Scotland advice (20,
307 44). TRBs will be assessed using eight items (45, 46). Questions will be preceded by an introductory
308 text, which aims to reduce socially desirable responding by providing individuals with implied
309 permission to report either a lack of, or lapses in, adherence.

310 **Mental and general health.** We will measure general health by a standard single self-report item
311 (47). Depression and anxiety will be assessed with an adaption of the ultra-brief anxiety and
312 depression scale (Patient Health Questionnaire-4; PHQ-4 (48)). Finally, participants will be asked
313 whether they received a letter from their general practitioner telling them that they were at high risk
314 and should stay at home. If they answered 'Yes', they will be asked whether they have been in
315 isolation because they have been shielding.

316 **Theorised motivational and behavioural explanatory factors.** The guiding theoretical frameworks
317 for understanding COVID-19 will be Leventhal's common-sense model of self-regulation (CS-SRM;
318 (49)), social cognitive theory (SCT; (37)) and protection motivation theory (PMT; (40)). We have
319 adapted the brief illness perception questionnaire (50) for COVID-19. The brief illness perception
320 questionnaire uses a single statement to assess each of the constructs from the CS-SRM, namely:
321 identity, consequences, duration (time-line), recurrence (time-line), personal control, treatment
322 control, and emotional representation (worried and anxious); participants indicate their level of
323 agreement with each statement. Questions are differently phrased for participants who currently have
324 (or suspect they have) COVID-19, who have had (or suspect they have had) COVID-19 in the past.
325 The causal component of the COVID-19 representation is assessed with 7 items; participants indicate
326 the extent to which they believe each item is/was/would likely be the cause of their getting COVID-19
327 using a 4-point scale (1= to a great extent, 4= not at all).

328 We will assess outcome expectancies, self-efficacy (towards the avoidance of COVID-19 and
329 performing the TRBs (51)), perceived COVID-19 severity, perceived vulnerability, comparative
330 vulnerability, response efficacy, behavioural norms, and intentions to perform the TRBs (adapted from
331 (52, 53)).

332 **Sociodemographic variables.** Sociodemographic information included in the core survey are; place
333 of residence and area deprivation (based on postcode), age, indicated gender, ethnicity, number of
334 adults and children living in people's household, household tenure, and employment status (47).

335

336 **Additional factors, changes in Government guidelines, and event related questions**

337 In addition to the measures of the core, the survey will also include measures of additional
338 factors that are likely to predict one or both of the outcome variables; adherence to TRBs and mental
339 and general health. For example, we plan to include measurement of long-term (disabling) conditions
340 (LTCs) at least once among the whole population. People who experience the most serious
341 consequences of COVID-19, including death, often have underlying LTCs (54). LTCs can therefore
342 impact TRBs, as people with LTCs may adhere more strictly to limit their risks of COVID-19.

343 In addition, the survey has the capacity to adapt to changes in Government guidelines (i.e.,
344 change to other Phases of the post-lockdown (13), and to respond to events (e.g., political
345 demonstrations as the ones for Black Lives Matter currently). These additional measures can be
346 proposed by the core research group, members of the consortium and the PPI groups. The core
347 research group will make the final decision on all proposed inclusions. We will also systematically
348 monitor the weekly UK news (front pages of papers), minister briefings, official data reports, and
349 social media for relevant events so that the weekly COVID-19 context coinciding with each
350 administration of the survey can be described.

351

352 **Ethics and consent**

353 Participants will be informed about the purpose of the CHARIS study, how their data will be
354 treated and stored, of their right to terminate their participation in the study at any time without giving
355 a reason, and for each question where we are asking personal/sensitive information participants will
356 explicitly be reminded that they do not have to answer if they prefer not to. All participants will then be
357 asked to provide verbal informed consent prior to starting the survey, and for sharing their personal

358 information for follow-up research related to the study (Appendix 1). Verbal debriefing will inform
359 participants that if the survey has raised any concerns about their health that, they should contact
360 their general practitioner. Ethical approval was granted by the Life Sciences and Medicine College
361 Ethics Review Board (CERB) at the University of Aberdeen (CERB/2020/5/1942).

362

363 **Dissemination**

364 This study aims to have academic and conceptual impact by making a demonstrable
365 contribution to understanding theorised human motivations and behaviours, adherence to TRBs, and
366 mental and general health in a global pandemic. Key outputs will therefore include articles for
367 publication in peer-review journals.

368 More importantly, the study also aims to have societal and instrumental impact by influencing
369 the measures used to reduce COVID-19 transmissions and monitor measures that address impacts
370 on mental and general health that are being developed by UK governments and other decision-
371 makers. Key outputs are therefore weekly bulletins that describe the data and present univariate
372 analyses that will provide fast, real-time insights. These weekly bulletins will be complemented with
373 bimonthly in-depth reports that will present the multivariate predictive data, and illustrate how the
374 results might be used to support adherence and mental and general health. The bulletins and reports
375 will be distributed to the Scottish Government and their agencies, and will be made immediately
376 available on the study website (<https://www.abdn.ac.uk/CHARIS>), and study's own twitter feed
377 (@CHARIS CVD19).

378

379 **Statistical analysis**

380 Data on adherence to TRBs (i.e., the three domains and overall), and health (i.e., mental and
381 general health) of the study population will be presented. Summary statistics, including means,
382 standard deviations, medians and ranges for continuous variables and frequency distributions for
383 binary and categorical variables will be used. In addition, descriptive analysis will be conducted for the
384 theorised motivational and behavioural factors.

385 To identify who is and is not adhering to the TRBs and who is experiencing mental and
386 general health problems we will perform univariate and multivariate logistic regression analysis,
387 assessing associations between the sociodemographic variables and each of the TRBs and mental

388 and general health outcomes separately. For the weekly report we use a binary outcome of non-
389 adherence, defined as people who only sometimes, rarely, or never adhere to the TRBs. For the
390 publications and bimonthly reports we will also take the continuous measure into account.

391 To identify why there is variation in adherence to TRBs and mental and general health we will
392 perform univariate and multivariate logistic regression analysis, assessing associations between the
393 theorised motivational and behavioural factors and each of the TRBs and mental and general health
394 outcomes separately. These analysis will be done on a weekly basis to provide fast, real-time
395 insights.

396 For the more in-depth analysis we will use cumulative data, in monthly bulletins compounded
397 over 4 weeks, for the publications over the total study period. Multivariate models will be constructed
398 using a backward elimination procedure, including variable that are significantly associated with the
399 outcome in univariate analysis. Multivariate analyses will be performed with logistic regression using
400 the outcome variables, adherence to TRBs and mental and general health as dependent variables. In
401 addition, theories (CS-SMR, SCT, PMT) will be tested using hierarchical multivariate regression
402 analysis.

403 What might explain (non-)adherence to TRBs and differences in mental and general health
404 among groups of people (i.e., women responds differently from men), will be assessed in a
405 moderated mediation analysis, using the SPSS macro provided by Preacher and colleagues (55). For
406 each of the sociodemographic variables that is significantly associated with adherence to TRBs
407 and/or mental and general health, we will assess whether the effects are mediated by the theorised
408 motivational and behavioural factors. We will follow four steps (56): (1) the independent and
409 mediating variables must be significantly related; (2) the independent and dependent variables must
410 be significantly related; (3) the mediator and dependent variable must be significantly related; and (4)
411 the relationship between the independent variable and dependent variable should be non-significant
412 or weaker when the mediator is added.

413 To describe the effects of government guidance and media reporting of COVID-19 and
414 examine their influence on people's beliefs and behaviours, we will assess change over time. For
415 continuous effects, each week's data will be included in the model for a time series analysis (linear
416 trend over time). This covariate will be used as a continuous variable with wave 1 = 1, up to wave
417 14 = 14, indicating a change in the odds ratio per week. For effects of a specific event(s), a dummy

418 code for time before and after the event will be included in the regression analysis. Possible
419 interaction terms between the linear trend over time, and other variables will also be assessed.

420 Analysis will be performed in SPSS (IBM version 24). Statistical significance will be defined as
421 a p-value ≤ 0.5 for all analyses, and odds ratios and 95% confidence intervals will be reported where
422 relevant.

423

424 **Discussion**

425 The CHARIS study will provide insights into TRBs, and how adherence to these TRBs
426 changes over time as the COVID-19 outbreak progresses, and government restrictions are change.
427 Additionally, this study will identify the beliefs derived from CS-SRM, SCT and PMT, and
428 sociodemographic factors that predict adherence to TRBs. This understanding will support the
429 tailoring and targeting of interventions to improve adherence to TRBs, and support general and
430 mental health. For example, the content of public health messages could be tailored to strengthen
431 beliefs associated with higher levels of adherence, and targeted at communities who are struggling to
432 adhere. Similarly, CHARIS will identify communities with declining mental health enabling support
433 services to be better targeted.

434

435 **Strengths**

436 The CHARIS study has several strengths. First, CHARIS is underpinned by evidence-based
437 psychological theory and thus supports a cumulative approach to evidence. The use of three valid
438 and reliable motivational and behavioural theories that explain how people respond to illness, how
439 they respond to risk, and how they think about behaviour and behaviour change. Therefore, CHARIS
440 can draw on a large existing evidence base that informs the measures used, and details how
441 individual constructs are meaningfully related. This avoids the much criticised 'cafeteria' style
442 research that is not conducive to the development of a cumulative approach to evidence building (57,
443 58). A cumulative approach is vital to support our understanding of the behaviour of populations
444 during a pandemic, which is crucial in circumstances where changing behaviour is the only available
445 route to halting the pandemic.

446 Second, CHARIS will provide fast, real-time, information to support and inform decision
447 making for policy-makers, public health and service commissioners. Third, the weekly data collection,

448 enables fine-grained analyses of people's reactions to government directives and instructions as they
449 are happening. The repeated measurement over 147 waves makes it possible to directly assess the
450 impact of directives and advice from the government for TRBs, in contrast to previous retrospective
451 studies or studies applying hypothetical situations (59).

452 Fourth, our study will start as the Government-imposed restrictions went in to Phase One
453 post-lockdown. The restrictions began to be eased, and more people are allowed to go back to their
454 workplaces, and to start to meet with others outside of their own households. The timing of the
455 CHARIS study places it in the unique position to assess (changing) adherence to TRBs, in response
456 to potentially changing beliefs about the behaviours and the illness, as the Scottish government
457 implements new Phases to gradually lift the restrictions. Moreover, we can assess the effects of
458 prolonged adherence to TRBs, and beliefs about behaviours and illness on mental and general
459 health.

460 Fifth, CHARIS study data is collected via telephone, which requires the survey to be succinct
461 and the questions easily understood. Therefore, the majority of adults will be able to take part in
462 CHARIS, in line with the call that there is a need for more representative research, particularly in
463 vulnerable populations (60, 61). People can be included who do not have online access, who are
464 typically older, who are more deprived, typically those who are also most at risk from COVID-19.
465 Sixth, recruitment will aim for a representative sample, making the findings generalizable to the
466 Scottish population.

467

468 **Limitations**

469 Our study also has some limitations. First, the use of a telephone survey necessitates the use
470 of self-report measures only. This is not a limitation in relation to the measurement of beliefs or mental
471 and general perceived health as these are only available for measurement via self-report. However,
472 measuring behaviour by self-report is open to a number of sources of error, including memory errors
473 and social desirability bias. Social desirability to report adherence is likely, however we have mitigated
474 the impact of social desirability where possible by employing the introductory text from the medication
475 adherence reporting scale (45, 46). The text on this scale was designed specifically to reduce social
476 desirability by providing individuals with implied permission to report either a lack of, or lapses in,
477 adherence. Furthermore, it is impossible to assess adherence to all the TRBs included in CHARIS by

478 any method other than by self-report. Overall, we believe the advantages of telephone interviewing in
479 terms of population reach and generalisability far outweigh the disadvantages.

480 Second, the telephone call is limited to 20-minutes duration. This means we have had to be
481 use brief measures of mental and general health, however, both measures are validated and reliable.
482 Similarly, some constructs were measured very briefly in the core questionnaire. Whilst this enables
483 tracking of a larger number of themes over time, we recognised this as a limitation. To address the
484 use of brief measures we have planned less frequent inclusion of some constructs, for example,
485 access to open spaces is measured with one question in the core questionnaire, focused only on the
486 home, but will be measured much more extensively during one specified week to provide a context for
487 the single question in the core questionnaire, and provide an opportunity to have in-depth analysis of
488 this theme with the data collected in one of the weeks. Moreover, some themes were not part of the
489 core at all, and only will only be assessed less frequently. In addition, we plan a companion qualitative
490 study that will purposively sample from the survey participants each week to understand the
491 contextualised, multifaceted nature of people's beliefs, TRBs, and mental and general health.

492 The CHARIS Study is well placed to make a significant contribution to the knowledge base
493 around (changes in) adherence to TRBs, mental health, and potential explanatory variables, in the
494 current COVID-19 pandemic. Further, findings should provide valuable insights to assist preparation
495 for any future events.

496

497 **Abbreviations**

498 CHARIS: COVID Health and Adherence Research in Scotland, CS-SRM: common-sense model of
499 self-regulation, LTCs: long-term conditions, NHS: national health service, NRSPC-PPI: NHS
500 Research Scotland Primary Care Patient and Public Involvement, PHQ-4: Patient Health
501 Questionnaire-4, PMT: protection motivation theory, SCT: social cognitive theory, SHC: Scottish
502 Health Council, TRBs: transmission-reducing behaviours, UK: United Kingdom, UWIST: University of
503 Wales Institute of Science and Technology.

504

505 **Declarations**

506 **Ethics approval and consent to participate**

507 This study was approved by the Life Sciences and Medicine College Ethics Review Board (CERB) at
508 the University of Aberdeen (CERB/2020/5/1942). All participants provide informed consent for
509 participation in CHARIS.

510

511 **Availability of data and material**

512 On completion of the study, data (anonymised) will be available for interested parties on request.

513

514 **Competing interests**

515 The authors declare that they have no competing interests.

516

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519 funders reviewed the study, and did not have a role in study design, data collection and analysis,
520 decision to publish, or preparation of the manuscript.

521

522 **Authors' contributions**

523 DD, MJ, GH, and CDD coordinate the study and drafted the manuscript. DD, MJ, GH, CDD, and the
524 CHARIS consortium are involved with the development of the questionnaire, and identification of
525 potential research themes. All authors are involved in the study design, reviewed the manuscript and
526 approved the final version for publication.

527

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707

708

709 **Appendix 1: Survey week 1**

710
711 **Study info and consent:**

712
713 Good morning / afternoon / evening. My name is _____. I'm calling from Ipsos
714 MORI Scotland an independent research organisation. We're conducting a short survey on behalf of
715 The University of Aberdeen about how people in Scotland are experiencing the Coronavirus
716 lockdown.

717
718 The results of the survey will be used to help understand how the lockdown has affected different
719 communities across Scotland and what impact the easing of the lockdown is having for them.

720
721 Would you be able to spare 15 minutes or so to answer some questions please? If now is not a good
722 time I can ring back later.

723
724 We appreciate that this is a challenging time for many people. If there are any questions you would
725 rather not answer, that is completely fine – just let me know. If you want to stop the survey, or need
726 to take a break at any time, that's also fine.

727
728 Before we start, I just want to clarify that I will be asking you questions about your mental and
729 physical health. You are under no obligation to answer these questions, participation in the survey is
730 voluntary and you can change your mind at any time. If you would like to find out more about the
731 study, you can go to the University of Aberdeen's website www.abdn.ac.uk, and type CHARIS into
732 the search box. If you would like to read the Survey Information Notice, which includes a link to the
733 University of Aberdeen's Privacy Notice beforehand you can access it online.

734
735 Are you happy to proceed with the interview? Yes/No

736
737 **Demographics**

738
739 **Intro text:** *The first set of questions are about yourself and your household. You do not have to give*
740 *an answer if you do not want to.*

Questions	Response Scale
Consent postcode The next question asks for your postcode. We are asking for this so we can understand responses from people from different parts of Scotland. Your postal code is considered personal information and you do not have to give an answer if you do not want to. Are you happy to answer this question?	Yes No
Can you please let me know your full postcode?	Type full post code Prefer not to say
Coded from post code: REGION	Glasgow Highlands and Islands Lothians Mid Scotland and Fife North East Scotland South West Central

What was your age on your last birthday?	Type number
If Prefer not to say: I will read out a number of age bands. Could you tell me which band you age falls into?	Under 16 16-17 18-24 25-34 35-44 45-54 55-64 65-69 70+ Prefer not to say
Which of the following describes how you think of yourself?	Male Female In another way Prefer not to say
Which of the following best describes what you were doing last week? Were you...	Employed full time, 30 hours or more a week, and not on furlough Employed part time, 8 - 29 hours a week, and not on furlough Employed full time but currently on furlough Employed part time but currently on furlough Self-employed Unemployed and seeking work Unemployed and <u>not</u> seeking work Studying at school, college or university Looking after the home Retired Not working due to long-term illness or disability Prefer not to say
How many people aged 16 or older, including yourself, live in your household right now?	Number More than 10 Prefer not to say
How many children under the age of 16 live in your household now? Please include all children, regardless of their relationship to you, e.g. step children, grandchild, siblings etc.	Number More than 10 Prefer not to say
Thinking about any outside space you may have at the property you are currently living in. By outside space, I mean a garden, balcony, patio, etc. Do you have access to an outside space at your property, and is that a private space, for use by your household only, or a space shared with other households?	Yes, a private outside space only Yes, a shared outside space only Yes, private and shared outside spaces No Prefer not to say

742 **Mental and General Health**

743

744 **Intro Text:** *The next few question are about your health and your mental health – how you have been*
 745 *feeling. Please remember that if there is a question you prefer not to answer – that is fine.*

Questions	Response Scale
In general, how would you rate your overall health?	Very good Good Fair Bad Very bad
Do you have a physical or mental health condition or illness lasting or expected to last 12 months or more?	Yes No
Does your condition or illness reduce your ability to carry-out day-to-day activities?	Yes, a lot Yes, a little Not at all
Over the last 2 weeks, how often have you been bothered by the following problems? Tell me which answer option best applies. 1. Feeling nervous, anxious, or on edge 2. Not being able to stop or control worrying 3. Feeling down, depressed, or hopeless 4. Little interest or pleasure in doing things	Not at All Several Days More Than Half the Days Nearly Every Day
<i>I'd now like to ask you about how you are feeling today. As I read each one, I would like you to tell me the extent to which you are feeling that today. Do you feel....</i> 1. cheerful 2. sad 3. stressed 4. calm 5. energetic 6. tired	Not at all Just a little Somewhat Moderately Quite a lot Very much

746

747 **Social Support**

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749 **Intro Text:** *The next few question are about your relationships with other people. Please remember*
 750 *that if there is a question you prefer not to answer – that is fine.*

Questions	Response Scale
To what extent, if at all, do you agree or disagree with each of the following statements: You have someone: 1. you can count on to listen to you when you need to talk 2. to give you good advice about a problem 3. who shows you love and affection 4. to help you with daily chores	Strongly agree Tend to Agree Tend to Disagree Strongly disagree
Do you have as much contact as you would like with someone you feel close to, someone in whom you can trust and confide?	Yes No
The next question is about how you feel about different aspects of your life. For each aspect, please tell me how often, if at all, you feel that way. How often, do you feel...? 1. that you lack companionship 2. left out 3. isolated from others?	Always Often Sometimes Hardly ever Never

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752 **Adherence**

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754 **Intro text:** *During the coronavirus pandemic, we have all been asked to restrict our contact with other*
 755 *people. But, it is often difficult to follow guidelines exactly. Many people find a way of trying to cope*
 756 *during this lock-down that suits them and this often differs from the exact Government instructions.*
 757 *We would like to ask you a few questions about how you have been dealing with the lock-down*
 758 *guidelines.*

Questions	Response Scale
Did you go outside your home last week?	Yes No (skip next question)
Please tell me how often, if at all, you have done each of the following when you have been outside your home in the last week? If any of these are not applicable to you, please say so. In the past week, you... <ol style="list-style-type: none"> When you went out, it was only for permitted reasons (i.e. for basic necessities, daily exercise, basic animal welfare, medical need, travelling for work purposes) stayed 2 metres (6 feet) away from other people, except those who live in your household. wore a face covering when you were in a shop wore a face covering when you travelled on public transport washed your hands as soon as you got home 	Always Most times Sometimes Rarely Never
For each of the following statements, please tell me how often, if at all, you have done the following in the past week: <ol style="list-style-type: none"> When you washed your hands you used soap and water When you washed your hands you did this for at least 20 seconds You washed your hands before eating and drinking 	Always Most times Sometimes Rarely Never

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760 **Beliefs and Worries about COVID**

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762 **Intro Text:** *This next set of questions are about what you think about COVID-19. Please remember*
 763 *that if there is a question you prefer not to answer – that is fine.*

Questions	Response Scale
Which of these statements best applies to you <ol style="list-style-type: none"> You currently have or think you may currently have COVID (ask current COVID) You have already had COVID or think you may have already had COVID (ask past COVID) You have not had COVID (ask No COVID) 	
Was your COVID-19 infection confirmed by a test?	Yes, confirmed by a test No, not confirmed by a test
Please tell me which of the following best describes how severe your symptoms of COVID-19 were or are	Severe Moderate Mild
Current COVID: Thinking about your experience of having COVID-19. How much do you agree or disagree with the following statements? Past COVID: Thinking about your personal experience of having had COVID-19. How much, if at all, do you agree or disagree with the following statements? No COVID: I would like you to think about what it would be like if you personally got COVID-19. How much, if at all, do you agree or disagree with the following statements? <ol style="list-style-type: none"> The symptoms of Covid are easy to recognise (current COVID) The symptoms of Covid were easy to recognise (past COVID) The symptoms of Covid would be easy to recognise (no COVID) 	Strongly agree Tend to agree Tend to disagree Strongly disagree

<ol style="list-style-type: none"> 2. Covid has bad consequences for your life (current COVID) Covid had major consequences for my life (past COVID) Covid would have major consequences for my life (no COVID) 3. Your Covid symptom will last a long time (current COVID) Your Covid symptoms lasted a long time (past COVID) COVID-19 symptoms would last a long time (no COVID) 4. You could get Covid again 5. There are actions you can take that influence how your body responds to having COVID-19 (current COVID) There were actions you could take to influence how your body responded to having COVID-19 (past COVID) There are actions you could take to influence how your body responds to having COVID-19 (no COVID) 6. Your COVID-19 will be cured with treatment that doctors or nurses provide (current COVID) Your COVID-19 was cured with treatment that doctors or nurses provided (past COVID) Your COVID-19 would be cured with treatment that doctors or nurses provide (no COVID) 7. You spend time worrying about having COVID-19 (current COVID) You spent time worrying about having COVID-19 (past COVID) You would spend time worrying about having COVID-19 (no COVID) 8. Having COVID-19 makes you feel anxious (current COVID) Having COVID-19 made you feel anxious (past COVID) Having COVID-19 would make you feel anxious (no COVID) 	
<p>Current COVID: To what extent, if any, do you think each of the following contributed to you getting COVID-19? Past COVID: To what extent, if any, do you think each of the following contributed to you getting COVID-19?</p> <ol style="list-style-type: none"> 1. No COVID: If you were to get COVID-19, to what extent, if any, do you think each of the following would be likely to contribute to you personally getting COVID-19: Bad luck 2. A germ or virus 3. Too much contact with other people 4. Not washing your hands enough 5. Not wearing a face covering when you went outside your home 6. One of your family brought it into your home 7. Other people didn't keep their distance when you were out 8. Lack of personal protective equipment for NHS or care home staff, e.g. face masks 9. Poor response to the pandemic from the Scottish Government 10. Poor response to the pandemic from the UK Government in London 11. Air pollution 12. Climate crisis 	<p>To a great extent To some extent Hardly at all Not at all</p>
<p>Compared to other people similar to you in terms of age, gender, etc. do you think your chances of getting ill with COVID-19 are:</p>	<p>A lot higher Higher About the same Lower A lot lower</p>
<p>How much, if at all, do you agree or disagree with the following statements: If I got Covid it would be serious for me</p> <ol style="list-style-type: none"> 1. If you were ill with COVID-19 it would be serious for you 2. It is likely that you will get COVID-19 3. The thought of getting COVID-19 makes you anxious 4. If you follow the government instructions of limiting contact with people, washing your hands thoroughly and frequently, and wearing a face covering when out shopping or on public transport it will stop you getting COVID-19 	<p>Strongly agree Tend to agree Tend to disagree Strongly disagree</p>

5. You are confident that you can avoid getting COVID-19 by following the government instructions of limiting contact with people, washing your hands thoroughly and frequently, and wearing a face covering when out shopping or on public transport	
How many people in your area do you think are following the government instructions of limiting contact with people, washing their hands thoroughly and frequently, and wearing a face covering when out shopping or on public transport most or all of the time?	Everyone Most people Some people Few people Hardly anyone
How confident or not are you that you can follow the government instructions, all or most of the time, on each of the following? 1. Limiting contact with people 2. Washing your hands thoroughly and frequently 3. Wearing a face covering when out shopping or on public transport	Very confident Fairly confident Not very confident Not at all confident
Do you intend to follow all the government instructions on each of the following? 1. Limiting contact with people 2. Washing your hands thoroughly and frequently 3. Wearing a face covering when out shopping or on public transport	Always Most times Sometimes Rarely Never

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Additional demographics

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Intro text: I have a final set of questions that asks for a few more details about yourself.

Question	Response
The next question is about yourself and your ethnicity and might be considered sensitive. You do not have to give an answer if you do not want to. Are you happy to answer this question?	Yes No
Which of the following best describes your ethnicity?	White Mixed or Multiple Ethnic group Asian or Asian Scottish Asian British African Caribbean or Black Arab Other ethnic group
What is your marital status? Are you	Married/Civil Partnership Living together Single Widowed Divorced Separated
At the beginning of the pandemic, did you receive a letter or text from your GP or the NHS telling you that you were at severe risk from COVID-19 and should stay at home?	Yes No
Have you been in isolation because you have been shielding as a result of receiving a letter or SMS from the NHS?	Yes No
Do you own your home, or rent it?	Own outright Buying on mortgage Rent from council Rent from Housing Association/ Trust Rent from private landlord Other

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769 **Debriefing**

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771 As mentioned at the start of the survey, your responses to the survey are confidential. The University
772 of Aberdeen would however find it very useful to have your postcode appended to your survey
773 responses, for the sole purpose of conducting analysis into how answers differ by various regional
774 factors. Your postcode is considered personal information and we therefore will not pass this to the
775 University of Aberdeen without your consent. Are you willing for your postcode to be passed to The
776 University of Aberdeen.

777

778 Yes / No

779

780 The University of Aberdeen may wish to carry out some follow-up research relating to this study within
781 the next 6 months. Would you be willing for the University of Aberdeen to contact you for this reason?
782 If you agree, we will include your name and contact details when we share survey results with the
783 University, for the sole purpose of allowing them to re-contact you. If you do not agree, your survey
784 responses will remain be anonymous.

785

786 Yes / No

787

788 Please give me your name.

789 Could you please confirm your telephone number that the University of Aberdeen can contact you on?

790

791 We realise this survey has touched on some sensitive topics. If you have any concerns about COVID-
792 19 or other health issues you can find a lot of information at NHSInform.scot. If you would like to find
793 out more about the study, you can go to the University of Aberdeen's website www.abdn.ac.uk, and
794 type CHARIS into the search box. Thank you for taking the time to participate in this study. Do you
795 require further details about the privacy policy mentioned at the beginning of the call?

796

797 Yes / No